DEVELOPMENT OF AN INTERPERSONALLY GROUNDED CONSTRUCTION MANAGEMENT CURRICULUM FOUNDATION MODEL

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Development of an Interpersonally Grounded Construction Management Curriculum Foundation Model

by

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ABSTRACT

Purpose: Education is the driving force of higher education institution(s) (HEIs) globally and is critical for student employability and practitioner recruitment. Yet, against this backdrop, research in the field is limited and hitherto, investigations into construction management curriculum development are scant. This research presents a foundational design specification for construction management programme curriculum development and aims to engender wider polemic debate as well as stimulate new insight into current higher education employability preparation practice.

Methodology: The overarching epistemology adopts interpretivist, pragmatic and post-positivist philosophical stances to critically analyse extant literature, secondary data and primary data on the foundational skills/competencies of construction management education. Abductive reasoning forms the overarching basis of a new emergent curriculum model that maps interpersonal skills and highlights the critical foundational skills and competencies necessary.

Findings: Research findings illustrate that construction management curriculum development lacks a cohesive community of practice and curriculum agenda. Importantly, it appears that although the modern construction manager needs an appreciation of digital technologies under the umbrella of Industry 4.0, their interpersonal skills and competencies were observed to far outweigh and exceed these. Premised upon these findings, the curriculum foundation model developed delineates the four key interpersonal skills and competencies construction management programmes should utilise for developing their curriculum.

Originality: This novel research unearths the lack of a cohesive curriculum agenda within construction management education, highlights the importance of interpersonal skills and competencies within the role of construction manager and based upon this, presents a curriculum foundation model.

GENERAL DEDICATION

This thesis is dedicated to the future students of construction leadership and management.

May the curricula that guides you be interpersonally grounded, technically supportive and student centred.

FAMILY DEDICATION

Emma M. and
Samuel Z. Posillico

You both are the love of my life. This thesis and my career in academia would not have been remotely possible without your love, support and encouragement.

Our first date, all those years ago, was a simple walk around town. I can't remember what we talked about or how long we walked, but I do remember that it was authentic…authentic in a way that made me see a lovely future with you.

Since that walk, we have been on a lot of journeys, some wonderful, some challenging, some heart-breaking and some breath-taking. However, I wouldn't change a thing. We have continued walk and talk and chart our course.

How can I ever thank you for all that you are and have done for me? I love you both so much!

> ♫ *...just like way back in the days of old*
> *Then magnificently we will float*
> *Into the mystic* ♫

Joseph C. and
Rosemarie Z. Posillico

Our dinner table conversations from the local diner to the cafeteria at Saint Rose were the small but profoundly impactful moments we shared. You inspired me to always be myself, be empathetic and place the needs of other before my own. Not only are you wonderful educators but wonderful parents. If I am half the parent and educator you are, I will consider myself extremely fortunate. I love you both.

> ♫ *I see trees of green, red roses too*
> *I see them bloom for me and you*
> *And I think to myself what a wonderful world* ♫

continued

John G. and
Regina A. Zaffuts

The older I become, the more I realise just how extraordinary a couple you were. From educational excellence to a loving relationship, you created a perfect environment to pursue life's adventures. I learned so much from you both…Oh, I wish for just one more chat with you! I love you both.

♫ *And I'm dreaming of you tonight*
I miss you all the time
All the stars are calling out your name
Ever since you went away
There's no sleeping you off my mind
I miss you all the time ♫

Joseph C. and
Marie N. Posillico

I long for the days where we can sit by the lake's edge in Saranac to fish, chat, laugh, discuss, think and ponder. Your humbleness, selfless service and true compassion resonates greatly after all these years. I love you both.

♫ *I'll be seeing you*
In all the old familiar places
That this heart of mine embraces
All day through ♫

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Move away…!

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This is just the beginning…

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This calls for a celebratory Bovril!

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listed alphabetically

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continued

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“Until one is committed, there is hesitancy, the chance to draw back, always ineffectiveness. Concerning all acts of initiative (and creation), there is one elementary truth the ignorance of which kills countless ideas and splendid plans: that the moment one definitely commits oneself, the providence moves too. All sorts of things occur to help one that would never otherwise have occurred. A whole stream of events issues from the decision, raising in one’s favour all manner of unforeseen incidents and meetings and material assistance, which no man could have dreamt would have come his way.”

- *W.H. Murray*

Dr Todd A. Stanislav

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What a wonderful SoTL ecosystem…

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LIST OF ACRONYMS

AR	Augmented Reality
ASC	Associated Schools of Construction
BIM	Building Information Modelling
CDSME	Curriculum Development Subject Matter Expert
CIB	International Council for Research and Innovation in Building and Construction
CIOB	Chartered Institute of Building
CMCD	Construction Management Curriculum Development
CME	Construction Management Education
CMP	Construction Management Programme
CNBR	Co-operative Network of Building Researchers
FE	Further Education
H_0	Null Hypothesis
H_a	Alternative Hypothesis
HECD	Higher Education Curriculum Development
HEI	Higher Education Institution(s)
IoT	Internet of Things
MS	Microsoft
OfS	Office for Students
ONS	Office of National Statistics
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
QAA	Quality Assurance Agency
REF	Research Excellence Framework
RII	Relative Importance Index
RICS	Royal Institution of Chartered Surveyors
RPYS	Reference Publication Year Spectroscopy
SD	Standard Deviation
SME	Subject Matter Expert
SoTL	Scholarship of Teaching and Learning
SPSS	IBM® SPSS Statistics
STEM	Science, Technology, Engineering and Mathematics
TEF	Teaching Excellence Framework

UK	United Kingdom
US *or* USA	United States of America
VR	Virtual Reality
WA	Weighted Average

LIST OF APPENDICES

LIST OF PUBLICATIONS

Chapter 3 is a slightly modified version of 'Curriculum Development in the Higher Education Literature: A Synthesis Focusing on Construction Management Programmes' published in *Industry and Higher Education*.

Posillico, J.J., Edwards, D.J., Roberts, C. and Shelbourn, M. (2021a) Curriculum development in the higher education literature: A synthesis focusing on construction management programmes. *Industry in Higher Education*. September 2021. DOI: https://doi.org/10.1177/09504222211044894.

Chapter 4 is a slightly modified version of 'A Conceptual Construction Management Curriculum Model Grounded in Scientometric Analysis' published in *Engineering, Construction and Architectural Management*.

Posillico, J.J., Edwards, D.J., Roberts, C.J. and Shelbourn, M. (2022a) A Conceptual Construction Management Curriculum Model Grounded in Scientometric Analysis. *Engineering, Construction and Architectural Management*, In Press. DOI: https://doi.org/10.1108/ECAM-10-2021-0899.

CHAPTER 1

INTRODUCTION

INTRODUCTION

Across the United Kingdom (UK) approximately 343,000 organisations, employing around 2.4 million individuals, are either employed or manage businesses within the construction sector (Rhodes, 2019). From speciality contractors to comprehensive construction management firms, construction managers lie at the heart of the construction profession (Brockmann, 2021). Orchestrating not only raw and fabricated building materials but skilled and un-skilled human resources alike, construction managers require a diverse set of skills inclusive of interpersonal skills (i.e., communication, listening, teamwork and empathy) (Farler and Haan, 2021) and technical skills (i.e., scheduling, estimating and building information modelling (BIM)) (Al Amri *et al*., 2021). More specifically, a harmonious balance between the two skill sets is imperative for the effective management of construction projects (Vaz-Serra *et al*., 2021), thus the considerable importance of having informed and relevant university construction management programme curricula. In the absence of such, construction managers would be unable to communicate or manage effectively between the various professions that constitute the project management team.

Higher education institutions (HEIs) provide a fertile learned environment and structure geared towards the advancement and refinement of students' employability, professional and life skills (Brint, 2018; Bok, 2020). To meet these aforementioned objectives, HEIs implement a series of curricula aimed at achieving both academic and interpersonal goals set for students (Gable, 2021; Kosslyn and Nelson, 2017; Quinn, 2019). Curricula is so intrinsically entrenched within HEI programmes that many students and staff select to study, research and/or work at an institution solely based upon its reputation (Hieu *et al*., 2020; Nusier and El Refae, 2021; Saiti *et al.*, 2017). In essence, curricula are the defining feature of HEIs which acts as a shell and holding place of numerous specific programmes, each with explicit tailored curricula designed to 'fit' industry employment requirements. This status quo has engendered new curriculum theory and development as a collaborative field of study which examines multiple intertwined layers of education sequence, pedagogy, psychology and sociology (Green, 2018; Proctor, 2020).

Compared to traditional disciplines (e.g., maths, engineering and physics), construction management is a comparatively juvenile 'technical-based' discipline that developed out of advancements and intricacies of the post-war era – specifically, the need to rebuild infrastructure to aid economic recovery (Charted Institute of Building, 2021; Howell *et al.*, 2011). As with most technical-based programmes, equilibrium in content taught must be achieved between contemporary industry relevance and academic rigour couched within a changing construction and academic topology (Borg and Scott-Young, 2020; Bröchner and Sezer, 2020). Just as a project plan and schedule are essential tools for the successful construction of a building, so too is the curriculum for a construction management programme. The curriculum defines and delineates the path of study, including critical study topics, activities and milestones that cumulatively prepare the 'journeyman student' for a career in industry. Despite the significant influx of automation and digitisation (under the guise of Industry 4.0), at its core, the construction industry is a human-skilled discipline. Therefore, an individual's knowledge, skills, abilities and competencies are fundamental to industry's success. Within this context as delineated, the importance of an appropriate, focused and relevant educational provision is paramount.

This chapter introduces the contextual nature of the research, specifically discussing higher education curriculum development (HECD) in the context of interpersonal and technical skills and competencies for construction management education (CME). Additionally, this chapter outlines the: 1) research problem statement and underpinning contextual background; 2) study's aim; 3) motivation for the research undertaken; 4) study's significance and contribution to new knowledge; 5) study's structure; and 6) ethical statement. In doing so, this chapter provides a logical introduction to the thesis and guides the reader through the thought processes adopted to undertake this research.

RESEARCH PROBLEM STATEMENT AND MOTIVATION FOR THE STUDY

The motivation for this present study is rooted in personal experience augmented by evidence within extant literature of an absence of curricula insight related to the discipline, its core fundamentals and its configuration with practicing industry. The increase in specialised craftworkers, disruptive digital technologies, advancements in building engineering and stakeholder influence (amongst many other complex factors) have not only led to the continual refinement of the construction manager role but have placed this role as a central hub to the building process. Despite this role's prominence and significance, the supporting educational provision is relatively infant, lacks clarity across educational provisions and is falling short in terms of knowledge sharing between HEIs. As such, a focused examination of construction management curriculum is needed to start defining/re-defining the core educational delivery for aspiring construction management students.

AIM OF THE STUDY

This study aims to develop and validate a construction management curriculum foundation model (as a framework) that specifically focuses upon the skills and competencies contemporary construction managers need to efficiently and effectively manage multi-collaborative teams and projects. Such a model provides: a steadfast datum for which construction management curriculum development (CMCD) can originate from; a blueprint guidance for HEIs to consider the further development and refinement of their own CMCD; and engenders wider academic debate in this novel area of scientific endeavour. The study commences with an extensive analysis of extant academic literature in HECD. Secondary data, obtained from university course/module specifications and construction management organisation's job advertisements are also analysed to cross compare against the prevailing academic discourse. Finally, primary data is collected and evaluated from global built environment academics. From the aggregate literature, secondary and primary data, a proof-of-concept model is developed and validated by a series of subject matter expert (SME) interviews. Recommendations from the study are applied to areas of future research and inquiry.

SIGNIFICANCE OF THE STUDY

Hitherto, construction management curriculum development has received scant academic attention, yet the profession is pivotal to the construction and civil engineering industry (Posillico *et al*., 2021a) and HEIs who train future generations for employment in the sector (Posillico *et al*., 2022a). To explore this phenomenon in greater detail, this study utilises a diverse but complementary set of methods and techniques. Bibliometric and scientometric analyses were conducted on extant literature related to HECD and CMCD revealing a dearth of publications and an absent community of practice. Textual analysis of publicly available secondary data was examined to review accredited construction management courses within the UK resulting in identification of a set of vague skills and competencies inherent of the courses. A culmination of literature and secondary data led to the development of a *conceptual model* for CMCD. Textual analysis was also utilised on construction manager job advertisements from influential construction organisations within the UK to provide a finer granularity to the skills and competencies unearthed from construction management course analysis. Primary data was collected via a Likert-scale survey instrument and statistically analysed concerning the levels of importance for interpersonal and technical skills and competencies resulting from the aggregate secondary data findings. This resulted in the abductive development of a *proof-of-concept curriculum foundation model* (which extended the former conceptual model and added granularity of detail) which was subsequently validated by subject matter experts (SMEs) during semi-structured interviews. This study contributes to not only to the HECD literature, but the CMCD holistic vein of research. Specifically, a final *curriculum foundation model* is presented for existing and new construction management courses to utilise as a bedrock starting point in curriculum development/re-development.

THE STUDY

Research Questions

The following questions were identified based upon the research problem statement and research study aim:

1. What is the existing curriculum development landscape in higher education? Subsequently, what is the existing curriculum development landscape regarding construction management education?
2. What are the core skills and competencies current construction management courses are promoting, supporting, developing and utilising?
3. What are the core skills and competencies current construction organisations are looking for in the role of construction manager?
4. How can construction management programmes (CMP) best combine the essential core skills and competencies in their curricula?

Research Objectives

This research will develop a construction management curriculum foundation model that includes the core skills and competencies upon which the remainder of the curriculum can be built. This model provides a contextually robust (yet simplistic in comprehension) framework to facilitate easy understanding and distribution across the discipline. The research objectives are:

1. To identify the current landscape for curriculum development within higher education, specifically with regards to construction management education.
2. To identify the current status of construction management courses relative to core skills and competencies and compare these findings with current construction industry job profile skills and competencies for the role of construction manager.

3. To develop an undergraduate curriculum model foundation which delineates upon the importance of core skills and competencies needed for current and future industry success.
4. To validate the curriculum foundation model from curriculum development subject matter experts (CDSMEs) through a series of semi-structured interviews with the motivation to narrow the gap between industry needs and graduate skill sets acquired at HEIs.

Research Methodology and Design

Six main aspects, as noted in Saunders *et al*. (2016) 'Research Onion,' comprise the research methodology: 1) philosophical selection; 2) determination of approach; 4) selection of research choices; 4) identification of research strategies; 5) indication of time horizon; and 6) utilisation of techniques and procedures. A succinct summary of the methods and approaches utilised throughout the research is now elucidated upon in some greater detail. A more granular description and contextualisation of these methods and approaches are detailed in Chapter 2 (methodology).

Philosophical Selection

Philosophy emphasises the fundamental dialogue that directs and facilitates developments in scientific thinking and knowledge formation (Saunders *et al*., 2016). Philosophy contains various branches and approaches and can include ethics, metaphysics, political philosophy and so on (Fellows and Liu, 2015; Saunders *et al*., 2016). For this thesis however, epistemology will constitute the main branch adopted given the thesis preoccupation with the creation of new knowledge (i.e., nature, origin and scope) (Farrell *et al*., 2017; Fellows and Liu, 2015).

<u>Interpretivism</u>

Interpretivism places a high importance on social interactions and experiences for helping to define one's view, inclusive of the several complexities and differences inherent within a social context (Saunders *et al.*, 2016). From an ontological standpoint, interpretivism emphasises human elements in understanding because humans, themselves, create meaning (Saunders *et al.*, 2016). Since different people create different meanings, Fellows and Liu (2015) note that this creates a difference in research views that ultimately add to the richness of the prevailing discourse on research philosophy. Epistemologically, and according to Saunders *et al.* (2016), interpretivist researchers try to embrace and include the inherent complexity by trying to understand what is important to their research participants. To clarify the *why*, a researcher must understand the axiological impacts of interpretivism. Regarding interpretivism, the researcher's own values and beliefs will be present and act as a lens through which their interpretation of social situations are viewed (Saunders *et al.*, 2016). Interpretivism plays a large philosophical part within the study, specifically regarding the interpretation of extant HECD and CMCD literature, elucidation of secondary data sources from UK construction management programmes (CMP) and UK construction organisations as well as the discernment of semi-structured validation interviews.

<u>Postpositivism</u>

Postpositivism recognizes that there is one true reality, but also recognizes the limits of fully understanding such a reality which may be complex and open to some variability (Phillips and Burbules, 2000; Matias *et al.*, 2007; Horn, 2008; Phillips, 2014). From an ontological standpoint, postpositivists, similar to positivists, emphasize a structured, scientific path for understanding the nature of reality (O'Connor and Netting, 2011). However, postpositivism adds to this understanding that there are limitations to understanding and that this understanding may change over time and within different environments; a qualitative/critical-esque notion (Howell, 2013; Dziuban *et al.*, 2016). From an epistemological standpoint, Hartas, 2010 and Groat and Wang, 2013 note only that which is quantifiable, and objective would constitute acceptable knowledge. However, the idea for verification to understand acceptable knowledge is a main sticking point between positivists and postpositivists. Specifically, from an axiological standpoint, the researcher is detached from what is being researched because ontologically, there is one reality (Willis *et al.*, 2007; Davis and Harrison, 2013). However, postpositivists understand and accept that there is inherent researcher bias in all research but works to mitigate its impact (Matias *et al.*, 2007). Postpositivism supports a mixed philosophical stance within this present thesis, specifically regarding the secondary data keyword analysis and the Likert-scale survey instrument composition and statistical analysis.

<u>Pragmatism</u>

Pragmatism is a philosophy that stems itself in the importance of 'matter-of-fact' action (Bacon, 2012; Saunders *et al.*, 2016). As Atkin (2010) notes, one of the major themes of pragmatism is the '*turn to practice*.' For pragmatists, the concept of doubt and a sense that something is out of place or incorrect is a driving force (Chandra and Sharma, 2006; Saunders *et al.*, 2016). From an ontological standpoint, pragmatists recognize that the whole picture of reality cannot be obtained; only through processes, experiences, and practices can slices of reality (or multiple realities) be observed (Taylor *et al.*, 2008). Epistemologically, pragmatism revolves around problem solving, practicality and successful action (Saunders *et al.*, 2016; Putnam and Putnam, 2017). Said differently, what constitutes acceptable knowledge is contextual and those in which produce or allow for positive achievement (Shook and Margolis, 2006). Axiologically, pragmatism, similar to interpretivism, is value driven (Dudovskiy, 2016; Saunders *et al.*, 2016). Furthermore, the research undertaken is initiated and supported by the researcher's beliefs, values, and doubts; mirroring interpretivism, these humanistic expressions are not excluded from the research and are considered vital (Baert, 2005; Lorino, 2018). Similar to the interpretivist philosophy noted above, pragmatism accounts for a large philosophical part within this present thesis, specifically regarding the bibliometric analysis of extant HECD and CMCD literature, analysis of secondary data sources from UK CMP and UK construction organisations as well as the understanding of semi-structured validation interviews.

Determination of Approach

The central purpose associated with research approach revolves around the development or verification of a specific theory (Cargan, 2007). To achieve this, there are three main approaches: 1) inductive; 2) deductive (not utilised for this research); and 3) abductive (Fellows and Liu, 2015; Saunders *et al*., 2016) albeit there are four more less common approaches that could be used viz. 1) critical thinking; 2) cause and effect reasoning; 3) analogical reasoning; and 4) decomposition reasoning. Each provides a distinctive path to research with a shared objective revolving around the concept of theory (Lichtman, 2006; Wilson, 2010). Prudent attention is needed when selecting research approach(es) as they will directly impact the methodological choice for data collection (Saunders *et al*., 2016).

<u>Inductive Reasoning</u>

An inductive approach (indicative reasoning) begins with data collection to which a theory is spawned (Cargan, 2007; Wilson, 2010; Fellows and Liu, 2015; Saunders *et al.*, 2016). The researcher uses collected data to develop a theory rather than applying a present theory to collected data (Lichtman, 2006; Ekinci, 2015). An inductive approach is based on learning from experience in the sense that the researcher is repeatedly gaining knowledge whilst collecting data (Wilson, 2010; Dudovskiy, 2016). This present thesis utilises an inductive approach specifically regarding the analysis of extant HECD and CMCD literature, analysis of secondary data sources from UK construction management programmes (CMP) and UK construction organisations as well as the analysis of primary data sources from Likert-scale survey instrument and semi-structured validation interviews.

Abductive Reasoning

An abductive approach (abductive reasoning) is a semi-hybrid approach where the researcher moves between inductive and deductive in a pragmatic way to establish a structure of how a phenomenon occurred (Saunders *et al*., 2016). As Fellows and Liu (2105) note, abductive reasoning usually starts with an unforeseen situation or discovery and then works backward to build a plausible explanation. Abductive reasoning utilises a variety of 'signs' to help piece the larger picture together, which can then be interpreted and analysed by the researcher (Doven, 2021). An abductive approach, by its very nature utilises both qualitative and quantitative research (Brown University, 2022). This present thesis utilises an abductive approach to develop the *conceptual model*, *proof-of-concept model* and *curriculum foundation model*.

Methodological Choice

Once the research philosophy(ies) and approach(es) are determined, the methodological choice is the next layer of decision making (Saunders *et al*., 2016). Methodological choice can be grouped into two sections each with the same two parts. First, the researcher must choose between a mono-method, meaning single data collection technique, or multiple-method, meaning numerous data collection techniques (Saunders *et al*., 2016). Once this initial decision has been made, then the researcher must choose qualitative and/or quantitative data sources (Fellows and Liu, 2015).

Mixed-Method

Mixed-method, a branch of multiple-methods, is when the researcher combines both qualitative and quantitative methods and analysis procedures (Farrell *et al*., 2017). Within this study, mixed-methods are utilised consistently throughout all aspects. For example, location and interpretation of extant HECD and CMCD literature; discovery and elucidation of secondary data sources from UK construction management programmes (CMP) and UK construction organisations; composition and analysis of Likert-scale survey instrument primary data and the development and discernment of semi-structured validation interviews.

Qualitative and Quantitative Data

Qualitative data refers to data that is non-numeric in nature (Fellows and Liu, 2015; Saunders *et al*., 2016). For example, data that is collected from an interview transcript (words) and then analysed, would be considered qualitative (Naoum 2019). Quantitative data, on the other hand, refers to data that is numeric (Fellows and Liu, 2015; Saunders *et al*., 2016). For example, data that is collected from scientific measurement observations and then analysed, would be considered quantitative (Farrell *et al*., 2017). Within this present thesis, both qualitative and quantitative data are utilised consistently throughout all aspects. For example: interpretation of extant HECD and CMCD literature through bibliometrics and scientometrics; elucidation of secondary data sources from UK construction management programmes (CMP) and UK construction organisations; analysis of Likert-scale survey instrument primary data and the discernment of semi-structured validation interviews.

Time Horizons

Time horizons refer to the overall duration in which the research is taking place (Rose *et al*., 2015). There are two different types of time horizons: 1) longitudinal; and 2) cross-sectional (Saunders *et al*., 2016).

Cross-Sectional

A cross-sectional time horizon refers to research that occurs at a single point in time (Lavrakas, 2008). Specifically, cross-sectional studies do not take time impacts into consideration, only the observations occurring at that moment (Saunders *et al*., 2016) – hence, cross sectional studies represent a snapshot at a moment in time. This present thesis utilises exclusively a cross-sectional time horizon throughout the collection and analysis of extant literature, secondary data and primary data.

Strategies, Techniques and Procedures

The research strategy is the plan of how the research goal will be achieved (Saunders *et al*., 2016) and serves as the bridge between the research philosophy(ies) and the method(s) to collect data (Denzin and Lincoln, 2017). The techniques and procedures utilised by the researcher are the specific, granular practices to collect data (Fellows and Liu, 2015; Saunders *et al*., 2016). There are a plethora of different techniques and procedures to collect data that can be used singularly or in combination with numerous others (Naoum 2019). The main clusters adopted for this present thesis are presented below.

Secondary Data Collection

The use of extant literature formed the main secondary data source. The use of literature databases, such as Scopus and Web of Science, provided an extremely comprehensive collection of literature from leading journals and publisher from across the globe. The literature was used to contextualise the current HECD and CMCD landscapes by identifying key authors, publication outlets, date ranges and countries/institutions. Additionally, the extant literature was critical in the development of the *conceptual model*.

Other forms of secondary data were also collected and analysed, namely UK CMP course/module specifications and UK construction organisations job advertisements for construction/project manager. For UK CMPs secondary data, the Chartered Institute of Building's (CIOB) publication of accredited courses acted as the main document which identified approved construction management courses. From there, publicly available course/module specifications were obtained directly from the University's/programme's webpage. This data was utilised to help understand current construction management educational provision in regard to interpersonal and technical skills and competencies.

For UK construction organisations secondary data, ten construction organisations located in the UK, of substantial influence (measured in terms of revenue, employment and scope of services) were identified through leading trade publications. Job advertisements for the role of construction/project manager were obtained from each construction organisation through their publicly available human resources or careers website. This data was utilised to gain insight into the preferred skills and competencies of construction organisations related to the role of construction/project manager.

Primary Data Collection

Two sources of primary data were collected viz.: 1) academic perceptions of the importance of interpersonal and technical skills/competencies; and 2) semi-structured validation interviews. Regarding the first, a Likert-scale survey instrument was developed and distributed to built environment academics across the globe. The purpose behind this group of primary data was to collect the perceptions of importance of select interpersonal and technical skills related to a construction manager. Additionally, this data collection helped craft a *proof-of-concept model*. Regarding the second, semi-structured validation interviews were conducted with curriculum development subject matter experts (CDSME) to obtain their feedback on the *proof-of-concept model* for formalisation into a *curriculum foundation model*.

Bibliometric and Scientometric Analyses

Bibliometric and scientometric analyses is a statistical approach to quantitatively measuring the impact of research (van Eck and Waltman, 2010; Chamberlain *et al.*, 2019). Specifically, the measurement of citations, authorship, co-authorship, publication outlets, impact scores and a wide range of other literature metrics are utilised in aggregate for to provide robust literature analysis (Newman *et al.,* 2020; Smith *et al.,* 2021). Both analyses (via a host of software applications) were utilised with extant literature to help contextualise the HECD and CMCD landscapes as well as ascertain key authors, publication outlets, date ranges and co-authorship, amongst others. This analysis helped lead to the development of the *conceptual model*.

Textual Analysis

Textual analysis is a research method that aims to uncover the content and context of written and spoken language (Allen, 2017). The way in which individuals communicate – their choice, arrangement and frequency of words – can be analysed to understand underlying communication messages (McKee, 2003). This analysis (via Voyant Tools) was utilised on UK CMP and UK construction organisation secondary data to uncover frequently occurring words and themes. This analysis helped lead to the development of the *proof-of-concept model*.

Descriptive and Inferential Statistics

Descriptive statistics are utilised to describe and contextualise very basic information of the dataset (Holcomb, 2017). Descriptive statistics also help to provide a high-level summary of the dataset, without trying to reach pinpoint statistical conclusions (Lacort, 2014). This type of analysis forms the basis for more advance statistical analysis – inferential statistics (Holcomb, 2017). Inferential statistics are utilised to help draw conclusions, or inferences, about a dataset (Asadoorian and Kantarelis, 2005). Building off descriptive statistics, inferential statistics takes the reached conclusion(s) and apply it to a more overall population (Boslaugh, 2013). This type of analysis includes various mathematical tests, formulas and models to help pinpoint robust conclusions about a dataset (Asadoorian and Kantarelis, 2005). These analyses were utilised on the Likert-scale survey instrument primary data to help determine: demographic picture of the respondents, level of importance/significance of specific skills and competencies and ascertain a final skills and competencies ranking table. This analysis was instrumental in the development of the *proof-of-concept model*.

CONTRIBUTIONS TO KNOWLEDGE

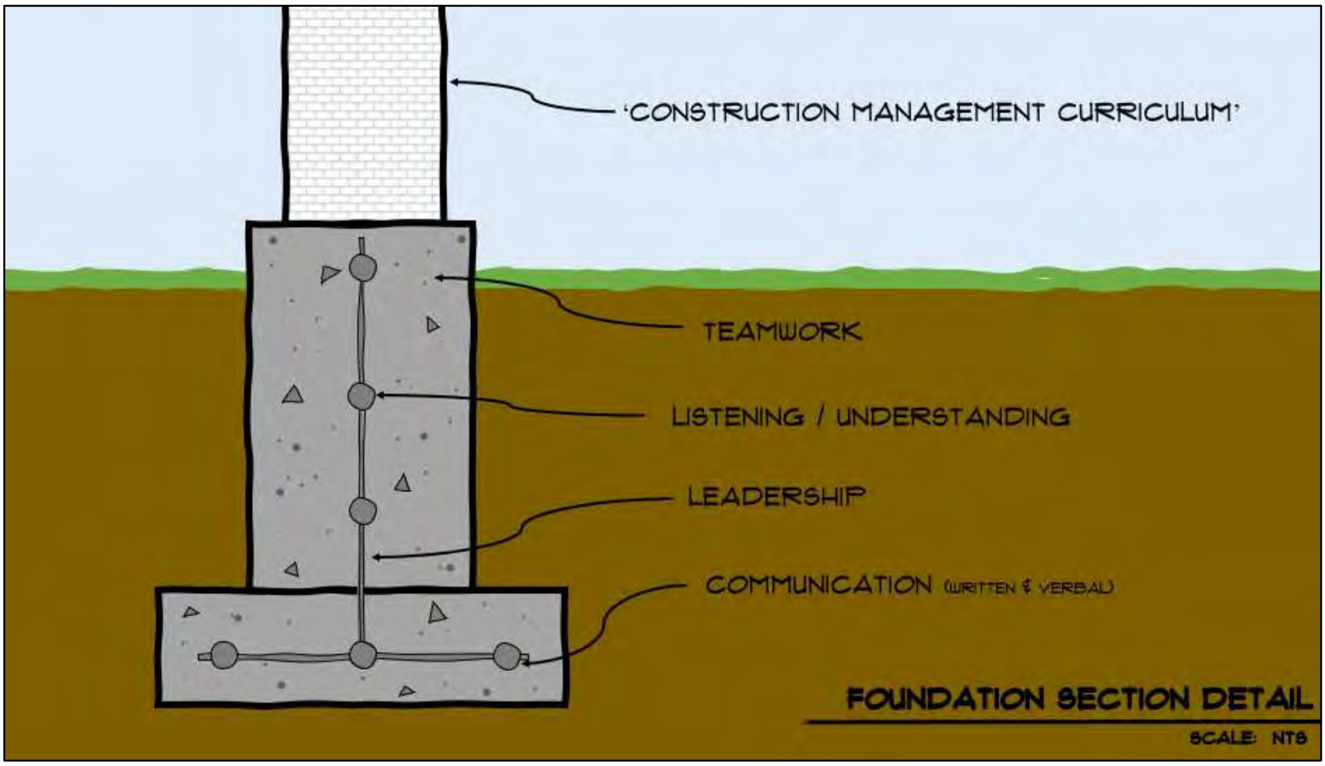
There are numerous contributions to knowledge that emerge from this research. Table 1.1 seeks to identify the major contributions to knowledge from each thesis chapter, noting that each specific chapter provides a finer layer of granulation as to the findings.

Table 1.1 – Overview of the Results from Each Thesis Chapter

Chapter No.	Chapter Title	Overview of Results
3	Curriculum Development in the Higher Education Literature: A Synthesis Focusing on Construction Management Programmes	1. Lack of a defined HECD community of practice within global HEIs. 2. 'Drop-in/Fly-by' approach to discussing curriculum development – a lack of dedicated research as a cohesive mass within extant literature. 3. Lack of construction education publication outlets across a variety of reputable publishers.
4	Development of a Conceptual Construction Management Curriculum Model Grounded in Scientometric Analysis	1. Lack of a defined construction management community of practice. 2. Conceptual model developed outlining internal and external factors of CMCD.
5	Professional Skills Development: Foundational Curriculum Skills and Competencies of UK Construction Management Programmes	1. Irregularity within programme structures amongst UK HEIs. 2. Interpersonal and technical skills and competencies are noted as essential to construction management. 3. Partial picture regarding 'professional skills development.'
6	Defining the Key 'Professional Development Skills' of Construction Managers from Influential UK Construction Organisations	1. High frequency of interpersonal skills found in practitioner job adverts. 2. Conversely, a notable vagueness regarding technical skills with silence on digital skills. 3. Current educational provision and industry person specification requirements are misaligned regarding core skills and competencies.
7	Developing a Proof-of-Concept Curriculum Foundation Model: A Primary Data Survey of Built Environment Academics	1. Strong preference for interpersonal skills – *teamwork*, *communication*, *leadership* and *listening and understanding*. 2. Minute support given for digital skills – an understanding of these is needed only to converse with others in a project management team. 3. Development of a proof-of-concept curriculum foundation model.
8	Proof-of-Concept Model Validation	1. Successful validation of the model.

Figure 1.1 presents the Curriculum Foundation Model detailing the core skills and competencies for which the foundation is composed. Each chapter, beginning with Chapter 3 and ending with Chapter 8, in an overall abductive manner systematically and iteratively builds the proof-of-concept model over three core stages of development viz: *conceptual model*, *proof-of-concept model* and *curriculum foundation model*.

Figure 1.1 – Curriculum Foundation Model



The final model has been validated by CDSMEs with over 100 combined years of education and curriculum development experience. A positive general consensus regarding the model, its elements and its application was achieved resulting in a validated model.

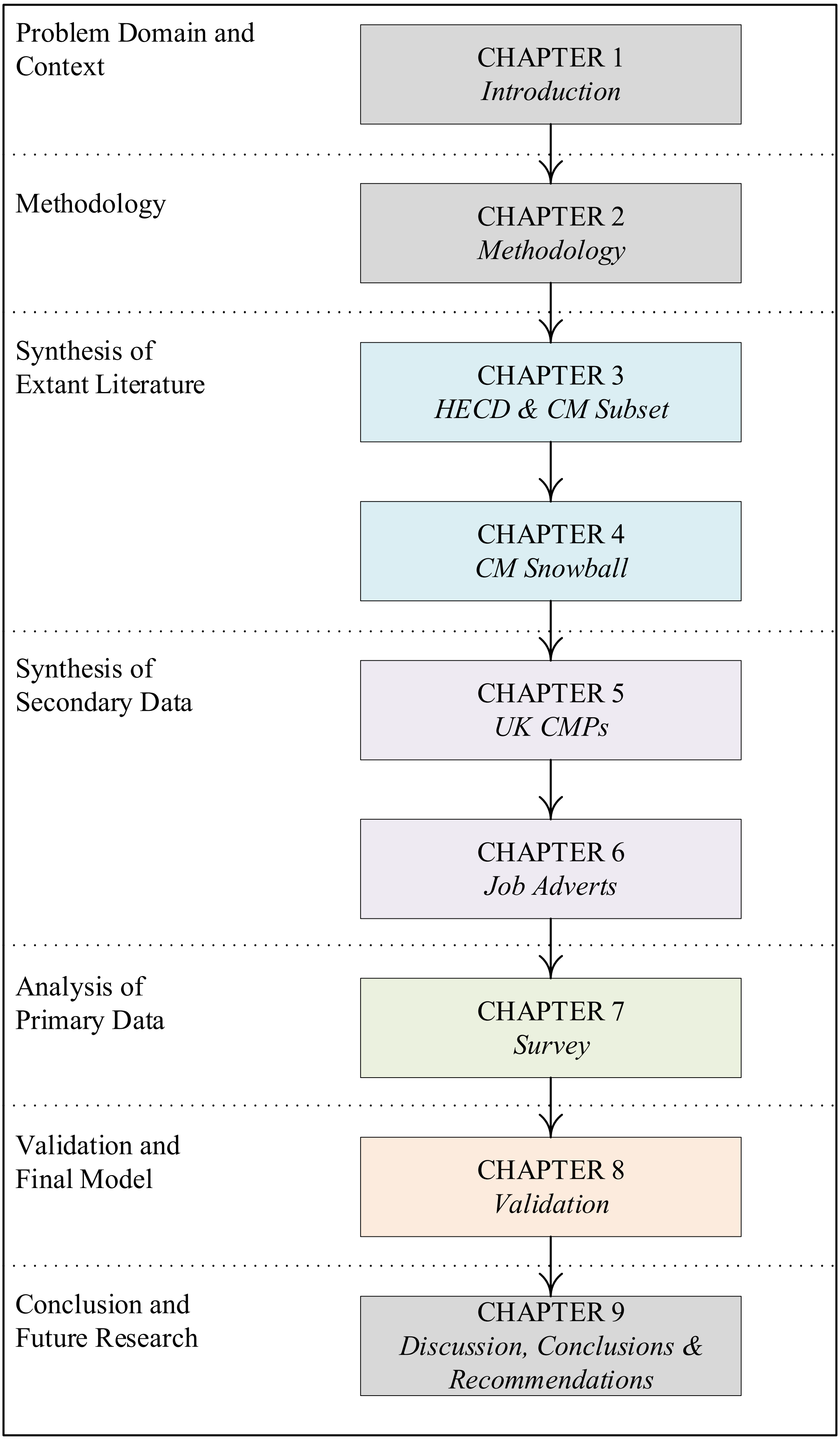
LIMITATIONS

There are important limitations of this work. First, when using a mixed philosophical approach (interpretivist and pragmatism mostly), research bias is an omnipresent issue of contention by virtue of the philosophies adopted (Lincoln and Guba, 2016; Saunders *et al*., 2016). This has been identified as a limitation and complementary data analyses (such as bibliometric, scientometric and textual analyses) were utilised to present a more impartial stance. Second, grounded theory as an approach is extremely wide in definition with inherent limitations, depending on the vein employed, for example, utilising literature to inform the development of a concept lacks applied research (i.e., testing in the HEI sector) – nevertheless, grounded theory is a valid and much proven research strategy that is widely used for this specific type of research undertaking (as presented in this thesis). Third, with secondary data, the strength and publication of this data can be a variable factor in analysis. Whilst the secondary data in this research has been published by reputable outlets, and which can safely be held in positive regard, the data nonetheless, this may not represent a complete representation of the truth. Fourth, whilst careful consideration has been given to the vernacular utilised within the Likert-scale survey instrument, there are undoubtably different interpretations of specific words, phrases and meanings which could impact the rating a respondent selects. Finally, whilst the semi-structured interviews facilitated open-ended comments, a quantitative space for interviewees to assign a numerical value to their comments, could add an additional layer of richness to the data. These limitations apart, the author argues that by adopting a range of approaches and data, the research ensembles a variety of clues and evidence that cumulatively provide a robust representation of the truth. In so doing, the work delineates directions for future work to now deductively test the theories developed in this thesis.

STRUCTURE OF THE THESIS

Figure 1.2 delineates the specific thesis process flow, specifically the parts, items and outputs for the various stages of the research. This consists of seven iterative stages (each separated by swim lanes) that cumulative progress from a *conceptual model* premised upon literature (Chapters 3 and 4), to a *proof-of-concept model* in Chapters 5, 6 and 7. This is subsequently validated in Chapter 8 – thus, constituting the *final validated model*.

Figure 1.2 – Thesis Flow Diagram



Chapter 1 – Introduction

Chapter One provides an outline for the ensuing research, sets the contextualisation of the research and the problem domain and, building upon the former, elucidates further upon the aims and objectives. The chapter then provides an overview of methods employed and provides a summary of thesis chapters.

Chapter 2 – Methodology

Chapter Two is split into two parts. Part one is modelled off Saunders *et al*. (2016) Research Onion and provides a granular overview of the methodology selected and implemented for the research. Specifically, this chapter expands on the: 1) philosophical selection; 2) research approaches; 3) time horizons; 4) overall specific methods utilised and 5) ethical consideration. Part two of the chapter is dedicated to the specific research design adopted for this thesis through its four stages (refer to Figure 2.5 of Methodology Chapter 2). Justification for choices made is also provided to ensure that a robust scientific approach to undertaking the work is confirmed.

Chapter 3 – Literature Review – Part I

This chapter contextualises curriculum development for construction disciplines in HEIs to incite wider polemic discourse and engender new insight into current provisions. Research findings illustrate that while curriculum development within HEIs has received increasing scrutiny and attention, a notable lack of connectivity between research conducted also exists. This lack of a cohesive nucleus in the prevailing body of knowledge is further exacerbated by the strong prevailing academic notion of 'individualism and self' – where bespoke curriculum development prevails within an 'every person for themselves' mentality. This research highlights the lack of a cohesive agenda for curriculum development within construction disciplines and in so doing, underscores the urgent need for a collaborative community of practice to optimise future educational provisions.

Chapter 4 – Literature Review – Part II

This chapter presents a conceptual model for construction management programme curriculum development and aims to engender wider polemic debate as well as stimulate new insight into current higher education practice. Research findings illustrate that the prevailing body of knowledge lacks a cohesive nucleus of research on CMCD. Rather, bespoke curriculum development research predominates in uncommunicative silos. Premised upon these findings, the conceptual curriculum model developed defines and delineates the universal internal factors (e.g., student marketplace, course leadership and academic precedents) and external factors (e.g., accreditation, construction industry and professional bodies) that impact upon curriculum development. Identification of these factors provides a sound basis upon which further research can be propagated to enhance curriculum development and unify the current disparate approaches adopted. This research highlights the lack of a cohesive agenda for curriculum development within mainstream construction management literature and based upon this, presents a conceptual model for future empirical analysis and testing.

Chapter 5 – Secondary Data – UK CM Programmes

This chapter presents a profile of the current skills and competencies that underpin CMP curricula within UK HEIs. In doing so, the work synthesises disparate taught provisions across a range of HEIs; conducts a cross-comparative analysis between these provisions; and engenders wider discourse and new insight into the consistency of current higher education practice. Research findings demonstrate that the specific content of CMP is bespoke and tailored by the programme teaching team at each individual HEI; albeit, all programmes reviewed are in congruence regards the importance of broad technical and interpersonal themes. However, the degree to which these themes are publicly presented differ from the curricular and institutional documentation; specifically, a more 'technical-based skill' image is being portrayed publicly whilst 'interpersonal skills' are strenuously working in the background of the curriculum. Hence, the foundational curriculum skills and competencies are firmly rooted in a sense of employability and career preparedness – a balance of technical and interpersonal skills. Identification of these skills and competencies provides a springboard for supplementary research to augment curriculum development. This research constitutes the first attempt to conduct a cross comparative analysis of descriptive metadata contained with curriculum development documents sourced from various UK HEIs. Emergent findings unearth the key skills and competencies that serve as the curriculum's foundation but also question whether a more consistent approach to construction management education should be sought.

Chapter 6 – Secondary Data – UK Job Adverts

This chapter presents a profile of the sought-after skills and competencies of construction managers in leading UK construction organisations. In doing so, the work contextualises the construction organisations national influence in terms of revenue and employability; conducts a textual analysis of interpersonal and technical skills and competencies from construction manager job advertisements to ascertain the specific skills and competencies desired by construction organisations; and provides a ranking of said skills and competencies to establish a skills and competencies hierarchy in order to inform curriculum development processes. Research findings demonstrate that interpersonal skills and competencies have a 70.59% of importance within the role of construction manager. There exists however, a prevalent vernacular imprecision, within the job advertisements about the specific technical skills and competencies for the role exist. Specifically, the lack of digital-esque skills such as virtual reality (VR), augmented reality (AR) and BIM is profound. Thus, a misalignment is present between the current educational provision and industry practice demand regarding the core foundational skills and competencies required of the construction management profession. This research constitutes an attempt (building upon previous UK construction management curriculum research (cf. Posillico *et al*., 2022a) to conduct a textual analysis of descriptive metadata contained within construction manager job advertisements from leading UK construction organisations. Emergent findings revealed specific skills and competencies that are essential to the core of the modern construction manager's role.

Chapter 7 – Survey

This chapter presents a global perspective regarding the importance of select interpersonal and technical skills/competencies for the role of construction manager. Specifically, the work collects primary data regarding the level of importance for identified skills/competencies of construction managers; conducts descriptive and inferential statistical analysis on the survey results; and culminates in the development of a proof-of-concept model. Research findings demonstrate that whilst technical skills are relatively important for the construction manager's role, they significantly pale in comparison to interpersonal skills. Furthermore, an aggregate ranking of skills/competencies supports the notion that a substantial number of interpersonal skills/competencies out rank numerous technical skills/competencies. Additionally, within the technical skills/competencies, digital-esque themes rank towards the bottom of the table, with 'traditional' skills competencies (i.e., workflow, budgeting and costing) ranking higher. This research represents the final piece of data collection to establish a proof-of-concept model. Findings noted a hierarchy of interpersonal and technical skills/competencies which provided the nuance within the proof-of-concept model regarding the core foundational skills/competencies.

Chapter 8 – Validation

This chapter presents curriculum development subject matter expert (CDSME) feedback on the proof-of-concept model and aims to provide validation of said model. Research findings indicate that not only is the model robust in content and visually strong, but it also provides a much sought after tidy and decluttered view of curriculum development. Furthermore, the importance of a curriculum's foundation and the supportive relationship of interpersonal skills/competencies to technical skills/competencies are profoundly essential. This research qualitatively analyses a series of semi-structured validation interviews which resulted in an overall general consensus amongst participants.

Chapter 9 – Discussion, Recommendations and Conclusions

This chapter presents an overall conclusion to the study by first reiterating the key findings. Following this, an outline of the main contributions to knowledge for each chapter are noted which lead into a discussion on the study's recommendations. Commentary on the study's limitations is also discussed. Areas of future research emanating from the study are then posed concluding the study and offering numerous bridges to succeeding research areas and topics.

CONCLUSIONS

The first chapter has presented the primary focus of the study which includes: 1) contextual background of the research; 2) aims and objectives of the research; 3) research motivation; and 4) the significance of the research. A specific research flow diagram (Figure 1.2) is also presented outlining the chapters contained within the present thesis.

Initial research regarding curriculum development within HEIs and, in particular CMPs, has underscored two main points. First, the symbiotic relationship between CMPs and the construction industry is profound. CMPs serve as one of the main sources for construction organisations to onboard management-level talent. Likewise, the construction industry assists with educational provision within the programmes by providing placement, site visit and technology opportunities to students and staff. Second, despite past conventions and pre-conceived notions about the construction industry, construction project managers are just that – managers. They manage the people who are managing the people who are physically building the structure. As such, the remit of skills and competencies required for such a post are under constant evaluation due to the influx of disruptive technologies (BIM, VR, AR) within the construction sector. Moreover, this evaluation of skills and competencies needs to be cyclical so that CMPs can maintain proper bearing and reflect these skills and competencies within their programme's curriculum.

CHAPTER 2

METHODOLOGY

INTRODUCTION

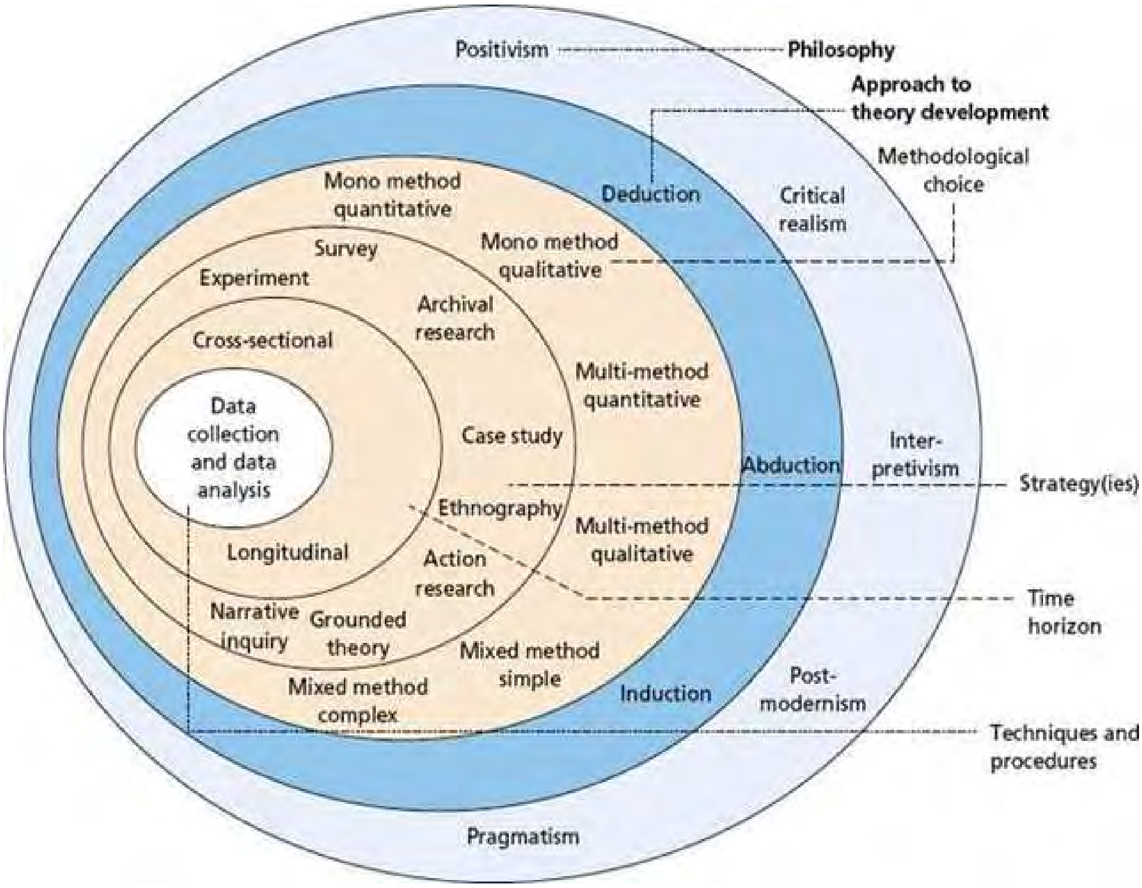
Methodology is perhaps the most important aspect of any thesis given that the integral scientific quality and reliability of the outcomes (namely in the analysis, discussion and conclusions sections) are premised upon them (Fellows and Liu, 2015; Saunders *et al*., 2016). Consequently, this chapter elucidates upon and delineates the various philosophies, approaches, strategies and methods, etc. that govern the development of a rigorous and robust research process. Premised upon this synthesis of scientific narrative, decisions are taken regarding the specific details of the approach adopted within this present thesis.

When constructing a methodology for research, Saunders *et al*. (2016) offers a six layered model, *The Research Onion*, which outlines the various stages a researcher navigates through whilst planning and conducting their research. The six layers are: 1) philosophy; 2) approaches; 3) methodological choice; 4) strategies; 5) time horizons; and 6) techniques and procedures (refer to Figure 2.1). The use of *The Research Onion* is systematic, where the researcher works their way through each layer in order – thinking, planning, deciding and enacting at each stage. For a researcher to discuss the strategies to be employed on a study without contemplating and selecting their philosophical underpinning(s) would be troublesome: as *The Research Onion* depicts, each layer leads to and forms the base for the next. Only after a researcher, in the example above, has selected their philosophical underpinning(s), navigated through the study approaches and selected methodology(ies) can they determine the most appropriate strategies for the research. Consequently, this chapter has been outlined to mirror the six layers of *The Research Onion*, with an applied narrative for the specifics of this thesis.

PHILOSOPHY

Philosophy underscores the fundamental discourse that governs and moderates developments in scientific thinking and knowledge formation (Saunders *et al*., 2016). Philosophy contains a number of different branches and approaches that have been developed since the Pre-Scholastic era and can include ethics, metaphysics, political philosophy and so on (Fellows and Liu, 2015; Saunders *et al*., 2016). For this thesis however, epistemology will constitute the main branch adopted given the thesis preoccupation with the creation of new knowledge (i.e., nature, origin and scope) (Farrell *et al*., 2017; Fellows and Liu, 2015). Prominent philosophical stances are now discussed in some further detail.

Figure 2.1 – Saunders *et al*. (2016) Research Onion



Interpretivism

Interpretivism places a high value on social interactions and experiences for helping to define one's view, inclusive of the numerous complexities and differences inherent within a social context (Saunders *et al.*, 2016). As noted by Fellows and Liu (2015), interpretivism suggests that reality is created by oneself, and thus multiple realities exist, which are evident through observations and perceptions. Burrell and Morgan (2016) continue by stating that interpretivism is subjective in nature due to the various realities created by individuals. Table 2.1 identifies four definitions of interpretivism.

Table 2.1 – Definitions of Interpretivism

Definition of Interpretivism	Source
"Interpretivism emphasises that humans are different from physical phenomena because they create meaning."	Saunders *et al.*, 2016, p. 140
"…interpretivism proposed a relativist world of multiple realities that are constructed and co-constructed by the mind(s) and required to be studied as a whole."	Lincoln and Guba, 2016, p. 88
"…interpretivism argues that reality is relative and so, there can be many different, valid realities; the task for research is to interpret and understand those realities rather than to determine cause-effect relationships for general, predictive purposes."	Fellows and Liu, 2015, p. 20
"The interpretivist approach, looks for culturally derived and historically situated interpretations of the social life-world."	Crotty, 1998, p. 67

Interpretivism Ontology

From an ontological standpoint, interpretivism emphasizes human elements in understanding because humans, themselves, create meaning (Saunders *et al.*, 2016). Since different people create different meanings, Fellows and Liu (2015) note that this creates a difference in research views. Interpretivism looks to highlight these unique differences rather than synthesize and apply an overarching theory to these differences (Saunders *et al.*, 2016). For example, when trying to understand the social contexts of a university community, an interpretivist view would look at the administration, faculty, support staff and student bodies individually, since each group would have their own unique experiences. In contrast, if these unique experiences were boiled down into a common, universal experience, the dynamic, inherent character traits and differences would be lost.

Interpretivism Epistemology

Epistemologically, Wintersberger (2017) notes, social contexts cannot be studied or viewed in the same manner as the natural world; thus, what constitutes as acceptable knowledge in a social context is inherently different from the natural world. According to Saunders *et al.* (2016), interpretivist researchers try to embrace and include the inherent complexity by trying to understand what is important to their research participants. The use of interviews and observations, as well as secondary data, such as literature reviews and bibliometric and content analysis are ways in which an interpretivist can collect data (Dudovskiy, 2016). Furthermore, Burrell and Morgan (2016) note that, from an interpretivist view, there is order, cohesiveness and integration within the human or social construct.

Interpretivism Axiology

In effort to clarify the *why*, a researcher must understand the axiological impacts of interpretivism. Regarding interpretivism, the researcher's own values and beliefs will be present and act as a lens through which their interpretation of social situations are viewed (Saunders *et al.*, 2016). Furthermore, Fellows and Liu (2015) suggest that the researcher is human and with being human, the researcher carries values, beliefs and conventions that should not be strictly excluded from the research environment; their interpretation is subjective and vital. Simply put, the axiology of interpretivism is value laden (Lincoln and Guba, 2016).

Major Strands Within Interpretivism

Within the broad philosophical stance of interpretivism, three strands of interpretivism exist: phenomenology (Beck, 2021; Dudovskiy, 2016), hermeneutics (Zimmerman, 2015) and symbolic interactionism (Saunders *et al.,* 2016; Crotty, 1998). Phenomenologists focus on the research participants' experiences and the recollection of said experiences (Beck, 2021). As Dudovskiy (2016) notes, phenomenologists seek to obtain first-hand experience with the subject being studied as through this authentic experience, one can fully under that specific social context. Hermeneutics on the other hand, focus on specific cultural artifacts such as wisdom literature and philosophical texts (Dudovskiy, 2016; Zimmermann, 2015). Specifically, under a true or classical hermeneutic philosophy, the researcher seeks to interpret, albeit empathetically, the text from the view of the original author (Mir *et al.*, 2016). Symbolic interactionists, with routes in a pragmatic philosophical stance, look to social interactions as the catalyst for meaning (Crotty, 1998). In other words, from a symbolic interactionism view, individuals build themselves and society through social interactions (Charmaz *et al.*, 2019). Thus, when researching such social constructs, the researcher needs to observe individual's elucidations of others within that specific social construct (Charmaz *et al.*, 2019). Focusing on observations regarding conversations, meetings and group work allows a symbolic interactionist to analyse social meanings.

The Purpose of Interpretivism

A main purpose of an interpretivist philosophical stance is to seek clarity as to *why* things are as such (Farrell *et al.*, 2017). This is in opposition to seeking clarity as to *what* things are;

determining facts, which is more of a positivist philosophy. In other words, from an interpretivist view, there is a curiosity to *"understand the very basis and source of social reality"* (Burrell and Morgan, 2016). Likewise, the natural world cannot be understood in the same manner as the social world (Hatch and Yanow, 2003). Table 2.2 outlines interpretivism's stance on five general assumptions.

Table 2.2 – Assumptions of Interpretivism

Assumption	Interpretivism	Source
Ontology *(nature of reality)*	Social context with multiple interpretations of reality.	Burrell and Morgan, 2016 Fellows and Liu, 2015 Saunders *et al.*, 2016
Epistemology *(acceptable knowledge)*	Socially constructed through observations and narratives.	Dudovskiy, 2016 Wintersberger, 2017
Axiology *(role of values)*	Researcher is value laden and researcher beliefs, values and assumptions are critical within research.	Fellows and Liu, 2015 Lincoln and Guba, 2016 Saunders *et al.*, 2016
Subject / Researcher Relationship	Subject and researcher are intertwined in the research; no separation.	Fellows and Liu, 2015 Saunders *et al.*, 2016
Goals	Answering the *'why.'*	Burrell and Morgan, 2016 Farrell *et al.*, 2017

There has been much debate and discussion regarding the place of interpretivism with the realm of science (Geertz, 2017; Hatch and Yanow, 2003). Specifically, since an interpretivist premise is rooted in interpretation, observation and connectedness of social constructs, one true result or meaning is unachievable (Hatch and Yanow, 2003). However, the purpose of interpretivism is not to uncover one true reality, as for example, in physical sciences (Geertz, 2017). Thus, when discussing social constructs or groups of social beings interacting with one another, an interpretivist philosophical stance is appropriate. Hatch and Yanow (2003) note, as implied by Geertz (2017), interpretivism is suited for studies within the realm of the humanities – albeit it is a standard philosophy adopted for literature reviews (cf. Alankarage *et al*., 2022; Asare *et al*., 2022; Chamberlin *et al*., 2019).

How Interpretivism is Used in the Social Sciences

Interpretivism is very closely associated with the social sciences (and humanities, which will be discussed later in this section), which is the branch of science that studies human relationships, behaviours and interactions. The social sciences can be further broken down into six branches (e.g., anthropology, sociology, social psychology, political science, economics and educational psychology), which specifically focus on a finite area of study (Nisbet, 2019). Briefly looking into social sciences literature, one can clearly see the direct use of an interpretivist philosophy. From an anthropologic perspective, Mościcki (2018), when examining the relationship between human migration and visual studies, used interpretivism as a guiding philosophy. In a similar fashion, sociologist researchers Ruiz-Junco and Morrison (2019) adopted an interpretivist stance while discussing the role of empathy as a palliative and hospice care therapy. In the field of social psychology researchers, Zhao and Selman (2020) studied the socialization process of Chinese adolescents from different cultural settings in an effort to interpret and better understand the larger cultural discourses and individual understanding. Likewise, from a political science viewpoint, Hanson and O'Dwyer (2019), while studying an individual's perception of patriotism and nationalism as a sense of national identity, used interpretivist and pragmatic philosophical stances to help interpret narrative findings and apply the study results in a larger ideological context. Furthermore, Kruger *et al.* (2018) specifically address the use of interpretivism as an effective methodology to identify overlooked opportunities for establishing alternate economic practices within a de-growth and post-growth context. Kruger *et al.* (2018) stress the focus of 'mean making' to respond to difference economic situations. Finally, within the field of educational psychology, Wilkins (2020) used an interpretivist philosophy when researching how HEIs located in the United Arab Emirates position themselves within a highly competitive market and compete against other HEIs. The latter application is particularly pertinent for the present research.

An interpretivist philosophical stance has been successfully used within the social sciences within a wide range of research contexts (Bird and Donelan, 2020; Oldershaw, 2019; Pendse, 2020). Each researcher or research team studied different aspects of a social science discipline, with different aims and objectives and consistently used an interpretivist philosophy. While interpretivism is prevalent within this research, it is not the only philosophy used. However, a common theme displayed is the focus on human interaction, social understanding and seeking to answer the *'why'* about a topic.

How Interpretivism is Used in the Humanities

Not surprisingly, the same common theme and use of interpretivism is evident within the humanities. First, looking into the discipline of languages, Kuhn (2019), discusses the use of a computational analysis tool, in conjunction with a hermeneutic text interpretation to help increase the quality of textual analysis from a transdisciplinary collaboration viewpoint. Oldershaw (2019), when researching literary-institutional arrangements, used an interpretivist stance to view past secondary sources to establish a new literary period not defined by literary style, but by institutional practices. Within the performing arts, Bird and Donelan (2020) piloted a study to utilize performance arts (drama) to supplement adult learning. Specifically, Bird and Donelan (2020) used selective drama segments at precise times in conjunction with text education to help increase deeper connectedness, critical learning and social collective learning amongst the participants. Finally, from a historical context, when researching Spanish colonial imprints of the Philippines, Pendse (2020), used interpretivism to expand upon an encompassing picture of Spanish colonial text impacts within the Philippines inclusive of period identification and the interjection of lesser-known artifacts.

Again, interpretivism was used consistently throughout humanities research in conjunction with other philosophical stances. However, similar to the research in the social sciences, interpretivism took a leading role in research philosophy.

How Interpretivism is Used in Construction Management

Saunders *et al.* (2016) and Fellows and Liu (2015) note, interpretivism is highly suitable for business and management research because these subject areas are complex organisms full of unique situations. Specific to this thesis, the umbrella topics of business and management are discussed within the context of construction project management.

Cuganesan and Floris (2020) worked within an interpretivist philosophy when researching community engagement within infrastructure megaprojects. Specifically, the researchers (*ibid*) viewed the project teams' ability to take the perspective of local communities and resolving contradictions between the project and said communities. Along a similar line of research, Lam *et al.* (2019) studied extant literature, through an interpretivist philosophy, to present a comprehensive and applicable approach for estimating construction building material waste.

When exploring the contemporary attitudes amongst construction professionals within the UK regarding fire safety, Mohamed *et al.* (2019), employed a multi-methodology approach, inclusive of interpretivism. Similarly, through an interpretivist stance, Breese *et al.* (2020) examined how a project sponsor role is experienced and understood by senior management assuming that specific role through participants views, thoughts and observations.

Roberts *et al.* (2019) used an interpretivist approach when completing a systematic and holistic literature review of post-occupancy evaluations. The researchers utilised bibliometric analysis of the extant literature to help interpret the wider body of knowledge and identify impediments to its wider industry adoption. In a similar fashion, Al-Saeed *et al.* (2020), when presenting a framework for integrating BIM digital objects to automate construction product manufacturing processes, used a mixed philosophical approach, inclusive of interpretivism. Additionally, Oraee *et al.* (2019), employed an interpretivist approach when researching the collaboration effectiveness of BIM-based construction networks to help identify the main barriers to such collaboration.

An interpretivist philosophy has been recently and successfully used within the context of construction project management. Similar to studies in the social sciences and humanities, the research within construction project management, focused on social and human connectedness, has been of a mixed-philosophical stance. Interpretivism is a leading philosophy due to its heavy focus on social constructs, however the researchers also employed secondary philosophical stances within their research. Again, a common thread is connecting the social sciences, humanities and construction project management social research; that common thread is an interpretivist philosophy.

Benefits and Limitations of Interpretivism

With any philosophical stance, there are inherent benefits and limitations. Qualitative data is aligned with an interpretivist stance and, as such, serves as an inherent benefit for obtaining a great depth of research knowledge on cultural, social and human-centric studies (Dudovskiy, 2016). Likewise, the wide reach of applicable disciplines in which interpretivism has been successfully employed offers a wonderful opportunity for inter-disciplinary research. Furthermore, as demonstrated from the research studies noted above, interpretivism can be utilised in a singular format or harmoniously with other philosophies. This flexibility is a benefit to the researcher when developing multi-faceted studies or trying to establish connections between social and physical constructs.

Fellows and Liu (2015) note that interpretivism accepts the notion that the researcher and the phenomenon researched are interwoven into the study which adds to the study's validity. In contrast, a positivist philosophy, which looks more at the physical sciences and for one true reality, seeks to separate the researcher and the researched; they are independent.

Interpretivism, on the other hand, recognizes the symbiotic relationship between the two (researcher and researched) and suggests that this relationship aids in reflecting a truer reality (Fellows and Liu, 2015).

Conversely, there are noted limitations within an interpretivist philosophy. Similar to the last benefit discussed, the relationship between the researcher and the researched also acts as a limitation (Saunders *et al.*, 2016). Commonly described as researcher / confirmation bias, this has a potential to impact the research because general assumptions about data collected cannot be made due to researcher views and values impacting the research (Dudovskiy, 2016). Furthermore, quantitative data is not associated with an interpretivist philosophy (Farrell *et al.*, 2017). As such, if the researcher is looking to evaluate or add a numerical component to their research for the purposes of validation or explanation, an interpretivist philosophy may not be appropriate. However, as noted above, a combination of philosophies can be used to overcome this limitation. Table 2.3 outlines the general benefits and limitations of interpretivism.

Table 2.3 – Benefits and Limitations of Interpretivism

Benefits	Source	Limitations	Source
Focuses on the 'why.'	Saunders *et al.*, 2016	Researcher and confirmation bias.	Saunders *et al.*, 2016
Inherently linked with qualitative data.	Farrell *et al.*, 2017		
Researcher and researched close relationship.	Lincoln and Guba, 2016	Sole reliance on qualitative data.	Dudovskiy, 2016 Farrell *et al.*, 2017
Wide range inter-disciplinary research opportunities.	Geertz, 2017 Hatch and Yanow, 2003		

Interpretivism Limitation Mitigation Strategies

As noted above, researcher bias is the predominant limitation associated with interpretivism. As the philosophy's name implies, the researcher engages in the act of interpreting a set of observations, sources, artifacts, thus bias is inherently present. To reduce the significance of researcher bias, a first step, seemingly obvious but critical, is the acceptance and recognition that it exists and will continue to exist; it cannot be entirely removed. As noted above, interpretation is the philosophy, and each researcher will interpret the same set of observations, sources and artifacts through their unique lens. While important, the above does not necessarily mitigate this limitation, rather raises awareness of it.

In a more formal mitigation practice, Mackieson *et al.* (2019) suggest the use of applied thematic analysis. The researchers (*ibid*) note that applied thematic analysis provides a structure to qualitative research using text-based documents. Specifically, Mackieson *et al.* (2019) used an applied thematic analysis when analysing the documents of Australian State of Victoria parliamentary debates of the introduction of Permanent Care Orders. In summary, an applied thematic analysis provided a framework for effectively increasing the transparency of the researcher's interpretation, which reduces the impact of researcher bias. In a construction management context, Roberts *et al.* (2019) and Al-Saeed *et al.* (2020) both utilised applied thematic analysis to reduce researcher bias.

Content analysis, a second formal mitigation practice, is much aligned with applied thematic analysis. Bengtsson (2016) notes that content analysis can be used with both quantitative and qualitative data, which offers a unique, cross-method opportunity to reduce researcher bias and increase interpretation transparency. Briefly, content analysis in a qualitative context, reduces the text data into themes and/or groups in an effort to bring clarity and understanding to the data; usually assisted through a software platform (Bengtsson, 2016; Kuhn, 2019). Content analysis can help offset researcher bias within an interpretivist philosophical stance by mimicking aspects of quantitative research outputs. Specifically, since content analysis reduces text into themes and/or groups, sometimes through a software platform (which can be safely assumed as having a neutral bias), these specific themes and/or groups can be viewed as transparent (Bengtsson, 2016). From these outputs, the researcher can then apply their interpretation to the subject(s) being studied. In a construction management context, Al-Saeed *et al.* (2020) utilised content analysis to reduce researcher bias.

Interpretivism is predominately associated with qualitative methods. The alignment of the methodology and method is itself a limitation. One strategy to mitigate this limitation is to reduce the reliance on qualitative data and introduce aspects of quantitative data (Coe *et al.*, 2017; Cohen *et al.*, 2017). Inherently, the introduction of quantitative data signals a mixed-philosophical approach, which is linked to this mitigation strategy. From a construction management lens, Al-Saeed *et al.* (2020) and Mohamed *et al.* (2019) utilised a mixed-philosophical approach to mitigate interpretivism's reliance on qualitative data. Table 2.4 outlines methods to mitigate the limitations associated with interpretivism.

Table 2.4 – Interpretivism Limitations Mitigation

Limitations	**Source**	**Limitation Mitigation**	**Source** *(general)*	**Source** *(construction management)*
Researcher and confirmation bias.	Saunders *et al.*, 2016	Applied Thematic Analysis Content Analysis.	Bengtsson, 2016 Mackieson *et al.*, 2019	Al-Saeed *et al.*, 2020 Roberts *et al.*, 2019
Sole reliance on qualitative data.	Dudovskiy, 2016 Farrell *et al.*, 2017	Multi-philosophical stances within the research.	Coe *et al.*, 2017 Cohen *et al.*, 2017	Al-Saeed *et al.*, 2020 Mohamed *et al.*, 2019

Postpositivism

Postpositivism, according to Adam (2014), Alvesson and Sköldberg (2009), Frey (2018), Horn (2008) and Sias (2009) is a philosophical stance that developed to contrast some key points within the positivist methodology but is not anti-positivism. Postpositivism recognizes that there is one true reality, but also recognizes the limits of fully understanding such a reality (Horn, 2008; Matias *et al.*, 2007; Phillips, 2014; Phillips and Burbules, 2000). Postpositivism is a strengthening of positivism in that the integration of qualitative methods to a previously quantitatively dominated philosophy (positivism) help to increase the complexity and rigor of the research design (Adam, 2014; Creswell, 2007). Said differently, a postpositivist can, using the scientific method, make a prediction about something, but this would only be an approximation. The postpositivist accepts that there is a variability in the outcome given the environment in which it is observed (Dziuban *et al.*, 2016; Howell, 2013). As Adam (2014) puts eloquently:

> *"...postpositivism deals with three main questions relating to: (1) the quality of the (input) data; (2) the use of a more integrated approach; and (3) the context of the studied phenomenon. Positivism somehow presupposes that data are good quality and adequate if they can be quantified, and bypasses the problem of context by dealing with the multitude of variables and correlations between them"* (Adam, 2014, p. 7).

Table 2.5 identifies six definition excerpts of postpositivism.

Table 2.5 - Definitions of Postpositivism

Definition of Postpositivism	Source
"...postpositivists see the limitations of the world order. They may approach research deterministically and seek cause and effect, but they understand that these are subject to change and are not absolute. They assume that findings may only be applicable to the situation at hand and are open to revision and reinterpretation in other environments."	Dziuban *et al.*, 2016, p. 15
"Postpositivism recognizes the role of subjectivity but seeks to maintain a position of modified objectivity."	O'Connor and Netting, 2011, p. 56
"Post-positivism is very similar to positivism, the difference being that when studying social reality, post-positivism recognizes that researcher cannot be absolutely positive about their knowledge claims. Post-positivism asserts that social research can only approximate reality."	Hesse-Biber and Leavy, 2011, p. 16
"The goal of postpositivist research, basic or applied, is to find the truth about something. Postpositivists do not believe you can convincingly find truth with one study, but each study is part of a broader effort to get closer and closer to the truth through a series of research studies."	Willis *et al.*, 2007, p. 74
"In general, postpositivists have a more restrained view of our capacity to ever 'know' reality than do positivists. Postpositivists recognize limitations in the ability of human to cognize and understand the world fully."	Horn, 2008, p. 36

Postpositivism Ontology

From an ontological standpoint, postpositivists, similar to positivists, emphasize a structured, scientific path for understanding the nature of reality (O'Connor and Netting, 2011). However, postpositivism adds to this understanding that there are limitations to understanding and that this understanding may change over time and within different environments; a qualitative/critical-esque notion (Dziuban *et al.*, 2016; Howell, 2013). If a postpositivist were conducting research on the social contexts of a University community, the strucutre of the reserch would mirror that of the physical sciences, looking for quantifiable facts and observations. From this type of data, the postpositivist researcher would then draw conclusions, explain relationships and comment on the social behavior of the University community, noting specifically that these 'results' would be objective but could be different in other communities and social situations (Howell, 2013).

Postpositivism Epistemology

Epistemologically, Groat and Wang (2013) and Hartas (2010) note only that which is quantifiable and objective would constitute acceptable knowledge. However, the idea for verification to understand acceptable knowledge is a main sticking point between positivists and postpositivists. Postpositivism introduced the concept of falsification (Frey, 2018; Bhattacharya, 2017; Howell, 2013; Willis *et al.*, 2007) which notes that one can obtain a sense of reality by proving something invalid. For a classic example of falsification, one can claim that all swans are white, however it would be considered impossible to know, or observe, that all swans are white. If one black swan was observed, on the other hand, then the notion that all swans are white would be void (Frey, 2018; Howell, 2013). In other words, a researcher cannot know all things, but can argue a theory by a single null outcome. The postpositivist research uses a combination of quantitative and qualitative data to help increase the complexity and rigor of the research (Adam, 2014; Creswell, 2007; Matias *et al.*, 2007).

Postpositivism Axiology

Axiologically, postpositivism and positivism are closely aligned (Horn, 2008; Matias *et al.*, 2007). Specifically, the researcher is detached from what is being researched because ontologically, there is one reality (Davis and Harrison, 2013; Willis *et al.*, 2007). However, postpositivists understand and accept that there is inherent researcher bias in all research but work to mitigate its impact (Matias *et al.*, 2007).

The Purpose of Postpositivism

The main purpose of a postpositivist philosophical stance is continuing to build knowledge as to what the true reality is; knowing that there are limitations to fully understanding this reality (cf. Hartas, 2010; Horn, 2008; Matias *et al.*, 2007; Phillips, 2014). While closely aligned with positivism, (cf. Alvesson and Sköldberg, 2009; Frey, 2018; Horn, 2008) the ontological stance of knowledge limits (Dziuban *et al.*, 2016; Howell, 2013; O'Connor and Netting, 2011), the epistemological introduction of falsification (Bhattacharya, 2017; Frey, 2018; Howell, 2013; Willis *et al.*, 2007) and the axiological recognition of value-laden research (Matias *et al.*, 2007) differentiate postpositivism. Table 2.6 outlines postpositivism's stance on five general assumptions.

Table 2.6 – Assumptions of Postpositivism

Assumption	Postpositivism	Source
Ontology *(nature of reality)*	One true ordered reality, but there are limits to researcher's ability to accurately capture it.	Prasad, 2018 Willis *et al.,* 2007
Epistemology *(acceptable knowledge)*	Facts can be measured and proved, falsification & null hypothesis. Casual relationships and regularities lead to predictions that can change over time.	Uhl-Bien and Ospina, 2012
Axiology *(role of values)*	Researcher is independent and removed from the research; they are value-laden and work to mitigate impacts.	Leavy, 2020 Willis *et al.,* 2007
Subject / Researcher Relationship	Subject and researcher are separate but also recognize inherent connectedness.	Sias, 2009
Goals	Find causal relationships.	Willis *et al.,* 2007 Sias, 2009

How Postpositivism is Used in the Physical/Biological Sciences

Postpositivism, while closely associated with positivism (Adam, 2014; Alvesson and Sköldberg, 2009; Frey, 2018; Horn, 2008), does not necessarily equate to a direct use within the physical and biological sciences (Hesse-Biber and Leavy, 2011). However, postpositivism's notion of a 'unified' physical and social science (Sias, 2009) does lend credence to the use of the philosophy within the physical and biological sciences, given that a human context is also being examined. Briefly looking into both physical and biological science literature, one can clearly see use of a postpositivist philosophy (cf. Chen *et al.*, 2019; Mansour *et al.*, 2020; Richter *et al.*, 2019).

From a physics perspective, Mansour *et al.* (2020), used a postpositivist methodology when evaluating the impact on magnetic resonance imaging (MRI) image quality through varying angle sequences. In addition to using standard quantitative data collection methods, a visual rating by experienced radiologists via a Likert questionnaire was also used. Chen *et al.* (2019), when examining patients' perceptions of positron emission tomography–magnetic resonance imaging procedures and its correlation with image quality, used a postpositivist philosophical stance. Similar to Mansour *et al.* (2020), a Likert questionnaire was utilised in conjunction with more traditional quantitative data collection methods. Likewise, from a chemistry viewpoint, Delfino *et al.* (2020), used a postpositivist methodology when analysing the relationship between Brazilian public high school teachers' sedentary behaviour patterns and dietary and lifestyle habits. Furthermore, Richter *et al.* (2019), when evaluating the knowledge, attitudes and practice patterns of physicians prescribing topical oestrogen for women with a history of breast cancer and urogenital atrophy, used a postpositivist methodology. Specifically, the research teams utilised Likert questionnaires to obtain both quantitative and qualitative data.

Chik *et al.* (2019) employed a postpositivist philosophical stance when examining subject matter experts' awareness of wind disaster risk mitigation in Northern Peninsular Malaysia. The researchers used a Likert questionnaire as well as traditional quantitative data analysis within their examination. Furthermore, Sulaiman *et al.* (2019) when researching and analysing the coastal communities' perception toward mangrove forests in the Suli subdistrict, utilised a postpositivist methodology. Polgar and Thomas (2020), in their text regarding health sciences, note the use of postpositivism as an alternative methodology due to its incorporation of qualitative aspects to help offset positivism's 'medial method' and increase the social aspects of health science. Additionally, Vasudev and Goswami (2020) used a postpositivist philosophical stance when researching the relationship between stakeholder attitudes within conservation biology to having a positive attitude toward wildlife.

A postpositivist philosophical stance has been successfully used within the physical and biological sciences. While each research team studied different aspects of their discipline, a common theme can be gleaned. Specifically, the aspect of a human element or social context appears in the above noted research. While the overarching discipline is that of the physical and biological sciences, the researchers are also looking at human perception, awareness, thought and social complexities. Consequently, a postpositivist methodology is appropriate because, as noted above, postpositivism recognizes the value and importance of both quantitative and qualitative data in the research.

How Postpositivism is Used in the Social Sciences and Humanities

While there has been debate over the use of a postpositivist philosophical stance within the social sciences and humanities (Hesse-Biber and Leavy, 2011), the incorporation of quantitative components has expanded postpositivism into other areas of social study (Adam, 2014; Dziuban *et al.*, 2016; Howell, 2013). As Sias (2009) notes, the physical and social sciences (according to postpositivism) are linked because humans (social) are objects within the physical world.

Malik *et al.* (2020) use a postpositivist philosophical stance when researching political and managerial approaches to Indonesian government via local elections. Similarly, Myers *et al.* (2020) used a postpositivist methodology when examining, using a survey, the effect of public deliberation on the willingness of people of participate in local politics. From a sociology perspective, Baker *et al.* (2020) employed a postpositivist methodology when examining the perspectives and experiences of California climate researchers regarding practitioner engagement. When researching the satisfaction of parents regarding their children's school food management system in Russia, Adamchuk *et al.* (2020) used a postpositivist philosophical stance. Taylor *et al.* (2020), from an anthropological perspective, utilised a postpositivist methodology when examining, through a survey, the traits and characteristics of various scholars in regard to their pro-environmental behaviour. Similarly, Tao *et al.* (2020), when researching the impact of festival participation on ethnic identity, using a questionnaire survey, adopted a postpositivist philosophical stance.

Wustro and Conradie (2020) used a postpositivist methodology when revisiting prior examinations of the stability of farmers' risk perceptions in one community in South Africa. Likewise, Gandhi and Johnson (2020), when researching the performance of participatory water institutions in India's Eastern Indo-Gangetic region using new institutional economics and management fundamentals, employed a postpositivist philosophical stance. Similar to both research teams, the use of Likert questionnaires helped obtain quantitative data for analysis.

From a psychology viewpoint, Machová *et al.* (2020), using a postpositivist methodology, researched whether a ten-minute interaction with a dog impacted various psychological and medical measurements in female students. Similarly, Obrenovic *et al.* (2020) explored the relationship between work-family conflict and job performance and measured the effects on psychological safety and well-being. Within Obrenovic *et al.* (2020) research, a postpositivism philosophical stance was used. Consistent within both research teams was the use of Likert questionnaires to assist with quantitative data collection.

Working within an educational context, Hewett and La Paro (2020) used a postpositivist methodology when researching the relationship between collegiality and supervisor support to the climate and quality of early childhood education programs. In a similar context, van Woezik *et al.* (2020), examined lifelong learning skills of first year students in a higher education medical program. Both research teams used a Likert questionnaire to assist in the collection of quantitative data for more traditionally positivist analysis.

Moving into the Humanities, from a linguistical view, Galante (2020) studied the reliability and validity Plurilingual and Pluricultural Competence scale within two multilingual cities in Canada. Throughout the research, a postpositivist methodology was used. Continuing, Verhagen *et al.* (2020) used a postpositivist philosophical stance when examining variation in linguistic experiences. Specifically, the research team, collected linguistic data, from Likert questionnaires regarding variations across items, participants, time and methods to quantitatively analyse and test hypotheses in the linguistic field.

From a literature perspective, Bell *et al.* (2019) used a postpositivist methodology when researching and developing an empirical tool for examining textual features. Specifically, the researchers (*ibid*) note that a Likert scale tool was utilised due to its generation of data that can be analysed quantitatively but also allows for qualitative interrelations. Furthermore, Caro (2016) continues with a postpositivist philosophical stance when analysing the emotional response differences to audio descriptions. The researcher (*ibid*) used a Likert questionnaire as well as heart rate measurements to identify data that (similar to Bell *et al.* (2019)) could be analysed quantitatively and qualitatively.

Regarding the performing and visual arts, Lauring *et al.* (2016) employed a postpositivist methodology when examining the relationship between social / monetary information and the liking / rating of art. Additionally, Bartolome *et al.* (2019), when exploring the use of a voice interactive guide designed to increase the accessibility of visual arts for visually impaired people, use a postpositivist methodology. Similar to the research mentioned above, the use of Likert questionnaires to obtain quantitative data to help supplement qualitative data is shown.

While postpositivism is not directly associated with the social sciences and humanities, there have been successful attempts by research teams to apply a mixed method or sole postpositivist philosophical stance. The use of both quantitative and qualitative data that a postpositivist methodology can support, in conjunction with the recognition of human and social contexts impacting research, has led to the wide spanning reach of postpositivism in traditionally single methodology fields.

How Postpositivism is Used in Construction Management

Martínez-López (2014), Piekkari and Welch (2011), Sias (2009) and Tsang (2017) suggest postpositivism is an appropriate philosophy for management research due to the *plurality* of the subject, both quantitative and qualitative in content. As Adam (2014) and Creswell (2007) note, postpositivists use of quantitative and qualitative methods helps to uncover the rich complexities and rigor that are inherent in the management discipline. Specific to this thesis, the umbrella topics of business and management are discussed within the context of construction project management. Newman *et al.* (2020) when examining the deployment of Industry 4.0 within the construction industry from a bibliometric and UK case study standpoint, used a mixed methodological approach inclusive of postpositivism. Chileshe *et al.* (2020) in a similar mixed methodological approach inclusive of postpositivism, researched perceptions of challenges affecting bid decisions of native building contractors in Tanzania. In a similar fashion, Al-Saeed *et al.* (2020), continued to use a mixed methodological approach, inclusive of postpositivism, when developing a concept framework for BIM digital objects implementation to help automate and increase construction product manufacturers' processes. Darko *et al.* (2020), when using scientometric analysis and visualization of research examining artificial intelligence in the construction industry, used a mixed methodology inclusive of postpositivism.

Ogunsanya *et al.* (2019), utilised a postpositivist methodology when examining, through exploratory factor analysis, the barriers to Nigerian sustain construction industry procurement. Additionally, Omopariola *et al.* (2019), researched contractors' perceptions of the impact of cash flow on construction projects through a mixed methodological approach, inclusive of postpositivism.

As demonstrated above, a postpositivist philosophy has been recently and successfully used within the context of construction project management. An emphasis on a mixed methodological approach is evident in the above research. The integration of both quantitative and qualitative approaches allows for the research to account for the value-laden, social context found within the construction project management discipline while simultaneously applying an empirical research undertone.

Benefits and Limitations of Postpositivism

With any philosophical stance, there are inherent benefits and limitations. Quantitative and qualitative data is aligned with a postpositivist stance and as such, serves as an inherent benefit for obtaining multiple levels of data to increase research rigor (Adam, 2014; Creswell, 2007). Similar to the positivist philosophy, postpositivism accepts the premise of the scientific method in terms of inquiry as a series of logically related steps (Creswell, 2007). From this, the application of postpositivism within both the physical/biological sciences and the social sciences and humanities appears common (Adam, 2014; Dziuban *et al.*, 2016; Howell, 2013; Sias, 2009). Continuing with this line of thought, as demonstrated in the select research above, specifically the field of construction project management, postpositivism is utilised as part of a mixed methodology; most notably interpretivism. This relationship echoes Creswell's (2007) note of another postpositivist benefit in the form of multiple perspectives from research participants (value-laden) (Matias *et al.*, 2007). Although postpositivism is not interpretivism, the symbiotic interaction between the two philosophies can yield high rigor research.

On the other hand, there are noted limitations within a postpositivist philosophy. Similar to the benefits discussed (empirical and non-empirical data, value-laden, logical inquiry), these can also act as limitations in a singular sense. Specifically, as Gefen (2019) comments, the combination and relationship of empirical and qualitative data can lead to a fuzziness in terms of the data. For example, if a researcher is researching an abstract concept, there may be challenges in translating this into measurable terms (Leavy, 2020). Unlike positivism, where numbers and mathematics reign supreme (Dudovskiy, 2016; Cassell, 2015; Pawlikowski *et al.*, 2018) and thus ambiguity is low, postpositivism, in essence, blends numerical and qualitative data. Once the qualitative data is presented, an interpretivist or discourse (Hartas, 2010) element is introduced which can lend to a more translucent view of the research. Again, this is mirrored by Horn (2008), Matias *et al.* (2007) and Phillips (2014) with the notion that there are limits to fully understanding and knowing true reality. Postpositivism also accepts that the research being conducted seeks to be value-free but recognizes that researcher bias is present, and efforts should be made to reduce the significance of this impact (Matias *et al.*, 2007). While on face value these implications could be taken as minimal (qualitative and interpretation of the researcher), postpositivism also includes aspects of quantitative research which can offer a slippery negative slope if researcher influence is left unchecked (Prasad, 2018). Table 2.7 outlines the general benefits and limitations of postpositivism.

Table 2.7 – Benefits and Limitations of Postpositivism

Benefits	Source	Limitations	Source
Quantitative and qualitative data increase research rigor.	Adam, 2014 Creswell, 2007	Relationship fuzziness between quantitative and qualitative data.	Gefen, 2019 Hartas, 2010
Multiple perspectives from participants.	Adam, 2014 Matias *et al.*, 2007		
Universal throughout physical/biological and social sciences.	Adam, 2014 Dziuban *et al.*, 2016 Howell, 2013 Sias, 2009	Seeks to be value free, but can lead to researcher and confirmation bias.	Matias *et al.*, 2007

Postpositivism Limitation Mitigation Strategies

While seeking to be value free, postpositivism also recognizes that researcher bias is inherent when humans are engaging in research (Dziuban *et al.*, 2016). To that end, it is imperative for researchers to recognize the presence of bias from the outset of the research. One way in which researcher bias can be mitigated is by simply recognizing it (Frey, 2018). More robustly, including multiple researchers within the team allows for more thought, opinions and eyes attune to the bias. Finally, a variety of instruments, mostly quantitative in nature, can help mitigate the bias by validating, checking and proving results and findings (Chileshe *et al.*, 2020; Newman *et al.*, 2020). This is not to say that quantitative instruments are removed from bias; however, the presence of such bias in an empirical formula, method or process is considerably lower than that of qualitative analysis.

The mixture of qualitative and quantitative data within postpositivism as Gefen (2019) and Hartas (2010) note, can lead to a 'fuzziness' in terms of the data. Qualitative and quantitative data, taken separately, are at opposite ends of the spectrum, similar to the relationship between interpretivism and positivism. Postpositivism accepts the validity of both data sets within research, yet when incorporated to not necessarily mix homogenously; there is an area of cloudiness (Jones *et al.*, 2014). In effort to mitigate this limitation, researchers can work to separate the data into distinct silos (not mixing qualitative and quantitative) yet incorporate the findings under one, integrated analysis (Manfra and Bolick, 2017). Another mitigation strategy would be to incorporate mixed methodologies to help clarify the findings and analyses (Al-Saeed *et al.*, 2020).

Within a construction project management context, the above-mentioned mitigation strategies are visible. Looking first at researcher bias, all six studies noted were completed within a research team between three to six researchers (cf. Newman *et al.,* 2020; Chileshe *et al.,* 2020; Al-Saeed *et al.,* 2020; Darko *et al.,* 2020; Ogunsanya *et al.,* 2019; and Omopariola *et al.,* 2019). While not fool-proof, the increase in researchers can help reduce the presence of researcher bias. Continuing, five of the six research teams employed a mixed methodological approach within their research and all five the research teams used the same combination of philosophies: interpretivism and postpositivism. Specifically looking at the use of quantitative instruments to reduce researcher bias while engaging in qualitative aspects of research, the presence of bibliometric analysis, content analysis, thematic analysis and scientific mapping is evident (Newman *et al.,* 2020; Al-Saeed *et al.,* 2020; and Darko *et al.,* 2020). Table 2.8 outlines methods to mitigate the limitations associated with postpositivism.

Table 2.8 – Postpositivism Limitations Mitigation

Limitations	Source	Limitation Mitigation	Source *(general)*	Source *(construction management)*
Relationship fuzziness between quantitative and qualitative data.	Gefen, 2019 Hartas, 2010	Data silos with integrated analysis. Mixed methodological stance.	Manfra and Bolick, 2017	Al-Saeed *et al.*, 2020 Chileshe *et al.*, 2020 Darko *et al.*, 2020 Newman *et al.*, 2020 Omopariola *et al.*, 2019
Seeks to be value free, but can lead to researcher and confirmation bias.	Matias *et al.*, 2007	Thematic, content and bibliometric analysis. Research teams.	Jones *et al.*, 2014	Al-Saeed *et al.*, 2020 Chileshe *et al.*, 2020 Darko *et al.*, 2020 Newman *et al.*, 2020 Ogunsanya *et al.*, 2019 Omopariola *et al.*, 2019

Pragmatism

Pragmatism is a philosophy that roots itself in the relevance of 'matter-of-fact' action (Bacon, 2012; Saunders *et al.*, 2016). As Atkin (2010) notes, one of the major themes of pragmatism is the '*turn to practice*.' Said differently, pragmatism is focused on concepts that support some type of action (Chandra and Sharma, 2006; Dudovskiy, 2016; Plowright, 2016). For pragmatists, the concept of doubt and a sense that something is out of place or incorrect is a driving force (Chandra and Sharma, 2006; Saunders *et al.*, 2016). This leads to a critical aspect of pragmitism, the research inquiry, which provides the guiding light for research methodology and thus a ‘practical solution’ (Dudovskiy, 2016; Saunders *et al.*, 2016). To help achieve this ‘practical solution,’ a combination of theories, concepts, ideas and stratgies are available for use spaning the positivism – interpretivism spectrum (Bagger, 2018; Malachowski, 2013; Saunders *et al.*, 2016). Table 2.9 identifies three definition excerpts of pragmatism.

Table 2.9 - Definitions of Pragmatism

Definition of Pragmatism	Source
“Pragmatism is, broadly, an approach to philosophy that clusters loosely around a set of themes and a common tradition. The most clearly Pragmatist of these themes is what we might call a turn to practice. The idea is that in order to understand philosophical concepts fully, we must look to those ordinary practices that take such concepts as central.”	Atkin, 2010, p. 3
“Pragmatism asserts that concepts are only relevant where they support action.”	Keleman and Rumens, 2008 as cited in Saunders *et al.*, 2016, p. 143
“However, it is worth bearing in mind that the indelible connection between action and thought is one of the main identifying characteristics of pragmatism, where action is the practical effect or consequent of thought and ideas. In other words, and put more simply, our ideas and theories must be founded in experience and linked to the practicalities of that experience.”	Plowright, 2012, p. 14

Pragmatism Ontology

From an ontological standpoint, pragmatism mirrors that of interpretivism and postpositivism; reality is rich, complex and ever changing (Saunders *et al.*, 2016). Pragmatists recognize that the whole picture of reality cannot be obtained; only through processes, experiences and practices can slices of realty (or multiple realities) be observed (Taylor *et al.*, 2008). If for example, when trying to understand the social contexts of a university community, a pragmatist view would look at the administration, faculty, support staff and student bodies individually and together to try to identify issues or concerns that are out of place, since each group would have their own unique experiences. This is very similar to an interpretivist ontological position.

Pragmatism Epistemology

Epistemologically, pragmatism revolves around problem solving, practicality and successful action (Putnam and Putnam, 2017; Saunders *et al.*, 2016). Said differently, what constitutes acceptable knowledge is contextual and those in which produce or allow for positive achievement (Shook and Margolis, 2006). The sustained focus on relevant problem solving and determining what actions lead to the resolution is a key epistemological theme of pragmatism (Bacon, 2012). Specifically, the resolution or successful action helps to serve as information for future research, practice and overall contribution to the specific field(s) of study (Baert, 2005).

Pragmatism Axiology

Axiologically, pragmatism, similar to interpretivism, is value-driven (Dudovskiy, 2016; Saunders *et al.*, 2016). Furthermore, the research undertaken is initiated and supported by the researcher's beliefs, values and doubts; mirroring interpretivism, these humanistic expressions are not excluded from the research and are considered vital (Baert, 2005; Lorino, 2018). The researcher is also reflexive, in that he/she provides consistent thought about the research question / problem and the positive action explored (Shook and Margolis, 2006). Consequently, the researcher can employ various qualitative and quantitative methods as well as mixed and multiple methods to help 'solve the problem' by practical action (Dudovskiy, 2016; Pihlström, 2015).

The Purpose of Pragmatism

The main purpose of pragmatism is an aim to contribute practical outcomes and solutions (Saunders *et al.*, 2016). To assist with this, pragmatism focuses on successful experiences to help inform future practice (Bacon, 2012; Lorino, 2018). The researcher plays an important role, as doubt and his/her beliefs are valued and incorporated into the research (Baert, 2005; Lorino, 2018). As such, the researcher can utilize a vast spectrum of methods to help follow the research question and provide practical action outcomes (Dudovskiy, 2016). Table 2.10 outlines pragmatism's stance on five general assumptions.

Table 2.10 – Assumptions of Pragmatism

Assumption	Pragmatism	Source
Ontology *(nature of reality)*	Complex and rich with numerous, changing processes and experiences.	Goodman (2005)
Epistemology *(acceptable knowledge)*	Focus on relevant problem solving and determining what actions lead to the resolution.	Talisse and Aikin (2008)
Axiology *(role of values)*	Values-driven where the researcher's doubts, values and beliefs play an essential role. Researcher is reflexive.	Lachs (2012)
Subject / Researcher Relationship	Subject and researcher are intertwined in the research; no separation.	Lorino (2018)
Goals	Problem solving with practical action outcome(s).	Misak (2013)

How Pragmatism is Used in Education

The complexities or education theory, practices and processes align well with the pragmatist methodology (Heilbronn and Skilbeck, 2020; Stoller, 2018; Taylor *et al.*, 2008; Wang *et al.*, 2020). For example, Bate (2020) evaluated the British National Curriculum for Music to propose a strategy for how music could be more integrated into the 'social justice' case in education. Specifically, a pragmatist methodology was utilised to assess music education's value and comprehension. Moreover, Maudsley and Taylor (2020) utilize a pragmatist methodology when adding to previously reported systematic reviews on mobile devices within clinical placements. Specifically, the researchers used a content-thematic analysis within the pragmatist methodology. Raffo and Roth (2020) employ a pragmatist methodology when exploring how to further learner agency in urban educational institutions. Pointedly, the development of a pragmatic transactional perspective approach notes that students are subject and subjected to learning conditions as much as being subjects of their learning conditions. Additionally, Van Poeck *et al*. (2020) present an analytical framework, inspired by pragmatist educational scholarship, that supports qualitative and quantitative research on sustainability transitions education. Tarnopolsky and Kozhushko (2020) discuss the use of pragmatism within *'English for Specific Purposes'* courses. Specifically, the researchers point to the real-life experiences and practical experience aspects of pragmatism students bring and develop within these courses as critical to student success. Furthermore, Asdemir and Ahrens (2019), utilize a pragmatist methodology when developing and proposing a conceptual model for making academic knowledge more applicable to managerial practice.

Within the aspect of built environment education, Scott (2016) suggests the overarching goal of construction project management education, career preparedness, has helped bring pragmatism into the construction education dialogue. This is routed in the alignment of pragmatism with practical action outcomes. Alharbi *et al.* (2015) through a systematic analysis of literature and primary data, developed a pragmatic definition of architectural management for use in an educational setting, among other disciplines. Furthermore, Moore and Fisher (2017) suggest the need of pragmatism within built environment HEIs to assist in motivating postgraduate students learning in an e-learning context. As demonstrated in the select literature references, the use of pragmatism is very prevalent in the education discipline.

How Pragmatism is Used in Construction Management

Dudovskiy (2016), Lorino (2018) and Saunders *et al.* (2016) suggest pragmatism is an appropriate philosophy for management research due to its problem-solving nature and integration of multi-methods approach. Specific to this thesis, the umbrella topics of business and management are discussed within the context of construction project management. For example, Wasim *et al.* (2020) developed a pragmatic framework for design for manufacturing and assembly of non-structural prefabricated construction systems. In similar research, Johari and Jha (2020) utilised a pragmatic methodology when investigating factors that discourage construction workers from participating in continued skill development and, consequently, propose remedies for the deterrent factors. Similarly, Zhang *et al.* (2019), while researching the utilization of recycled aggregates within the construction industry, employed a pragmatic approach was utilised to propose a closed-loop recycling-based construction and demolition management plan. Alaka *et al.* (2016) utilised a pragmatist methodology to develop a framework that more rigorously and robustly allows the evaluation of construction businesses regarding bankruptcy prediction. McKenna and Baume (2015) discuss the use of pragmatism to help explore the complexity and coordination of project stakeholders' ideas, ethics and cultures.

As demonstrated above, a pragmatist methodology has been successfully used within the context of construction project management. A common theme in the above research is the focus on problem solving and the use of a multi-methods approach. This focus allowed the researchers to employ a pragmatist approach to help obtain a more authentic understanding of the social structures at play (cf. Bhaskar and Hartwig, 2016; Edwards *et al.*, 2014; Pilgrim, 2020a; Saunders *et al.*, 2016).

Benefits and Limitations of Pragmatism

With any philosophical stance, there are inherent benefits and limitations. Within pragmatism, one of the main benefits is the wide range of flexibility it offers the researcher (Lachs, 2012). Both quantitative and qualitative methods are recognized and employed throughout pragmatist research (Talisse and Aikin, 2008). This allows the researcher to shift between empirical methods and qualitative contexts fluidly, adjusting approaches to best suit the research problem at hand. Similarly, another benefit of pragmatism is the problem-solving theme or focus (Goodman, 2005). This mindset enables the researcher to focus on offering practical solutions to a problem (Misak, 2013). Specifically, and similar to the wide range of approaches the researcher can utilize, the goal is offering solutions to a problem, not necessarily on trying to uncover truth or identify relationships as in positivism and interpretivism (Lorino, 2018).

One limitation of pragmatism is its vulnerability to being taken for granted (Feilzer, 2010; Kankam, 2019). Stated differently, pragmatism is a problem-solving based methodology that is extremely adaptable to a wide range of fields. The application of pragmatism as an 'end all' or 'go-to' methodology may not be entirely appropriate (Saunders *et al.*, 2016). Another limitation to pragmatism is the researcher's axiological stance (Kaushik and Walsh, 2019; Morgan, 2007). Specifically, since pragmatism has a high degree of value-driven emphasis, the researcher's views can limit the research conducted. Table 2.11 outlines the general benefits and limitations of pragmatism.

Table 2.11 – Benefits and Limitations of Pragmatism

Benefits	Source	Limitations	Source
Flexibility within Research.	Lachs, 2012 Talisse and Aikin, 2008	Being taken for granted.	Feilzer, 2010 Kamkan, 2019 Saunders *et al.*, 2016
Problem-solving focus.	Misak, 2013 Goodman, 2005	Value-driven emphasis.	Kaushik and Walsh, 2019 Morgan, 2007

Pragmatism Limitation Mitigation Strategies

Within a construction project management context, the above-mentioned mitigation strategies are visible. Looking first at 'being taken for granted,' all four studies noted (cf. Ellis *et al.*, 2021; Gledson, 2021; Kissi *et al.*, 2022; Owusu-Manu *et al.*, 2020a) utilised a range of methodologies. In some instances where quantitative work was being completed, the use of multiple arithmetical and statistical metrics was implemented to support the quantitative work. (Ellis *et al*., 2021; Owusu-Manu *et al*., 2020b). When qualitative work was the focus of research, the inclusion of quantitative metrics helped to support the philosophical underpinning (Gledson, 2021; Kissi *et al*., 2022). Moreover, the incorporation of multiple philosophies can help mitigate the 'value-driven emphasis' inherent in pragmatism. Specifically, both Dao *et al*. (2021) and Ellis *et al*. (2021) utilised pragmatism and interpretivism to add credence and mitigate the value-driven emphasis limitation of pragmatism. Table 2.12 outlines methods to mitigate the limitations associated with pragmatism.

Table 2.12 – Pragmatism Limitations Mitigation

Limitations	**Source**	**Limitation Mitigation**	**Source** ***(general)***	**Source** ***(construction)***
Being taken for granted.	Feilzer, 2010 Kamkan, 2019 Saunders *et al*., 2016	Mixed methodological stance.	Lachs, 2012 Lorino, 2018 Talisse and Aikin, 2008	Ellis *et al*., 2021 Gledson, 2021 Kissi *et al*., 2022 Owusu-Manu *et al*., 2020a
Value-driven emphasis.	Kaushik and Walsh, 2019 Morgan, 2007	Multi-philosophical stances within the research.	Lachs, 2012 Lorino, 2018 Talisse and Aikin, 2008	Dao *et al*., 2021 Ellis *et al*., 2021

APPROACHES

Research approach focuses on theory, namely, the development or verification of a specific theory (Cargan, 2007). To achieve this, there are three main approaches used in construction management research viz.: 1) inductive; 2) deductive; and 3) abductive (Fellows and Liu, 2015; Saunders *et al*., 2016) albeit, there are four more less common approaches that could be used viz. 1) critical thinking; 2) cause and effect reasoning; 3) analogical reasoning; and 4) decomposition reasoning. Each provides a unique route to research with a shared goal revolving around the concept of theory (Lichtman, 2006; Wilson, 2010). Careful consideration is needed when selecting research approach(es) as they will directly impact the methodological choice for data collection (Saunders *et al*., 2016).

Inductive

An inductive approach (indicative reasoning) begins with the collection of data to which a theory is built or generated (Cargan, 2007; Fellows and Liu, 2015; Saunders *et al.*, 2016; Wilson, 2010). Said differently, the researcher uses collected data to build a theory rather than applying an existing theory to collected data (Ekinci, 2015; Lichtman, 2006). Figure 2.2 provides a visual depiction of inductive reasoning. An inductive approach is based on learning from experience in the sense that the researcher is continually gaining knowledge while collecting data; looking for patterns, conflicts and relationships so that a conclusion, or theory can be composed at the conclusion of research (Dudovskiy, 2016; Wilson, 2010). Inductive reasoning can be utilised in both qualitiative and quantitiave research (DePoy and Gitlin, 2011; Fellows and Liu, 2015) however, some scholars argue that inductive reasoning is more akin to qualitiative rather than quantitative research (Daum, 2012, Lichtman, 2006; Thyer, 2010). Table 2.13 identifies four definition excerpts of inductive reasoning.

Figure 2.2 - Inductive Reasoning

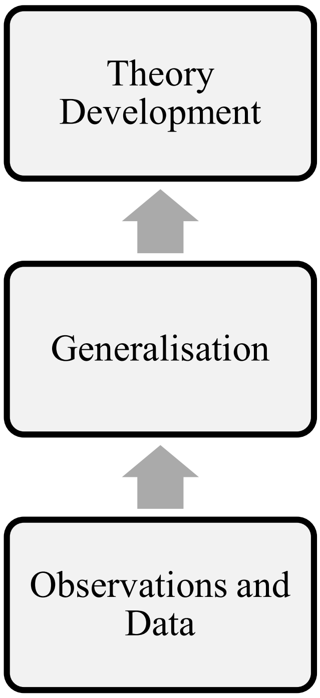


Table 2.13 - Definitions of Inductive Approach

Definition of Inductive Approach	Source
"If your [the researcher] research starts by collecting data to explore a phenomenon and you [the researcher] generate or build theory (often in the form of a conceptual framework), then you [the researcher] are using an inductive approach."	Saunders *et al.*, 2016, p. 145
"…inductive reasoning is often referred to as a 'bottom-up' approach to knowing, in which the researcher uses observations to build an abstraction or to describe a picture of the phenomenon that is being studied."	Lodico *et al.*, 2010 as cited in Dudovskiy, 2016
"In inductive [reasoning], one is reasoning from experience or observation relating to the general construction of the theory: data to theory."	Cargan, 2007, p. 31

Inductive Reasoning in Construction Management Research

Inductive reasoning has been successfully utilised within construction project management research. For example, Ventura *et al*. (2020) incorporated an inductive reasoning approach when studying VR as an aid to design review meetings. Newman *et al*. (2020) utilised inductive reasoning when reviewing relevant research related to Industry 4.0 within the construction industry to help identify barriers and opportunities for implementation. Furthermore, Santiago *et al*. (2020), when researching temporary construction workers' perspectives of 'near misses' and the safety risks associated with 'near miss' injuries, utilised an inductive reasoning approach.

Deductive

A deductive approach (deductive reasoning) begins with an established theory and then is tested through a research strategy specific to the research at hand. (Cargan, 2007; Fellows and Liu, 2015; Saunders *et al.*, 2016; Wilson, 2010). In other words, the researcher applies an existing theory to the subject content area being studied and then, through experiments and tests, validates and invalidates the existing theory relative to the subject area being studied (Ekinci, 2015; Lichtman, 2006). Figure 2.3 provides a visual depiction of deductive reasoning. A deductive approach revolves around developing premises rooted in existing theories and then developing a research plan to prove or disprove the premises and thus the application of the specific theories (Dudovskiy, 2016). Deductive reasoning can be utilised in both qualitiative and quantitiative research (DePoy and Gitlin, 2011; Fellows and Liu, 2015); however, some scholars argue that deductive reasoning is more akin to quantitative rather than qualitative research (Daum, 2012, Lichtman, 2006; Thyer, 2010). Table 2.14 identifies four definition excerpts of deductive reasoning.

Figure 2.3 - Deductive Reasoning

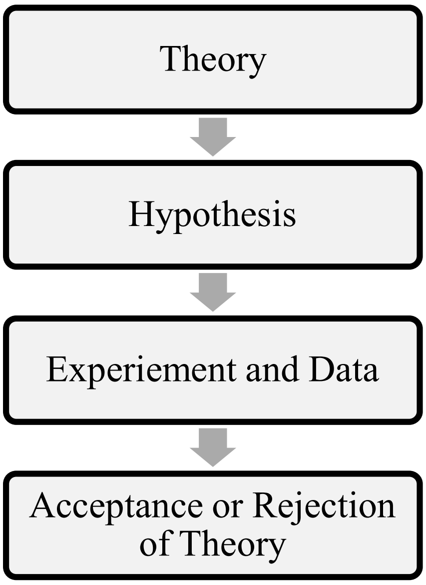


Table 2.14 - Definitions of Deductive Approach

Definition of Deductive Approach	Source
"...if your [the researcher's] research starts with theory, often developed from your [the researcher's] reading of the academic literature, and you [the researcher] design a research strategy to test the theory, you [the researcher] are using a deductive approach."	Saunders *et al.*, 2016, p. 145
"In studies with deductive approach, the researcher formulates a set of hypotheses at the start of the research. Then, relevant research methods are chosen and applied to test the hypothesis to prove them right or wrong."	Dudovskiy, 2016
"Using a deductive type of reasoning, the researcher begins with the acceptance of a general principle of belief based on a particular theoretical framework. This principle is then applied or used to explain a specific case or phenomenon. This approach involves 'drawing out' or verifying what is already accepted as true."	DePoy and Gitlin, 2011, p. 5

Deductive Reasoning in Construction Management Research

A deductive approach has been successfully utilised within construction project management research. Cheriyan and Choi (2020) used deductive reasoning when examining extant literature on fine dust pollution within the construction industry. Specifically, the researchers utilised content analysis of the literature to help cluster key concepts within this area of pollution research. Furthermore, Al-Saeed *et al*. (2020), when presenting a proof-of-concept framework for introducing BIM digital objects to help automate the processes of construction materials manufacturers, used a deductive reasoning approach. Similarly, Munir *et al*. (2020), employed a deductive approach when researching and identifying important issues and challenges of the asset management business value of BIM.

Abductive

An abductive approach (abductive reasoning) is a semi-hybrid approach where the researcher moves back and forth between inductive and deductive in a pragmatic manner to establish a scheme of how a specific event(s) occurred (Saunders *et al*., 2016). As Fellows and Liu (2105) note, abductive reasoning usually starts with an unexpected situation or discovery and then works backward to craft a conceivable explanation. Abductive reasoning utilises a myriad of ‘clues’ to help piece the larger picture together, which can then be interpreted and analysed by the researcher (Doven, 2021). Figure 2.4 provides a visual depiction of abductive reasoning. An abductive approach, by its very nature utilises both qualitative and quantitative research (Brown University, 2022). Table 2.15 identifies three definition excerpts of abductive reasoning.

Figure 2.4 - Abductive Reasoning

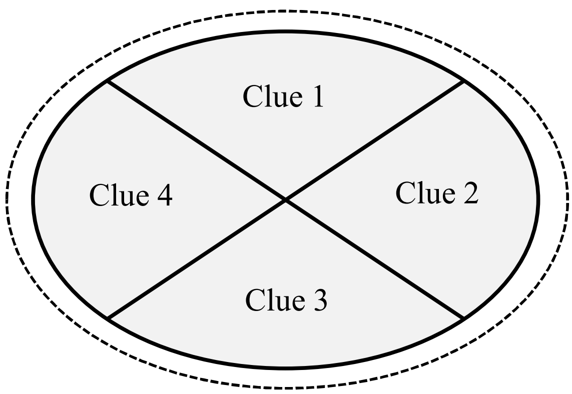


Table 2.15 – Definitions of Abductive Approach

Definition of Deductive Approach	Source
"Where you [the researcher] are collecting data to explore a phenomenon, identify themes and explain patterns, to generate a new or modify an existing theory which you subsequently test through additional data collection, you [the researcher] are using an abductive approach."	Saunders *et al*. 2016, p. 145
"Given evidence E and candidate explanations H_1..., H_n of E, infer the truth of that H_i which best explains E."	Douven, 2021
"Abductive reasoning is most easily understood through the analogy of a doctor diagnosing his patient's illness. He gathers a hypothesis from the patient's symptoms, or otherwise evidence that he deems factual, and from there, goes down the list of maladies and tries to assign the appropriate illness."	Brown University, 2022

Abductive Reasoning in Construction Management Research

An abductive approach has been successfully utilised within construction management research. Gregory *et al*. (2022) utilised abductive reasoning when analysing how new team participants integrate into already formed and established project teams. Furthermore, Johansen *et al.* (2021) when investigating the application of real-time location sensing system raw data to construction site operations, employed abductive reasoning. Finally, Koskela and Ballard (2021) used abductive reasoning when exploring the concepts of cost underestimation and code reduction.

Mixed Approaches in Construction Management Research

Mixed approaches have also been successfully utilised within construction project management research. Yu *et al*. (2020) used a combination of inductive and deductive and/or abductive reasoning when reviewing and researching existent literature in an effort to compose a framework for promoting electronic and sustainable procurement within the construction industry. Abdirad *et al*. (2020) also used a mixed approaches approach when examining, through a case study, how construction companies perceive, interpret and act upon information exchange procedures that are not parallel with past procedures. Furthermore, Madushika *et al*. (2020), while researching and investigating key performance indicators of value management in the Sri Lankan construction industry, utilised a mixed approaches. This body of knowledge illustrates that mixed approaches are a valid way of undertaking research in a construction management context.

METHODS

Once the research philosophy(ies) and approach(es) are determined, the methodological choice is the next layer of decision making (Saunders *et al*., 2016). Methodological choice can be grouped into two sections each with the same two parts. First, the researcher must choose between a mono-method, meaning single data collection technique, or multiple-method, meaning numerous data collection techniques (Saunders *et al*., 2016). Once this initial decision has been made, then the researcher must choose qualitative and/or quantitative data sources (Fellows and Liu, 2015).

Mono-Method

As the name implies, mono-method is when a researcher selects only one technique for data collection (Saunders *et al*., 2016). This can either be qualitative or quantitative (further extrapolated in the section below) yet cannot be a combination of the two (Fellows and Liu, 2015). For example, a researcher may utilise a qualitative semi-structured interview with qualitative analysis procedure (Saunders *et al*., 2016).

Multiple-Method

Multiple-method, on the other hand, is when a researcher selects more than one technique for data collection (Saunders *et al*., 2016). Under this method, a researcher still maintains either a qualitative or quantitative method but utilises numerous techniques (Fellows and Liu, 2015). For example, a researcher may utilise a qualitive semi-structured interview and secondary data text with qualitative analysis procedure (Saunders *et al*., 2016).

Under the multiple-method tree, there is a branch noted as mixed-method (Saunders *et al*., 2016). Mixed-method is when the researcher combines both qualitative and quantitative methods and analysis procedures (Farrell *et al*., 2017). For example, a researcher may utilise extant literature and Likert-scale survey instruments with qualitative and quantitative analysis procedures (Saunders *et al*., 2016).

Qualitative and Quantitative

Qualitative data refers to data that is non-numeric in nature (Fellows and Liu, 2015; Saunders *et al*., 2016). For example, data that is collected from an interview transcript (words) and then analysed, would be considered qualitative (Naoum 2019). Qualitative data allows a researcher to gain a deeper insight into why participants may think the way they do. Conversely, quantitative data refers to data that is numeric (Fellows and Liu, 2015; Saunders *et al*., 2016). For example, data that is collected from scientific measurement observations and then analysed would be considered quantitative (Farrell *et al*., 2017). Quantitative data is useful to provide a summary or overview of a vast body of data.

To combine the strengths of both data analysis types, many researchers use mixed methods that contain both quantitative and qualitative data (Farrell *et al.,* 2017; Fellows and Liu, 2015). When using a contrived example, while 90% of participants may quantitatively agree that a given phenomenon studied is accurate or good on a closed Likert scale, qualitative open questions allow the participant to elaborate further on why they believe this to be so.

TIME HORIZONS

Time horizons refer to the overall duration in which the research is taking place (Rose *et al*., 2015). There are two different types of time horizons: 1) longitudinal; and 2) cross-sectional (Saunders *et al*., 2016).

Longitudinal

A longitudinal time horizon refers to research that occurs over an extended temporal duration (Lavrakas, 2008) – examples include meteorological conditions recorded in a unit of time (e.g., hourly, weekly, monthly) over a longer period of time (e.g., years). Specifically, most longitudinal studies are keen to see the impact of time on the research, so numerous observations are made over prolonged time periods (Fellows and Liu, 2015). Furthermore, many longitudinal studies can be summarised as looking to ascertain cause-and-effect relationships (Rose *et al*., 2015). Longitudinal research has been successfully utilised within the built environment disciplines to ascertain the impacts and influences of specific variables over the course of time (cf. Pérez *et al*., 2022; Staggs *et al*., 2022; Staub-French *et al*., 2022).

Cross-Sectional

A cross-sectional time horizon refers to research that occurs at a single point in time (Lavrakas, 2008). Specifically, cross-sectional studies do not take time impacts into consideration, only the observations occurring at that moment (Saunders *et al*., 2016) – hence, cross sectional studies represent a snapshot at a moment in time. Examples include a questionnaire where respondents may express views and opinions on the day of an interview or questionnaire administered but this view or perception can change over time. Despite this limitation, cross sectional research has been successfully utilised within the built environment disciplines (cf. Ade-Ojo, 2022; Galardo and Trottier, 2022; Lin *et al*., 2022).

STRATEGIES, TECHNIQUES AND PROCEDURES

The research strategy is the plan of how the research goal will be achieved (Saunders *et al*., 2016) and serves as the bridge between the research philosophy(ies) and the method(s) to collect data (Denzin and Lincoln, 2017). There are numerous strategies that a researcher can adopt, some of what are presented below (i.e., grounded theory, survey) (Farrell *et al*., 2017). The techniques and procedures utilised by the researcher are the specific, granular practices to collect data (Fellows and Liu, 2015; Saunders *et al*., 2016). There are a plethora of different techniques and procedures to collect data that can be used singularly or in combination with numerous others (Naoum 2019). The specific techniques and procedures adopted for this research are noted in the subsections below.

Secondary Data

Secondary data is data that has been previously collected and made available to the larger population (Smith, 2008). Secondary data analysis is when a researcher utilises this data for their own research; utilising data collected by someone else for their analysis and research (Hughes and Tarrant, 2020). The term ‘secondary data’ specifically focuses on location in the data’s life cycle; data that has already been collected and made available (Vartanian, 2011). For example, if a researcher is engaged in primary data collection, once the results of the data are published, the primary data and analysis becomes secondary data (Goodwin, 2012). Furthermore, literature reviews, organisational reports, governmental statistics and the like are all considered secondary data (Chandola and Booker, 2021).

The analysis of secondary data also spans the full spectrum of analysis options. Qualitative, quantitative and mixed-methods are suitable for secondary data analysis, given the specifics of the data being analysed (Vartanian, 2011; Hughes and Tarrant, 2020). Secondary data analysis has been widely used within the built environment publications to further academic discourse and/or support the development and execution of primary research (cf. Bingham *et al*., 2022; Yang *et al*., 2022; Zhu *et al*., 2022).

Preferred Reporting Items for Systematic Reviews and Meta-Analyses

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) consists of a graphical flow chart and checklist for which researchers can ensure transparent reporting of systematic reviews and meta-analyses (Liberati *et al*., 2009). Specifically, in regard to the graphical flow chart, there are four main sections: Identification, Screening, Eligibility and Inclusion (Moher *et al*., 2009). Each of the sections guide the researcher through a series of processes aimed at mitigating the risk of blemished reviews and increasing the clearness of how reviews are directed (Page *et al*., 2021).

Bibliometric and Scientometric Analysis

A subset of Informetric Analysis, bibliometric and scientometric analyses are statistical approaches to quantitatively measuring the impact of research; where publications constitute a unit of analysis and secondary data source (Vinkler, 2010). Specifically, they focus upon the measurement of extant published work (Ball, 2021), namely authorship, co-authorship, publication dates, HEI affiliation, regionality, etc. (Ball 2021). The difference between these terms is that bibliometrics covers a wider range of all literature types, whereas scientometrics focuses more upon analysing peer reviewed journals. Scientometric analysis, unlike bibliometric analysis, deals with mediums beyond published literature (such as citations) (Chamberlain *et al.*, 2019); however, it can be adapted to complement bibliometric analysis (van Eck and Waltman, 2010). Online journal databases, such as Scopus and Web of Science, offer a comprehensive curated suite of on-line data metrics and analytics to engage with bibliometric analysis quickly and accurately (Newman *et al.,* 2020; Smith *et al.,* 2021).

One scientometric analysis software tool is VOSviewer – albeit there are others such as Gephi. Using a graphical representation, that specifically visualizes correlation strength as the distance between nodes (where warmer colours represent a higher/stronger correlation strength), VOSviewer can display large quantities of data in an easy-to-interpret format (Waltman *et al*., 2010). VOSviewer has been successfully used across the construction management discipline (Adegoriola *et al*., 2021; Araújo *et al*., 2020; He *et al*., 2019; Mantha *et al*., 2021; Norouzi *et* *al*., 2021). Such a visual interpretation of the relevant literature can allow for the identification of emergent common themes and relationships between the themes' elements.

A second scientometric analysis software tool is CitedReferencesExplorer (CRExplorer). CRExplorer specifically focuses on cited references of a user defined database (Thor *et al*., 2016). Rooted in reference publication year spectroscopy (RPYS), CRExplorer aims to identify the historical roots of a research discipline by providing a graphical representation of key publications against a timescale (Marx *et al*., 2013; Thor *et al*., 2021). CRExplorer has been successfully used across academic disciplines (cf. Malik *et al*., 2021; Vaidya *et al*., 2021; Yeung and Mozos, 2020). Although direct application to the construction management discipline does not appear to have taken place, the analysis of literature is not discipline specific and similar approaches to analysis can be used across a wide spectrum of academic disciplines. Furthermore, utilising CRExplorer in a construction management context offers a novel platform for future scientometric analysis of the discipline.

Textual Analysis

Textual analysis is a research method that aims to uncover the content and context of written and spoken language (Allen, 2017). The way in which individuals communicate – their choice, arrangement and frequency of words – can be analysed to understand underlying communication messages (McKee, 2003). One specific instrument to assist with textual analysis is Voyant Tools, which is an open-sourced software programme that can be used to analyse user inputted text (Sinclair and Rockwell, 2016). Voyant Tools is a user friendly 'web-based' interface which can populate the frequency of words, word associations, word context and trends as network visualisations (Sinclair and Rockwell, 2016). Voyant Tools has been extensively used in a wide range of built environment publications to develop new theories and/or report create a positional picture of contemporary developments for a given phenomenon under investigation – e.g., Andersson *et al*., 2020; Burton *et al*., 2021; Çimen, 2021; Marzouk and Enaba, 2019; Sobczak and Basco, 2020; Wanasinghe *et al*., 2020.

Grounded Theory

At its core, grounded theory constitutes an inductive strategy that allows for the development of theory from comprehensively analysed data (Arthur *et al*., 2012; Tarozzi, 2020). Specifically, according to Saunders *et al*. (2016), grounded theory, stemming out of very positivist based social research, aimed at providing a more interpretivist manner of interpreting and analysing social constructs. Grounded theory is an established research strategy within built environment literature and has been used to: explore the lived experience of engineering educators implementing problem-based learning in the classroom (Change *et al.*, 2019); develop a maths-related critical thinking theory for civil engineering design practices (Osman *et al.*, 2020); and develop a mitigation method map framework for the agile-hybrid management of projects (Sithambaram *et al.*, 2021).

Sampling

Sampling is the technique of selecting a portion of the target population for which subsequent experiments and investigations will take place (Naoum, 2019). There are two main branches of sampling: Probability and Non-Probability (Saunders *et al*., 2016). Probability sampling, also known as random sampling, is when a member of the population or target population has an equal opportunity to be selected for the research and is usually analysed via statistical means (Farrell *et al*., 2017). Conversely, non-probability sampling is when the selection of participants within the target population is mostly arbitrary and can be analysed both statistically and analytically (Saunders *et al*., 2016).

Snowball sampling is a non-probability sampling technique and is one of the most popular methods of sampling in qualitative research (Parker *et al*., 2019). Specifically, once a researcher has identified an initial set of participants, the participants are then asked to mention other participants who may be willing to participate in the research (Loiselle *et al*., 2011; Ruel *et al*., 2016). This 'referral' style of expanding the pool of research participants relies heavily on social networks and concludes when the specified sample size is met, or a saturation point reached (Neelankavil, 2007). The same process can be adapted to secondary data as well. Specifically, after identifying an initial literature review set, the literature's cited references can be reviewed and, where appropriate, added to expand upon the initial literature review (Tuckett *et al*., 2017).

Purposive sampling, also a non-probability sampling technique, that utilises the researcher's judgement to select specific instances within the target population which will enable the research question(s) to be answered (Saunders *et al*., 2016). This type of sampling usually occurs when dealing with small target populations (Farrell *et al*., 2017). Furthermore, several subsets of purposive sampling exist which further help the researcher in obtaining a representative sample for analysis (i.e., critical case, typical case, extreme case, heterogeneous and homogeneous) (Adabre *et al*., 2022; Jupp, 2006).

Cochran Formula

The Cochran Formula allows for a determination of an ideal sample size where the population is unknown but expected to be quite large (Kieser, 2020). The Cochran Formula also allows the researcher to ascertain the sought-after margin of error and confidence level (Blair *et al*., 2014). The Cochran Formula is noted below (see Equation 1), where *Z* is the corresponding z-score for the selected confidence level, *e* represents the margin of error, *p* equals the share of the population that exhibits the desirable trait and *q* equals 1 – *p*. Regarding *p*, it may not be feasible for the researcher to know the 'portion of the population with the attribute in question,' so a maximum variability (0.5 or half of the population) can be utilised (Chow *et al*., 2018).

$$n_0 = \frac{Z^2pq}{e^2}$$

Equation 1

The Cochran Formula is a reputable research technique within built environment literature and has been used to identify the sample size for a survey to help identify adaptable areas in the built environment in response to Industry 4.0 (Lekan *et al*., 2021); for a questionnaire aimed as identifying the factors influencing organisational risk tolerance levels (Khalilzadeh *et al*., 2019) and for a survey directed at experts assessing the risks of complex buildings in economically developing countries (Khosravi *et al*., 2020).

Primary Data

Primary data is the converse of secondary data – it is original data (Fellow and Liu, 2015). The term 'primary data' specifically focuses on location in the data's life cycle; data that is original and has not been collected in that specificity before (Saunders *et al*., 2016). There are various techniques to collect primary data, such as questionnaires, interviews and focus groups (discussed in more detail below), amongst a plethora of others such as: surveys, experiments, observations, etc. (Fellows and Liu, 2015; Saunders *et al*., 2016). The analysis of primary data, similar to that of secondary data, spans the full spectrum of analysis options. Qualitative, quantitative and mixed-methods are suitable for primary data analysis, given the specifics of the data being analysed (Farrell *et al*., 2017; Naoum, 2019). Primary data analysis has been widely used within the built environment publications to further academic discourse (cf. Durdyev *et al*., 2022; Sarvari *et al*., 2021; Scala *et al*., 2022).

Likert-Scale Survey Instrument

Likert rating is a non-comparative metric where each element is scaled independently of other elements in the grouping (Fellow and Liu, 2015). A unique and intrinsic characteristic of Likert rating is that is allows a respondent to note the degree or level they agree/disagree with a statement (Saunders *et al*., 2016). Specifically, each degree or level of agreement/disagreement is associated with a numerical value (Farrell *et al*., 2017). For example, a four-point Likert instrument may be formatted such that 4 = strongly agree, 3 = agree, 2 = disagree and 1 = strongly disagree (Saunders *et al*., 2016). The numerical values associated with qualitative statements (or questions) allow for statistical analysis of the data group(s).

Likert-scale survey instruments are an immensely popular primary data collection instrument within construction management research. Oladimeji (2022) utilised a five-point Likert scales survey to measure the influence of the COVID-19 pandemic on Nigerian construction firms' industry capability. Another five-point Likert-scale survey was implemented to determine and assess the barrier of transferring incomplete public construction projects to the private sector (Sarvari *et al*., 2021). Chattapadhyay *et al*. (2021) developed a five-point Likert-scale survey to obtain individual responses to the identification, assessment and prediction of risk on mega construction projects.

Cronbach's Alpha – Internal Consistency

To establish the reliability of the survey, Cronbach's alpha was utilised (Information Resources Management Association, 2022). Cronbach's alpha measures the internal consistency of a scaled survey instrument and is recognised as a determinant of a scale reliability (Information Resources Management Association, 2022). A survey scale is generally noted as reliable if the Cronbach's alpha value is > 0.700 (Al-Emran and Shaalan, 2021; Belkhamza and Wafa, 2012).

Focus Group

A focus group is a research practice in which data is collected through group dialogue, interaction and communication (Cyr, 2019). The group normally comprises of a small number of individuals who are prudently selected given the content of the research (Barbour, 2018). Focus groups can be categorised into three main themes: unstructured, semi-structured and structured (Oates and Alevizou, 2018). However, within the themes, the purpose of the focus group can take many different forms – e.g., exploratory, theory development, impression gathering, diagnostic and validation (Oates and Alevizou, 2018). A common characteristic of focus groups, regardless of the type or purpose, is the use of a facilitator or moderator (Liamputtong, 2011). The facilitator or moderator is usually part of the research team and helps to guide the group discussion yet does not infringe upon or introduce bias into the ensuing dialogue (Hennink, 2014).

Three main advantages for the use of focus groups are: richness of response data, participants can build off each other's responses and efficiency in collecting numerous individuals' views (Goebert and Rosenthal, 2002; Hennink, 2014). Similarly, there are some disadvantages for the use of focus groups. Specifically, difficulty to organise, some individuals can dominate the dialogue and sustained effort of the facilitator to remain neutral (Barbour and Morgan, 2017; Liamputtong, 2011).

Focus groups have been successfully utilised in a wide range of built environment disciplines. Frimpong *et al*. (2022) employed a focus group to help develop a survey instrument to measure physical and mental health conditions of construction workers. Eryürük *et al*. (2022) utilised a series of focus groups to validate criterion for stakeholder integration within construction projects. Furthermore, Adafin *et al*. (2022) instituted a focus group to collect primary data related to how innovation can help increase productivity and efficiency within the New Zealand construction industry. Finally, Scala *et al*. (2022) validated a collaborative scheduling maturity model through the use of a focus group.

Interview

An interview is a type of qualitative data collection instrument where an interviewer engages in a dialogue with an interviewee to gain their opinions (Naoum, 2019). There are three main types of interviews: unstructured, semi-structured and structured (Fellows and Liu, 2015). An unstructured interview is based on 'open-ended' questions where the interviewer has little to no deliberate guide or series of questions to ask (Farrell *et al*., 2017). An 'open-ended' question is a question in which the response can only be dynamic; a static (yes or no) response is not viable (Ross *et al*., 2019). A semi-structured interview, rooted in an unstructured interview style, allows the interviewer to have a guide as to the question topics to discuss with the interviewee (Naoum, 2019). The use of 'open-ended' and 'closed' questions are common in semi-structured interviews (Fellows and Liu, 2015). Unlike ‘open-ended’ questions, ‘closed’ questions can be answered by static responses (a range of predefined, provided responses) (Ross *et al*., 2019). A structured interview, on the other hand, is based solely on the interviewer asking only planned questions (Farrell *et al*., 2017).

The three styles of interviews have been recently and successfully administered within construction management research. Olanrewaju *et al*. (2022) utilised structured interviews to obtain healthcare maintenance organisations’ perceptions of hospital building faults. Unstructured interviews were used by Frimpong *et al*. (2022) to help obtain primary data which was used to increase understanding and awareness to the health status of young construction workers in Ghana. Durdyev *et al*. (2022) developed and administered semi-structured interviews to aid in uncovering the implementation barriers of BIM in facilities management practices.

Descriptive Statistics

Descriptive statistics are utilised to describe and contextualise very basic information of the dataset (Holcomb, 2017). Descriptive statistics also help to provide a high-level summary of the dataset, without trying to reach pinpoint statistical conclusions (Lacort, 2014). This type of analysis forms the basis for more advanced statistical analysis – inferential statistics (Holcomb, 2017). There are various techniques within descriptive statistics, such as ranking and weighted average (discussed in more detail below), amongst a plethora of others such as: measures of frequency, measures of variation, central tendency, interquartile range, etc. (Saunders *et al*., 2016).

Ranking

Ranking is utilised when the researcher is looking to obtain some sort of order priority within a data set (Alvo and Yu, 2014; Lavrakas, 2008). It is a simple and expedient method for evaluating the relationship between objects in a data set (Allen, 2017). The method can be adapted to various different types of qualitative and quantitative data with both large and small frequencies (Topcu *et al.*, 2021).

One specific ranking method is ‘standard competition ranking.’ Standard competition ranking is a quantitative ranking method where objects in a data set that are equal receive the same numerical rank (Vojnović, 2015). A gap is then placed before the numerical ranking continues

(Vojnović, 2015). For example: If W, X, Y and Z are objects in a data set where W is first, X and Y are equal and Z last, the numerical rank for the data set would be 1, 2, 2, 4 (Hazelkorn and Mihut, 2021).

Ranking has been successfully utilised within the built environment disciplines. Law *et al*. (2022) utilised ranking when evaluating the results of a questionnaire surveying about stakeholder's influence in adopting construction robotics. Furthermore, Che *et al*. (2022) hierarchically ranked and weighted the results of designers' key attributes from an expert panel. Finally, Karanikas and Hasan (2022) utilised the ranking of secondary data to add richness to primary data analysis related to compliance with occupational health and safety legislation in Bangladesh.

Weighted Average (WA)

Unlike an arithmetic mean, which treated each value equally, a WA places predetermined weighting, based on relative importance, on specific values (Saridakis and Cowling, 2020). A WA allows for the relative importance and/or frequency of values to impact the overall mean of the dataset (Ary *et al*., 2019). Treating values in this manner can allow for a greater accuracy in representation of the dataset (Saridakis and Cowling, 2020). The formula for WA is noted below (see Equation 2), where n equals the number of values to be averaged, w_i corresponds to the predetermined weighting of the values and X_i equals the values which are to be averaged.

$$W = \frac{\sum_{i=1}^{n} w_i X_i}{\sum_{i=1}^{n} w_i}$$

Equation 2

WA is a reliable data analysis technique within built environment literature. For example, Mmereki and Brouwer (2022) utilised WA during the analysis of extant literature data related to innovative materials and building methods for sustainable building projects. Furthermore, a WA was utilised by Afshar and Asadzadeh Zenozi (2022) when evaluating project evaluation criteria defined by subject matter experts. Finally, Salman (2022), when exploring the selection of construction bidders, utilised WA in analysis.

Inferential Statistics

Inferential statistics are utilised to help draw conclusions, or inferences, about a dataset (Asadoorian and Kantarelis, 2005). Building off descriptive statistics, inferential statistics takes the reached conclusion(s) and apply it to an overall population (Boslaugh, 2013). There are various techniques within inferential statistics, such as relative importance index, One Sample T-Test, Chi-square Test, Kruskal-Wallis Test and Spearman's Rank Correlation (discussed in more detail below), amongst a plethora of others such as: confidence intervals, null hypothesis, regression analysis, standard deviation, etc. (Farrell *et al*., 2017; Fellow and Liu, 2015; Naoum, 2019).

Relative Importance Index

The Relative Importance Index (RII) measures how important a specific item is related to the overall importance preference (IBM Corporation, 2021b). The RII formula is noted below (see Equation 3), where W represents the weighting given to each scale value, A represents the highest weight and N represents the total number of survey participants (Rowlinson, 2004).

$$RII = \frac{\sum W}{(A * N)}$$

Equation 3

RII is a robust statistical technique that has been extensively used within built environment literature. For example: Chadee *et al*. (2022) utilised RII to evaluate critical factors to cost overruns on public sector housing programmes. Furthermore, Suleiman (2022) implemented RII to assess the causes and effects of poor communication within the construction industry of the Middle East and North Africa region. Finally, Yap *et al*. (2022) employed RII to prioritise different knowledge management approach variables for analysis.

One Sample T-Test

A One Sample T-Test is an inferential statistical hypothesis test used to help determine if a population's mean differs from a specified or hypothesised value (JMP Statistical Discovery, 2022; Kent State University, 2022). The formula for a One Sample T-Test is noted below (see Equation 4) where μ is the proposed constant for the population mean, $\bar{x}$ designates the sample mean, n is the sample size and S is the sample standard deviation.

$$t = \frac{\bar{x} - \mu}{\frac{S}{\sqrt{n}}}$$

Equation 4

The One Sample T-Test is a vigorous statistical method that has been widely used within built environment literature. For example: Ghansah *et al*. (2022) utilised a One Sample T-Test when investigating the underlying measurement factors for building intelligence. Additionally, Aigbavboa *et al*. (2022), when evaluating the South African construction industry's response to the COVID-19 pandemic, implemented a One Sample T-Test to analyse results. Finally, Kiral and Demirkesen (2022) used a One Sample T-Test to review the statistical significance of data findings whilst exploring the impact of peripheral vision on construction site safety.

Chi-Square Test

The Chi-Square Test is an inferential statistical test that aims to determine the degree of difference between a set of actual (observed) data and an expected population data with no relationship (Glen, 2022a). The formula for a Chi-Square Test is noted below (see Equation 5) where O_i is the observed value and E_i is the expected value.

$$x^2 = \Sigma \frac{(O_i - E_i)^2}{E_i}$$

Equation 5

The Chi-Square Test is a robust statistical test that has been commonly used within built environment literature. For example: Jung *et al*. (2022) utilised a Chi-Square Test when analysing data related to the frequency and time of construction equipment related accidents on a project site. Additionally, Wang *et al*. (2022) utilised a Chi-Square Test, along with other statistical tests when evaluating factors related to the construction cost control audit process. Finally, Chan and Aghimien (2022) used a Chi-Square Test to analyse data collected after a Safe Working Cycle programme was implemented in various Hong Kong project sites.

Kruskal-Wallis Test

The Kruskal-Wallis Test is an inferential statistical test utilised to determine if the medians of two or more groups are significantly different (Glen, 2022b). The Kruskal-Wallis Test does not make an assumption that the population data is normally distributed (Corder and Foreman, 2009). The formula for the Kruskal-Wallis Test is noted below (see Equation 6) where *n* is sum of sample sizes for all samples, *c* represents the number of samples, T_j is the sum of ranks in the j^{th} sample and n_j represents the size of the j^{th} sample.

$$H = \left[\frac{12}{n(n+1)} \sum_{j=1}^{c} \frac{T_j^2}{n_j}\right] - 3(n+1)$$

Equation 6

The Kruskal-Wallis Test is a strong non-parametric statistical test that has been readily used within built environment literature. For example: Rani *et al*. (2022) utilised a Kruskal-Wallis Test when analysing data related to the factors affecting well-being in the construction workplace. Furthermore, a Kruskal-Wallis Test was implemented by Akinradewo *et al*. (2022) when exploring the barriers to implementation of blockchain technologies in the South African construction industry. Finally, Ade-Ojo (2022) used a Kruskal-Wallis Test when examining Nigerian built environment professional's awareness of specific green building requirements in housing developments.

Spearman's Rank Correlation Coefficient

Spearman's Rank Correlation Coefficient (R_s) Test is a non-parametric test used to ascertain the strength of relationship between two sets of variables (Allen, 2017; Tanner, 2012) using the following formula described in Equation 7.

$$R_s = 1 - \left(\frac{6\Sigma\,\mathrm{d}^2}{n^3 - n}\right)$$

Equation 7

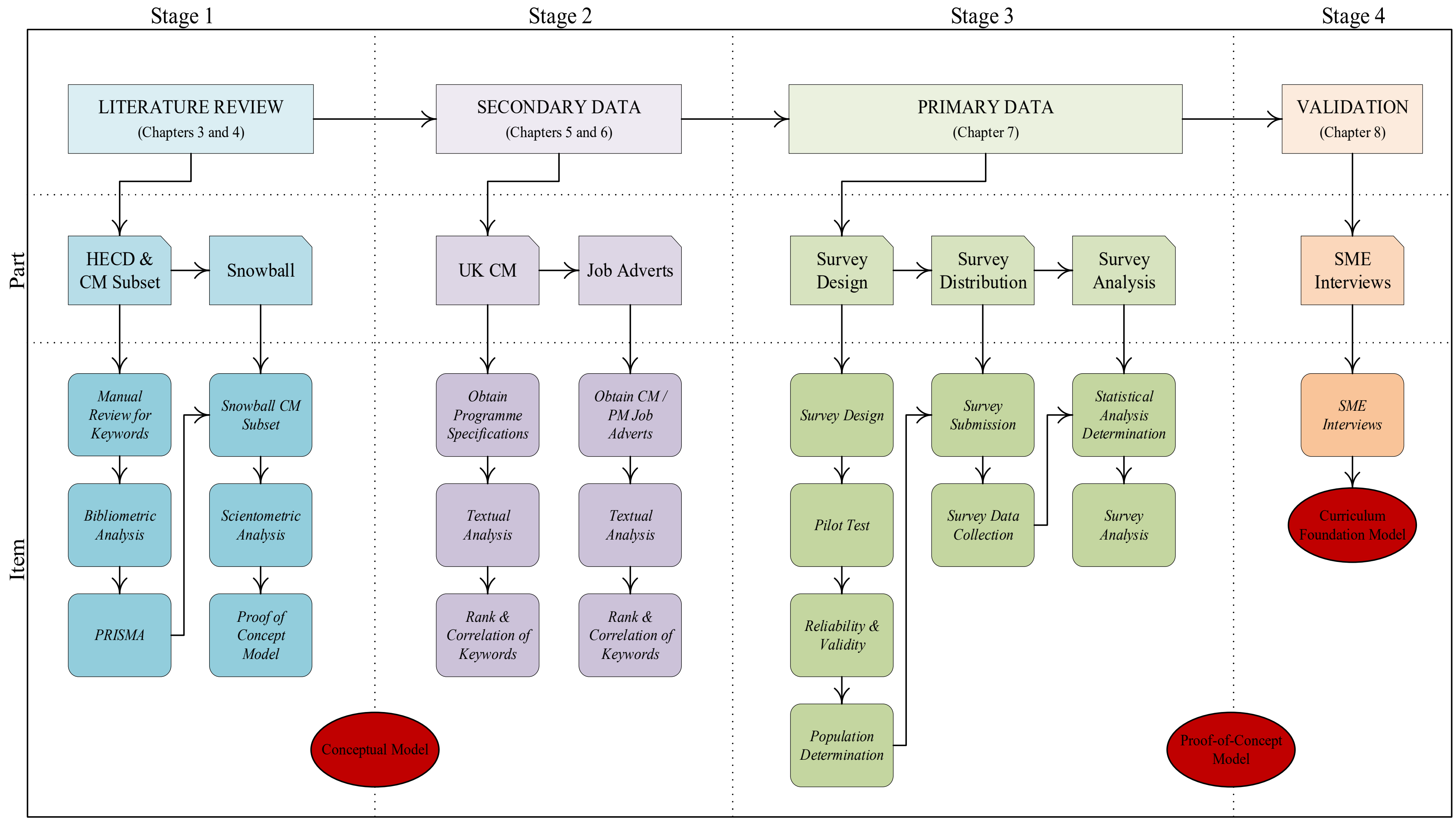
Where: R_s = Spearman's rank correlation coefficient; *d* = difference between the two ranks of each observation; and *n* = number of observations. Spearman's Rank Correlation Coefficient Test is an established research method within built environment literature and has been used to: help determine the incurred transaction code of project tenders procured via competitive bidding (Ameyaw *et al.*, 2021); evaluate the key performance indicators for commercial building renovations and fit-outs (Ho *et al.*, 2021); and to propose a multi-criteria decision-making tool for procurement methods in ambiguous and vague construction circumstances (Su and Li, 2021).

RESEARCH DESIGN

Whilst the above section describes the various aspects for the research methodology, this section provides justification for the methods and approach used.

Using multiple philosophies and primarily abductive reasoning (albeit other philosophies were used as various specific stages of the work), new models and theories on the composition of construction management curricula, mainly the core foundational elements, are formed. Figure 2.5 delineates the specific research process flow, specifically the parts, items and outputs for the various stages of the research. This consists of four iterative stages (each separated by delineated swim lanes) that cumulative progress from a *conceptual model* premised upon literature (Stage 1), to a *proof-of-concept model* in Stage 3. This is subsequently validated in Stage 4 – thus, constituting the *final validated model*.

Figure 2.5 – Research Process Flow Diagram



STAGE 1 – LITERATURE REVIEW

A mixed philosophical design is adopted and is rendered within inductive reasoning and grounded theory to critically analyse extant literature on curriculum design within HEIs (and specifically construction programmes) – the purpose being to generate emergent theories and insight on this phenomenon (cf. Chileshe *et al.,* 2021; Edwards *et al.,* 1998; Fathalizadeh *et al*., 2021; Newman *et al.*, 2020; Smith *et al.,* 2021).

As a methodological approach, a five-phase cascade process is adopted. First, an interpretivist lens is adopted to analyse secondary data from extant literature where each publication constitutes a unit of analysis (cf. Owusu-Manu *et al.,* 2021; Roberts *et al.,* 2018; Shirowzhan *et al.,* 2020; Spellacy *et al.,* 2020). Within this first phase, the literature search was divided into two dichotomous groups viz: 1) a holistic search of HECD to establish the contextual boundaries for the present study; and 2) the specific area of construction management education curriculum development to enable a comparative analysis to be undertaken. Second, pragmatism is then adopted to identify the extent of the problem domain but also determine potential viable solutions for such (Johari and Jha, 2020; Wasim *et al.*, 2020). Third, an interpretivist philosophical lens was employed to snowball sample secondary data from extant literature on CMCD (cf. Hortono *et al*., 2019; Saseendran *et al.*, 2020; Simpeh *et al*., 2021). An expanded contextual boundary of CMCD enabled further comparative analysis to be undertaken. Fourth, an interpretivist and pragmatic lens was engaged to deduce relationships, common themes and correlations from bibliographic maps and visuals of the aforementioned secondary data (Chellappa *et al*., 2021; Zhai *et al*., 2021). Finally, grounded theory was adopted to expand upon the extent of the problem domain and also to develop a theoretical model of CMCD as a potential viable solution (Bayramova *et al.*, 2021; Graham and Thomas, 2008).

Combining multiple philosophical lens into one overarching epistemological design is well established within contemporary construction and civil engineering management literature. For example: Akinlolu *et al.* (2020) reviewed the status and emerging trends in construction safety management technologies; Ghosh *et al.* (2020) examined patterns and trends in internet of things (IoT) research to identify future applications in the construction industry; and Oshodi *et al.* (2020) conducted a holistic synthesis of construction output modelling tools and techniques adopted within scientific literature. Cumulatively, this body of knowledge illustrates that this approach is valid and widely used.

Part – HECD and CM Subset

The Scopus and Web of Science electronic journal databases were adopted for the synthesis and analysis pertinent literature collated. Scopus and Web of Science have several advantages over similar journal databases, including: a comprehensive curated suite of publications, on-line data metrics and analytics and extensive (user-friendly) search term facilities (Newman *et al.,* 2020; Smith *et al.,* 2021). Prior to searching electronic journal databases, a manual review of pertinent literature (in English language) was undertaken to identify relevant keywords. It is acknowledged that a limitation of searching English literature alone may have meant that some useful literature may have been inadvertently omitted from this study. That said, most journals in this field publish in English and so any omissions are likely to be low in number. Five publications were initially reviewed on the broader topic of curriculum development to ascertain predominant keywords for utilisation in database searching – viz: Haning, M. (2021); McCunn *et al.* (2020); McManus and Rook (2021); Szczepankiewicz *et al.* (2021) and Veltman *et al.* (2021). Second, the main keywords found were entered into Scopus the search rule: "(TITLE-ABS-KEY ('curriculum') OR ('curricula') AND ('development') AND ('higher education') OR ('university') OR ('universities') AND LIMIT-TO (PUBYEAR 1912 to 2020) AND (LIMIT-TO (DOCTYPE, 'ar') AND (LIMIT-TO (LANGUAGE, 'English'))". This extended time period was adopted to encapsulate historical developments in the field. Furthermore, refined searches (on specific areas of interest – for example curriculum development in a construction context) could then be defined and delineated once the overarching contextualisation of the body of knowledge has been established.

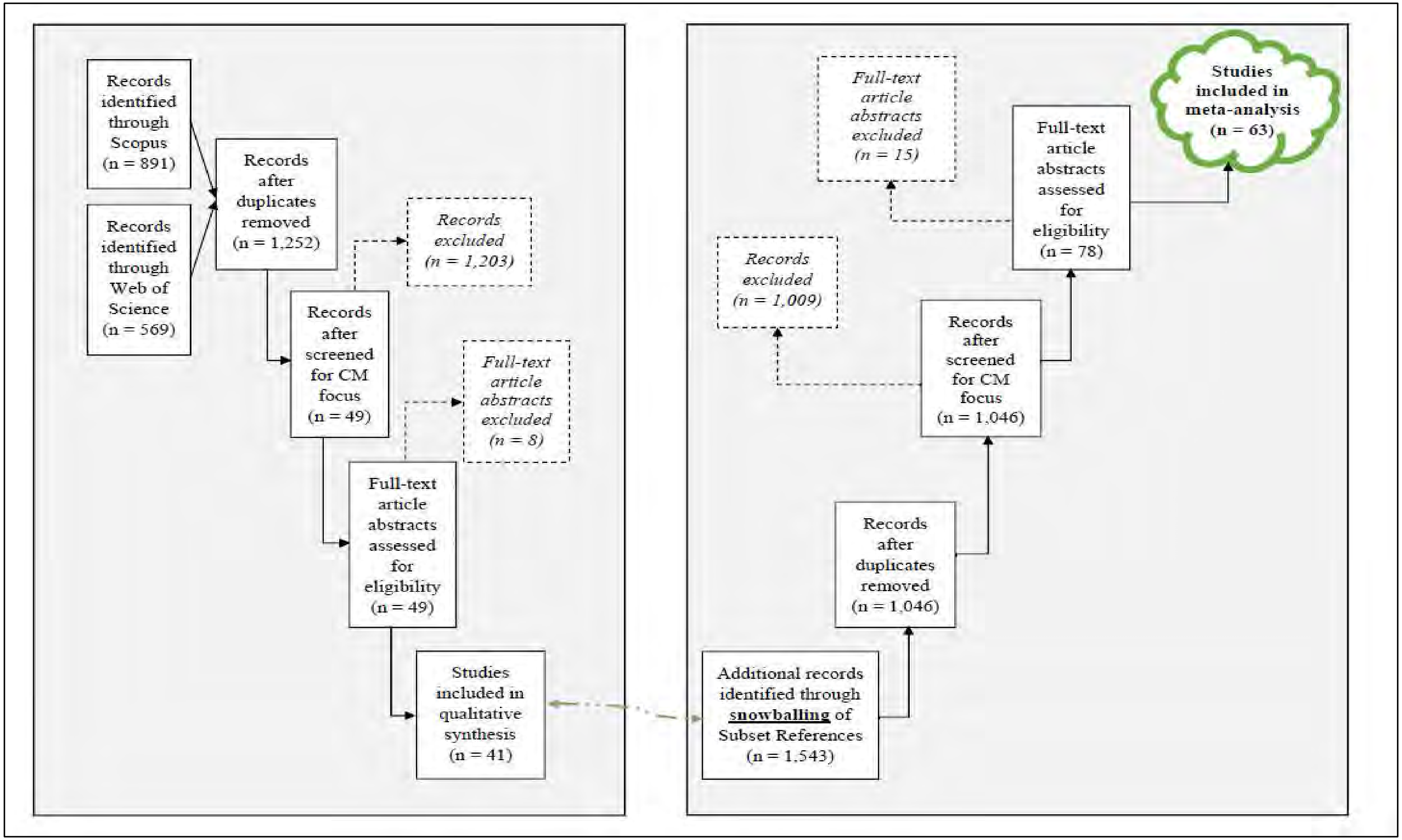
Part – Snowball

To systematically identify curriculum development work in a construction context, PRISMA (cf. Moher *et al.*, 2009) was adopted (refer to Figure 2.6). The same Scopus search criteria noted previously were utilised, albeit focusing on the 'Engineering' education sector for publications. Additionally, a secondary database, Web of Science, was introduced. Together, the Scopus and Web of Science databases aggregated a complementary pool of literature for a more robust, complete and granular analysis (Gusenbauer and Haddaway, 2020). The search criteria for Web of Science were structured on the Scopus keyword search but rearranged to accommodate the particulars of the Web of Science format: "TOPIC: (curriculum development higher education) OR TOPIC: (curricula development university) Refined by: DOCUMENT TYPES: (ARTICLE) AND LANGUAGES: (ENGLISH) Timespan: All years. Indexes: SCI-

EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI." Final results indicated 41 relevant publications.

Snowball sampling was then performed to expand the contextual boundary of CMCD and enable further comparative analysis to be undertaken (cf. Hortono *et al*., 2019; Saseendran *et al.*, 2020; Simpeh *et al*., 2021). Snowball sampling initially indicated 1,543 additional sources referenced in the original 41 publications. These additional sources were downloaded into a Microsoft Excel workbook for manual analysis of topic content and screening to remove irrelevant materials. Of the additional 1,543 sources, 497 were identified as duplicate publications and removed. A further 1,009 sources were removed after initial screening and vetting for specificity regarding CMCD. Full text abstracts for the final 37 publications were obtained and rigorously reviewed for applicability to the CMCD focus. A total of 15 sources were determined to be excluded; 12 were conference publications and three were unable to be located via numerous journal databases. A total of 22 additional sources (from snowballing) were added to the original 41 publications producing a final database total of 63 CMCD focused articles.

Figure 2.6 – PRISMA Flow Diagram for 'Construction Management Curriculum Development'



STAGE 2 – SECONDARY DATA

A mixed philosophical design is adopted and inductive and abductive reasoning used to acutely analyse extant secondary data on UK CMPs and construction manager job advertisements – the purpose being to contextualise the current state of professional skills requirements in construction managers so as to act as a barometer for specific preferred skills and competencies and engender new polemic discussion and debate (cf. Adekunle *et al.*, 2022; Brandão *et al.*, 2021; El Hajj, 2021; Piróg and Hibszer, 2021; Spellacy *et al.*, 2021).

An iterative six tier approach to research investigation is adopted. First, a pragmatic philosophical lens is employed to identify UK CMP and obtain their respective course specifications from university webpages and/or promotional material (cf. Si and Hubbard, 2021; Skipp and Dommett, 2021). Second, an interpretivist lens is employed to manually and via software, decipher keywords, shared themes and common associations into thematic clusters from the aforementioned secondary data (Adegoriola *et al.*, 2021; Sonkor and García De Soto, 2021). Third, a postpositivist philosophical stance is again implemented to rank the various terminology clusters to evaluate their differentiation significance between the programmes (Dao *et al.*, 2021; Sadeh *et al.*, 2021). Fourth, a pragmatic philosophical lens is employed to identify a group of influential UK construction organisations and their respective job advertisements for the role of construction manager (Maali *et al.*, 2022; Nolan and Gibson Jr., 2023). Fifth, an interpretivist lens is utilised to decipher keywords manually and electronically from the job advertisements (Xu *et al.*, 2022; Zhou *et al.*, 2022). Finally, a pragmatic philosophical stance is implemented to rank the various keywords, by frequency, to evaluate their relationships and significance between the job advertisements (Marzouk and Elshaboury, 2022; Nedjwa *et al.*, 2022).

Part – UK Construction Management Programmes

The CIOB is a world-leading, highly influential construction management professional body with a wide agenda aimed at improving the built environment sector (Chartered Institute of Building, 2021a; Chartered Institute of Building, 2021b). An important part of this agenda focuses on the education (both degree and non-degree) of construction management professionals; of which CIOB offers accredited programmes of study (Chartered Institute of Building, 2021c). Using CIOB's register of full-time undergraduate construction management degree courses (specifically Bachelor of Science (Hons)), a register of 35 universities offering a construction management degree were identified ($f = 35$). Whilst there are other pathways to obtain an undergraduate degree (apprenticeship, part-time and sandwich), the focus of this research was limited to the full-time pathway. From the register of universities, a search of each university's website was conducted to identify the programmes that had publicly published the programme's official course and/or module specifications; of which 19 were identified (constituting a 54.28% sample data collection rate – or 100% data collection rate of publicly available literature). The remaining 16 universities were removed from further query due to their lack of publicly available specifications. To preserve anonymity, each HEI was assigned a NATO phonetic alphabet name (ranging from A 'Alfa' to S 'Sierra') – noting that this complies with the author's host institution's ethical protocol but also underscoring the intention to present factual analysis of content only rather than rank ordering of content importance or perceived best programme content between individual HEIs.

Part – Job Advertisements

Utilising a host of construction industry publication company's rating and ranking indices, (*The Construction Index*, *Construction News*, *Construction Global* and *Construction Review Online*) construction companies with a noteworthy impact (turnover/revenue, profit and/or size) were identified ($f = 10$). Complete job advertisements for the role of 'Construction Manager' or 'Project Manager' were located within each of the companies' career/Human Resources portal and downloaded. The description of the 'key responsibilities / accountabilities,' 'role duties,' 'competencies,' 'personal requirements / qualities,' 'qualifications' and/or 'desirable criteria' for each of the ten job advertisements were uploaded into Voyant Tools to identify frequently occurring ($f \geq 4$) keywords. A summative list was assembled and then manually cleansed to remove duplicates and different grammatical forms of the same word which resulted in 101 keywords.

STAGE 3 – PRIMARY DATA

A mixed philosophical stance was implemented and inductive and abductive reasoning used to examine UK construction industry professionals' perceptions of professional skills – the purpose being to identify specific attributes for incorporation into higher education curriculum (cf. Hughes *et al*., 2021). A three-tiered research approach is adopted. First, a Likert-scale survey instrument is developed from the secondary data of UK construction / project manager job advertisements (Han *et al*., 2021; Rakowska and de Juana-Espinosa, 2021). Second, the survey instrument is distributed to built environment academics (cf. Ayodele and Olaleye, 2021; Wang *et al*., 2021). Finally, through a postpositivist lens, the results of the Likert scale survey instrument are statistically analysed to develop a proof-of-concept model of CMCD (cf. Adepoju and Aigbavboa, 2020; Dharmapalan *et al*., 2021). This model was later tested in stage 4 – Validation.

Part – Survey Design

Ethics

Maintaining the highest level of research ethics is of paramount importance, not only to the PhD researcher and supervisory team, but to the institution, profession and wider community. Before any primary data was collected, the PhD researcher sought formal ethics approval from Birmingham City University through the Faculty of Computing, Engineering and the Built Environment Academic Ethics Committee. This process involved a multi-stage Ethics Protocol form to be completed which outlined, in part, the nature of the research, potential physical, psychological and emotional risks, data analysis methods, data storage and destroying guidelines and participant recruitment. Additionally, an information sheet and consent form, which are provided to research participants before data collection, were included in the ethics approval submission to ensure that informed consent was obtained. All primary data collection in this research was conducted with anonymity with any identifying information redacted from the thesis. Additionally, prior to starting any interviews, permission was obtained to record the discussion for the use of dialogue transcribing. Formal ethics approval was received for this research on 31 March 2022.

The first section of the survey instrument was dedicated to the collection of demographic information. The inclusion of demographic questions is standard practice when designing a survey instrument (Farrell *et al*., 2017; Saunders *et al*., 2016) as this demonstrates that the data collected are from individuals with informed and useful opinions. Specifically, the survey instrument asked: 1) age range; 2) current employment role; 3) years worked in academia; 4) built environment programme affiliation and 5) years worked in industry. This ensured that only participants who were sufficiently knowledgeable and experienced (i.e., selection criteria) regards the phenomenon under investigation participated in the research.

The survey instrument questions were based upon the incremental analysis of extant literature (Chapters 3 and 4) and secondary data (Chapter 5), culminating in a final list of skills and competencies (Chapter 6). Specifically, Table 7.1 (within Chapter 7) notes where the survey instrument questions were derived from. The question limit was based primarily based upon ease of use relative to the high-paced and high-demand nature of academia which, in turn, would help with obtaining a healthy response rate (Yan *et al*., 2011). The style and user interface of the questions was also considered, primarily rating and ranking with open-ended question opportunities. This again, was utilised to dovetail with an academics' daily work constraints so that the survey could be completed quickly, easily and/or on a mobile device (Harrison *et al*., 2019). This strategy has been utilised by other researchers (cf. Hassanain *et al*., 2022; Pidgeon and Dawood, 2022; Saleh and Bista, 2017) – thus justifying this selection and method.

Likert rating is a non-comparative metric where each element is scaled independently of other elements in the grouping (Fellow and Liu, 2015). A unique and intrinsic characteristic of Likert rating is that is allows a respondent to note the degree or level they agree/disagree with a statement (Saunders *et al*., 2016). Specifically, each degree or level of agreement/disagreement is associated with a numerical value (Farrell *et al*., 2017). For example, a four-point Likert instrument may be formatted such that 4 = strongly agree, 3 = agree, 2 = disagree and 1 = strongly disagree (Saunders *et al*., 2016). The numerical values associated with qualitative statements allow for statistical analysis of the data group(s). Likert-scale survey instruments are an immensely popular primary data collection instrument within construction management research. Oladimeji (2022) utilised a five-point Likert-scale survey to measure the influence of the COVID-19 pandemic on Nigerian construction firms' industry capability. Another five-point Likert-scale survey was implemented to determine and assess the barrier of transferring incomplete public construction projects to the private sector (Sarvari *et al*., 2021). Chattapadhyay *et al*. (2021) developed a five-point Likert-scale survey to obtain individual responses to the identification, assessment and prediction of risk on mega construction projects.

Part – Survey Distribution

Purposive sampling was utilised to identify academics in built environment disciplines who had sufficient knowledge and experience to comment upon curriculum design and development (Adabre *et al*., 2022; Jupp, 2006). Electronic and online distribution of the survey was utilised to help reach a large population of knowledgeable respondents (Harrison *et al*., 2019). Additionally, electronic and online distribution tends to yield a higher responds rate due to its ease of use, availability and reliability (Saleh and Bista, 2017).

Part – Survey Analysis

IBM® SPSS Statistics (SPSS) was used for primary quantitative data analysis. SPSS is a software package that provides a robust set of statistical characteristics that allows a user to analyse and interpret complex datasets (IBM Corporation, 2021a). According to SPSS, its capabilities span across the entire analytical lifecycle: data preparation and management, comprehensive statistical analysis, visualisation suite to enhance communicability and forecasting modelling (IBM Corporation, 2021a). Specifically, regarding the comprehensive statistical analysis, SPSS notes upwards of 40 basic statistics operations and an additional 18 advanced statistics operations in the most basic software package offering (IBM Corporation, 2021a).

SPSS has been frequently and successfully used within the built environment – specifically regarding the statistical analysis of Likert scale survey results. Specifically, Alnaqbi and Yassin (2021) utilised SPSS when analysing results from a survey about critical success factors when adopting artificial intelligence in e-learning environments. Furthermore, Ong *et al*. (2021) statistically analysed survey results focused on online learning attribute preferences of students through the SPSS software package. Finally, Singh and Kumar (2021) analysed survey results related to lean construction and visual management tools using SPSS.

Both descriptive and inferential statistical analyses were utilised on the data collected. Descriptive statistics help to provide a high-level summary of the dataset, without trying to reach pinpoint statistical conclusions (Lacort, 2014). For this research the mean, median and WA, along with general mathematics, were the descriptive statistic methods utilised.

Inferential statistics are utilised to help draw conclusions about a dataset (Asadoorian and Kantarelis, 2005). Building off descriptive statistics, inferential statistics takes the reached conclusion(s) and apply it to a more overall population (Boslaugh, 2013). This type of analysis includes various mathematical tests, formulas and models to help pinpoint robust conclusions about a dataset (Asadoorian and Kantarelis, 2005). Specifically, Relative Importance Index

(RII), Interquartile Range, One Sample T-Test, Kruskal-Wallis Test and Chi-Square Test were the techniques utilised. These techniques were employed, as previously noted, to obtain a statistical measurement of significance to provide a more granular analysis to the general descriptive statistics.

STAGE 4 – VALIDATION

A mixed philosophical stance is employed and inductive reasoning used to observe curriculum development subject matter experts' (CDSME) insights of the proof-of-concept model – the purpose being to obtain model validation (cf. Kuoribo *et al*., 2022). A single tier research approach is adopted. Semi-structured interviews with CDSMEs were conducted, recorded and transcribed. The transcripts were then reviewed, textually, to determine if general consensus was achieved throughout the CDSMEs regarding the validity of the proof-of-concept model (cf. Christensen *et al*., 2022; Shafqat *et al*., 2022).

Part – Semi-Structured Interviews

The validation interviews were conducted individually (one-on-one) and video/audio recorded via MS Teams. A transcript of the interview was obtained through the MS Teams transcription application. A semi-structured interview process was utilised; a series of predetermined questions sourced from literature and the emergent findings of previous stages. Each question contained a cache of prompts at the interviewer's disposal to ensure that answers to questions posed received a full and complete answer. Moreover, each prompt included an associated tick box to ensure that as each response covered that respective point, it could be ticked off prior to moving to the next prompt if needed (reference Appendix 3). Prior to recording the interview, a review of the research, analysis and proof-of-concept model was discussed in a broad level of detail. This not only allowed the interviewee to gain background knowledge on the specific research topic, as well as affording an opportunity to check for understanding, but also an opportunity for both parties (interviewer and interviewee) to work through various conversational norms (greetings, familiarisation with speech patterns, pace of speech, enunciation, etc.). Specifically, the semi-structured interview asked six main questions viz.: 1) experience in professional education; 2) experience with curriculum development; 3) initial perceptions of proof-of-concept model; 4) importance of the foundation in a curriculum; 5) interpersonal skills/competencies supporting technical content and 6) open-ended concluding thoughts. These were accompanied by 24 prompts. The questions posed during the semi-structured interviews were purposely kept brief to allow for a free-flowing informal dialogue which allowed the interviewees to open up to questions posed in a relaxed and friendly environment.

Upon completion of the interviews, the corresponding transcripts were downloaded and reviewed for completeness. Any identifiable information was redacted and any transcription errors from the MS Teams application were rectified. Once a final transcript of the interview was formalised, it was analysed. To confirm validation of the proof-of-concept model, a general consensus was sought from CDSMEs. This qualitative approach to analysis allowed for the researcher to view the richness of the interviewees feedback in a deep and contextual level. This approach, as compared to a quantitative approach, was preferred due to the intertwined and connected nature inherent with curriculum development (Freebody, 2003). Tabulation of the responses to each of the main questions allowed the researcher to confirm saturation.

CHAPTER 3

CURRICULUM DEVELOPMENT IN THE HIGHER EDUCATION LITERATURE: A SYNTHESIS FOCUSING ON CONSTRUCTION MANAGEMENT PROGRAMMES

INTRODUCTION

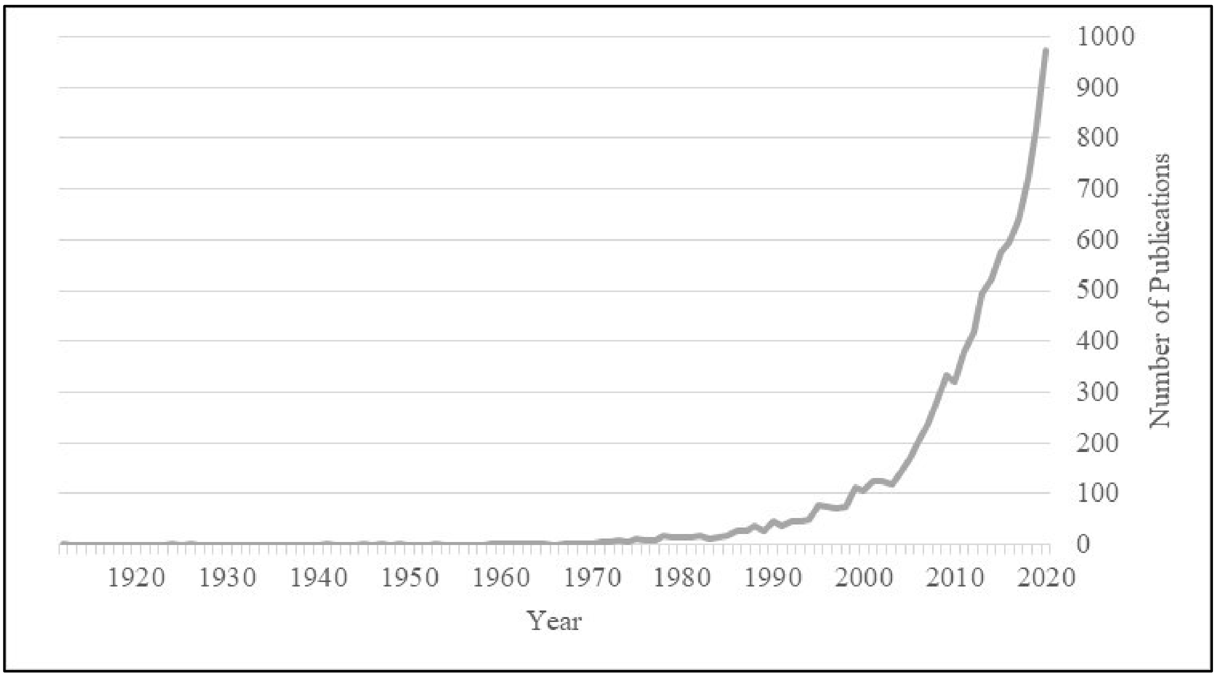
HEIs provide a fertile learned environment and structure geared towards the advancement and refinement of students' employability, professionalism and life skills (Bok, 2020; Brint, 2018). To meet these objectives, HEIs implement a series of curricula aimed at achieving both academic and interpersonal goals set for students (Gable, 2021; Kosslyn and Nelson, 2017; Quinn, 2019). Curricula are so intrinsically entrenched within HEI programmes that many students and staff select to study, research and/or work at an institution solely based upon its repute (Hieu *et al*., 2020; Nusier and El Refae, 2021; Saiti *et al.*, 2017). In essence, curricula are the defining feature of HEIs which act as a shell and holding place of numerous specific programmes, each with its own explicit tailored curriculum. This status quo has engendered new curriculum theory and development as a collaborative field of study which examines multiple intertwined layers of education sequence, pedagogy, psychology and sociology (Green, 2018; Proctor, 2020). It is from this collaborative subject field that greater insight into specific disciplines and programmes can be viewed.

Compared to traditional science, technology, engineering and mathematics (STEM) disciplines, construction management is a comparatively immature 'technical-based' discipline that developed out of advancements and intricacies of the post-war era – specifically, the need to rebuild infrastructure to aid economic recovery (Chartered Institute of Building, 2021; Howell *et al.*, 2011). As with most technical-based programmes, equilibrium in taught content must be achieved between contemporary industry relevance and academic rigour, couched within an omnipresent changing construction and academic topology (Borg and Scott-Young, 2020; Bröchner and Sezer, 2020). Just as a project plan and schedule are essential tools for the successful construction of a building, so too is curriculum development for a construction management programme. The curriculum defines and delineates the path of study, including critical study topics, activities and milestones that cumulatively prepare the 'journeyman student' for a career in industry and/or a return to academia or further education colleges to teach. For the purposes of this thesis, curriculum development is defined as a process that defines and delineates the content of a programme as well as enable concepts such as individual and collective ownership to actualise the programme (Kramer, 2005). Consequently, this present research is deliberately provocative and argues that HECD for CMPs is progressing unharmoniously, with little regard for relevant and coherent adaptation of educational frameworks and theories. Against this contextual backdrop, this research seeks to conduct a bibliometric analysis of pertinent literature to contextualise contemporary curriculum development within the broader HEI landscape to learn lessons from wider practice, before then focusing specifically upon CMPs. A secondary aim is to reflect upon key authors, origins of academic endeavours and prevailing developments as a means of engendering much needed wider polemic debate and signpost directions for future research.

RESULTS FOR HIGHER EDUCATION CURRICULUM DEVELOPMENT

The keyword search conducted during February 2021 identified 9,350 relevant publications which were downloaded into a Microsoft (MS) Excel database to permit content and thematic analysis. A comparison of the number of publications per year revealed a clear exponential increase in published research starting in the mid-1980s (refer to Figure 3.1). Reasons for this expansive increase could be related to a wide range of general factors including, but not limited to: an increased number of students gaining access to higher education (Universities UK, 2018); an increase in the number of HEIs (Bolton, 2021); and an increase in the quantity and speciality of degree offering programmes (Frank and Meyer, 2020).

Figure 3.1 – Publications from 1912 to 2020



Regions

The four nations publishing the highest publication count of HECD research, in descending count, were identified as the United States of America (USA), the UK, Australia and Canada.

The USA has published a majority of the total publications (i.e., frequency (f) = 3,399 or 36.35%), with the remaining nations at f = 1,371 or 14.66%, f = 742 or 7.94% and f = 401 or 4.29% respectively. The four nations were part of and are still closely aligned with the British Empire (both politically and philosophically). These historical pedagogical roots perhaps explain the large volume of publications across these regions and the concomitant high reputations that these countries have as leading educational providers globally (Mangan, 2012; Whitehead, 2007).

Furthermore, traditional philosophical education foundations may influence differences in education provisions or approaches between geographical regions, specifically when comparing Eastern and Western education. Littlejohn and Li (2021) point to the convergence of Eastern and Western cultures from the sixteenth century as a magnifier of philosophical differences and contentions. Similarly, Komatsu and Rappleye (2020) review modern Japanese educational philosophies and resultant outcomes against a traditional Western model, commenting on intrinsic differences. In other words, a strong reverence for the nature, purpose and power of curriculum displayed in a Western setting is not as evident in an Eastern context (*ibid*). Thus, a low number of Eastern nations researching curricula aligns with their underlying educational philosophies. That said, the observed higher count of Western dominated work on curriculum development could also be an inherent limitation of the English language search adopted for this research; future work could be undertaken to explore this potential limitation further.

Global growth in the number of HEIs may explain the national ranking in publications. Table 3.1 displays the number of publications and HEIs for the top ten nations, according to the International Association of Universities and the World Higher Education Database with collaboration from United Nations Educational, Scientific and Cultural Organization (World Higher Education Database, 2021). The countries with a significantly higher 'publication to higher education institution' ratio have noteworthy ties to the former British Empire (i.e., Australia, UK and Republic of South Africa), again underscoring an engrained curriculum focus resultant from historic influences. The exception to this general trend is the USA which ranks fairly low in regard to the 'publication to higher education institution' ratio. This is surprising given their dominance in curriculum research publications; yet the number of HEIs (2,118) is almost twice as much as the next highest nation (Peoples Republic of China) possibly indicating a saturation of institutions.

Table 3.1 – Ratio of Curriculum Publications to Total Number of HEIs per Nation

Country	Publications (*f*)	HEIs (*f*)	Ratio of Publications to HEIs (No.)
Australia	742	94	7.89
United Kingdom	1,371	248	5.53
Republic of South Africa	251	49	5.12
Netherlands	248	70	3.54
Canada	401	142	2.82
Spain	264	112	2.36
United States of America	3,399	2,118	1.60
Turkey	143	172	0.83
Germany	270	359	0.75
Peoples Republic of China	328	1,060	0.31

Educational Sectors

With regards to the breakdown of the publications across scientific disciplines, Table 3.2 illustrates that social sciences dominate the HECD discourse with 38.50% (f = 5,648) of publications produced. However, when comparing the descriptions of the educational sectors noted, 'social sciences' encompasses a wider breadth of subject areas which include engineering, nursing, medicine and the arts and humanities (Nisbet, 2019). Hence, the initial observation should be tempered appropriately. The second educational sector with a large percentage of HECD discussion is the medical, nursing and health professions domain (23.44% combined or f = 3,439). Health professions are more predisposed to frequent advancements in both procedure and theory (cf. Labovitz and Hubbard, 2020; Tyagi *et al.*, 2020) given a need to keep abreast of health and medical advancements made (cf. Ichikawa *et al.*, 2020; Tolsgaard *et al.*, 2020; Sreedharan and Varghese, 2020). Exemplars of work published in this area include: Emami *et al.* (2021) who employ integrated simulation teaching practices with humanities disciplines to help increase effective communication skills in oncology fellows; Hussain *et al.* (2021) who examine the attitudes and perceptions of United Arab Emirates medical and pharmacy students on social media and e-professionalism; O'Connor *et al.* (2021) who investigate the application of immersive 3D technology to help radiology students develop clinical skills; and Curtis *et al.* (2021) who develop an interdisciplinary clerkship for fourth-year medical students to help address knowledge gaps in clinical and professional skills and curriculum. Other published work includes: Perignat and Katz-Buonincontro (2019) who complete a literature review of integrated arts education within more technical disciplines and reveal a lack of curricula connectedness; Liu and Yi (2017) who examine the perception of insignificance in humanities education; and Varlotta (2018) who discusses the need for systemic university changes in an effort to help liberal arts education face 21st century challenges.

Table 3.2 – 'Higher Education Curriculum Development Database' Discipline Breakdown

Discipline	Publications (*f*)	Percentage (%)
Social Sciences	5,648	38.50%
Medicine	2,298	15.66%
Engineering	889	6.06%
Nursing	796	5.43%
Business, Management and Accounting	665	4.53%
Computer Science	593	4.04%
Arts and Humanities	526	3.59%
Psychology	456	3.11%
Environmental Science	449	3.06%
Health Professions	345	2.35%
6 Disciplines between 1.99% and 1.00%	1,169	7.79%
12 between 0.99% an 0.01%	836	5.70%

Journals

An alternative means of analysing the publications retrieved is to thematically group them into leading journals. Of the top 25 journals identified, representing $f = 1,486$ of the total publication count: 12 journals (48% or $f = 734$ publications) were medical, nursing or health profession related; four journals (16% or $f = 213$ publications) were 'engineering' focused; and nine journals (36% or $f = 539$ publications) were focused on overall higher education. By examining the journals themselves, multiple outlets and publication tracks could be observed. Table 3.3 identifies the top 25 journals by publication count in the database with standard metric information (such as 'Cite Score'). The most prevalent journals, in terms of publication quantity, rank outside of the top thirty education journals, indicating a lack of educational research impact or a lack of research in the specific subject area (which in many ways equates to the former). While the average CiteScore, a journal measurement metric based on yearly average citation counts (Zijlstra and McCullough, 2016) is reasonably high (4.0 average), the average 'education' discipline ranking is rather low and falls outside of the 90th percentile (Rank of 157, High of 3, Low of 471, Range of 468).

Table 3.3 – Top 25 Journals by Publication Quantity

Journal Category code	Journal	Publication Quantity (*f*)	Rank in 'Education' Discipline (No. out of 1,254)	CiteScore 2019 (No.)
HE	International Journal of Sustainability in Higher Education	107	169	3.2
MNHP	BMC Medical Education	106	234	2.8
MNHP	Nurse Education Today	102	77	4.6
MHNP	Medical Teacher	91	92	4.1
HE	Sustainability	88	Not Ranked	3.2
HE	Journal of Chemical Education	77	150	3.4
E	Journal of Cleaner Production	72	Not Ranked	10.9
MNHP	Journal of Surgical Education	58	201	3.0
HE	Studies in Higher Education	58	33	5.9
MNHP	Academic Medicine	54	37	5.7
E	International Journal of Engineering Education	54	413	1.9
MNHP	Journal of Dental Education	54	375	2.1
MNHP	Medical Education	51	38	5.7
HE	Higher Education	48	52	5.3
MNHP	Currents in Pharmacy Teaching and Learning	47	Not Ranked	1.2
E	European Journal of Engineering Education	47	167	3.2
HE	Journal of Geography in Higher Education	46	207	3.0
MNHP	American Journal of Pharmaceutical Education	45	284	2.5
MNHP	Journal of Advanced Nursing	44	Not Ranked	3.9
MNHP	European Journal of Dental Education	42	426	1.9
E	Computers and Education	40	3	12.7
HE	Higher Education Research and Development	40	121	3.7
MNHP	Nurse Education in Practice	40	254	2.7
HE	International Journal of Emerging Technologies in Learning	39	471	1.7
HE	Education and Training	36	128	3.6

NB - Journal category code: MNHP = medical, nursing or health professions; E = engineering; and HE = higher education.

As Table 3.3 depicts, the medical profession has a strong presence in HECD. However, the top 25 journals by publication count may be painting only a segment of the image. Viewing the journals themselves through a different lens, specifically with the term 'curriculum,' only seven of the top 1,000 journals noted within the 'education' discipline are dedicated / focused on curriculum as a broad topic and not interrelated with another field (refer to Table 3.4). Of the seven journals identified, only two (*Curriculum Journal* and *Journal of Curriculum Studies*), representing a total of 31 publications, are indicated within the MS Excel database constructed for this research. However, when reviewing the two journals against the other curriculum focused journals, they are the two highest ranked (221 and 372 out of 1,254 respectively) and have the highest CiteScores (2.9 and 2.1). While the ranking and CiteScores are low when viewed individually, they do carry weight when compared against other curriculum focused journals indicating that these two journals are at the top in terms of curriculum.

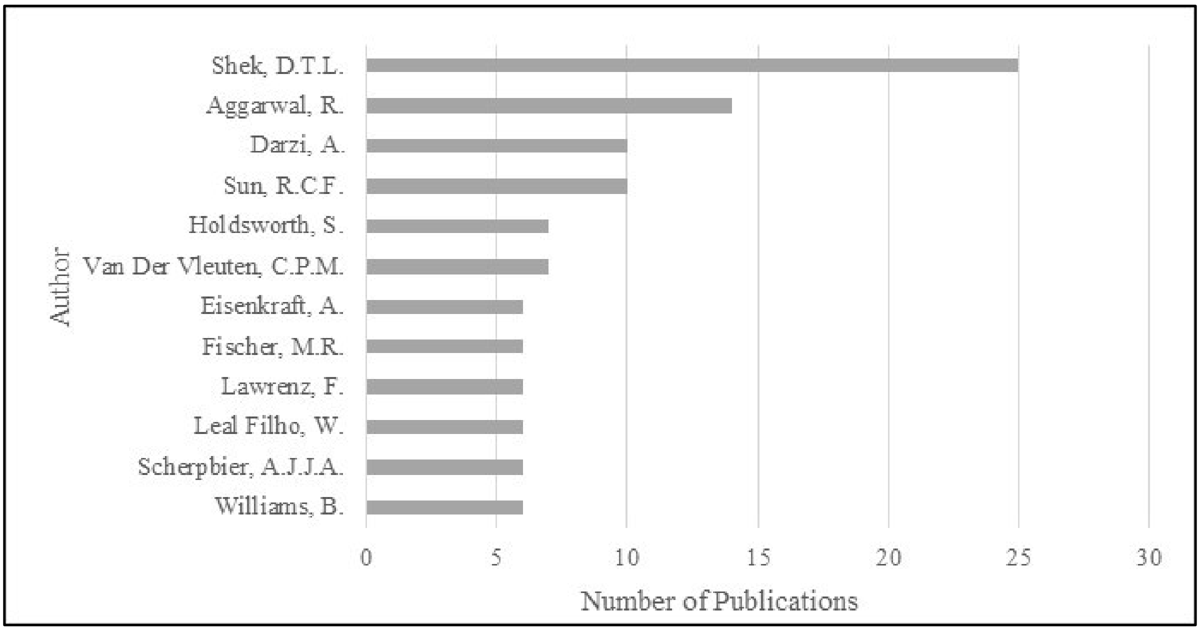
Table 3.4 – Curriculum Specific Academic Journals

Journal	Rank in Education Discipline (No. out of 1,254)	CiteScore 2019 (No.)	Included in original database?
Journal of Curriculum Studies	221	2.9	Yes
Curriculum Journal	372	2.1	Yes
Language, Culture and Curriculum	388	2.1	No
Curriculum Inquiry	441	1.8	No
Journal of Curriculum and Pedagogy	753	0.9	No
Curriculum Perspectives	827	0.7	No
Curriculum and Teaching	949	0.5	No

Authors

When ranking authors according to the number of publications, two authors appear to be leading in research and publication when compared to their peers, viz: Shek, D.T.L. and Aggarwal, R. (refer to Figure 3.2). Aside from these top two authors, there is not much differentiation in publication quantity amongst other prominent authors.

Figure 3.2 – Top 12 Authors Ranked by Publication Quantity



Other publication metrics can also be used to extrapolate information about the authors in order to help identify the key individuals in the higher education curriculum discourse (refer to Table

3.5). Of the top twelve authors, only two (Holdsworth, S. and Eisenkraft, A.) have a curriculum publication to total publication percentage above 10%. This demonstrates that curriculum is a small subset of the top authors' research focus.

Table 3.5 – Top 12 Authors by Curriculum Publication Quantity

Researcher	**Curriculum Publications (*f*)**	**Total Publications (*f*)**	**Percent (%)**	**Total Citations (*f*)**	**Curriculum Publication Citations (*f*)**	***h*-index (No.)**
Shek, D T.L.	25	918	2.72%	13,607	387	60
Aggarwal, R.	14	269	5.20%	9,250	691	53
Darzi, A. W.	10	1,391	0.72%	46,105	714	103
Sun, R. C.F.	10	118	8.47%	2,118	160	26
Holdsworth, S.	7	36	19.44%	303	38	10
Van Der Vleuten, C.P.M.	7	682	1.03%	24,495	209	75
Eisenkraft, A.	6	19	31.58%	105	54	6
Fischer, M.R.	6	225	2.67%	3,208	13	25
Lawrenz, F.	6	120	5.00%	2,092	54	20
Leal Filho, W.	6	265	2.26%	2,313	214	27
Scherpbier, A.J.J.A.	6	376	1.60%	10,131	152	55
Williams, B.	6	228	2.63%	2,569	52	23

It is also apparent that the main disciplines for the top twelve authors (representing the majority of their publications and citation counts) are varied with only two authors (Holdsworth, S. and Leal Filho, W.) primarily engaged within a higher education discipline (refer to Table 3.6). For these two authors, the quantity of publications produced is small and the corresponding field-weighted citation impact (which measures the influence of publication within the discipline), is slightly above average (1.0 representing average). Specifically, reviewing the percentage of topic related publications to the total number of author publications for the two identified authors, the percentages are low at 22.22% and 10.57%.

Table 3.6 – Top 12 Authors' Major Publication Discipline(s)

Researcher	**Scopus Topic**	**Total Publications in Topic (*f*)**	**Total Overall Publications (*f*)**	**Topic Publications to Overall Publications (%)**	**Topic Field-Weighted Citation Impact (No.)**
Shek, D T.L.	Youth Development; Outcome Evaluation; General Education	203	918	22.11%	0.70
Aggarwal, R.	Technical Skills; Robot Assisted Surgery; Laparoscopy	23	269	8.55%	1.16
Darzi, A. W.	Safety Climate; Operating Rooms; Teamwork	11	1,391	0.79%	0.95
Sun, R. C.F.	Youth Development; Outcome Evaluation; General Education	4	118	3.39%	0.70
*Holdsworth, S.	Education for Sustainability; Higher Education Institutions; Sustainability Science and Engineering	8	36	22.22%	1.05
Van Der Vleuten, C.P.M.	Multisource Feedback; Competency-Based Education; Trainee	40	682	5.87%	1.17
Eisenkraft, A.	Distributed Leadership; School Improvement; Professional Learning	1	19	5.26%	1.30
Fischer, M.R.	Clinical Reasoning; Cognitive Bias; Diagnostic Errors	13	225	5.78%	1.00
Lawrenz, F.	Evaluation Capacity Building; Empowerment Evaluation; Evaluator	4	120	3.33%	0.60
*Leal Filho, W.	Education for Sustainability; Higher Education Institutions; Sustainability Science and Engineering	28	265	10.57%	1.05
Scherpbier, A.J.J.A.	Transnational Education; Internationalization Process; Student Mobility	6	376	1.60%	0.88
Williams, B.	Empathy; Medical Students; Perspective Taking	10	228	4.39%	1.30

NB: * denotes researchers engaged in a higher education discipline.

To more clearly identify the most influential key authors within the HECD discipline, further granulation is required. A ratio comparison of the frequency of the authors' higher education curriculum publications to the frequency of the authors' total publications can perhaps uncover additional influential and key authors. This comparison helps to identify authors with less plurality, which may help identify leading, influential and persistent voices within the HECD discipline. Table 3.7 identifies an additional twelve authors that meet the aforementioned entry criteria.

Table 3.7 – Additional Authors with Higher Education Curriculum Publication Ratio and Citation Impact

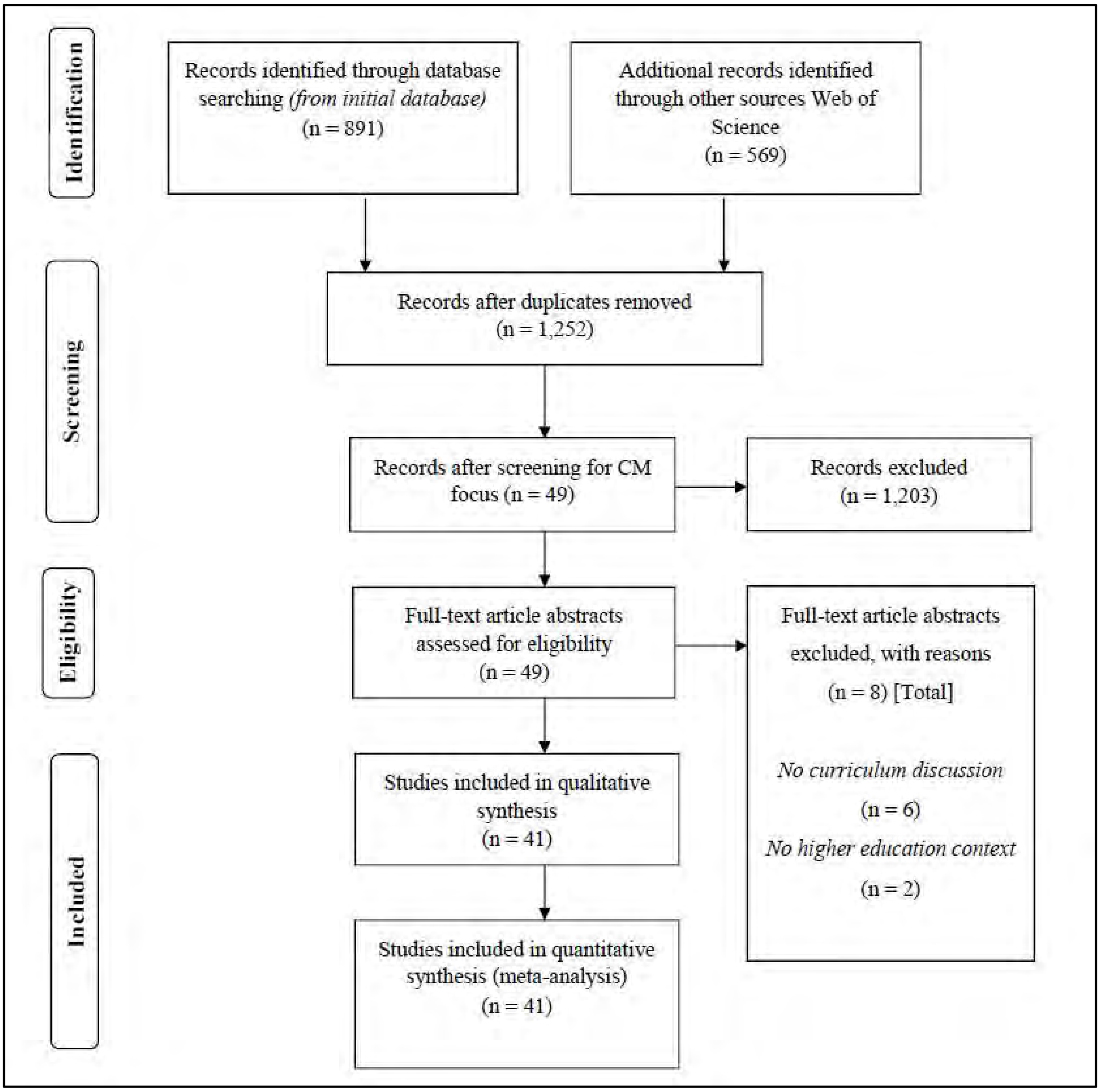
Researcher	Curriculum Publications (*f*)	Total Publications (*f*)	Percent (%)	Total Citations (*f*)	Curriculum Publication Citations (*f*)
Cebrián, G	5	19	26.32%	291	134
Ceulemans, K.	5	19	26.32%	1,238	278
Igwe, P. A.	5	30	16.67%	110	16
Okolie, U. C.	5	22	22.73%	65	9
Baughan, P.	4	7	57.14%	12	8
Belluigi, D. Z.	4	19	21.05%	101	5
Carmichael, M. A.	4	14	28.57%	95	28
Dlouhá, J.	4	15	26.67%	273	102
Foster, B.	4	6	66.67%	29	24
Frumin, K. M.	4	7	57.14%	33	24
Halman, S.	4	16	25.00%	432	30
Lammerding-Koeppel, M.	4	18	22.22%	115	7

Tables 3.6 and 3.7 indicate that the prevailing research discourse is often intertwined with other fields of study. For example, Aggarwal, R. has a total of 269 publications, mostly falling in the health professions sector, but only 14 of these relate to education. While Table 3.7 identifies authors with a lesser publication count, the percentage of their publications related to curriculum development are notably higher than the top authors who have written extensively on different, but related topics. From the holistic key author analysis, a clear, focused and dedicated global community of practice related to HECD is conspicuous by its absence. Rather, papers published focus on largely generic discussion on curriculum within a specific subject discipline.

CONSTRUCTION MANAGEMENT EDUCATION CURRICULUM DEVELOPMENT

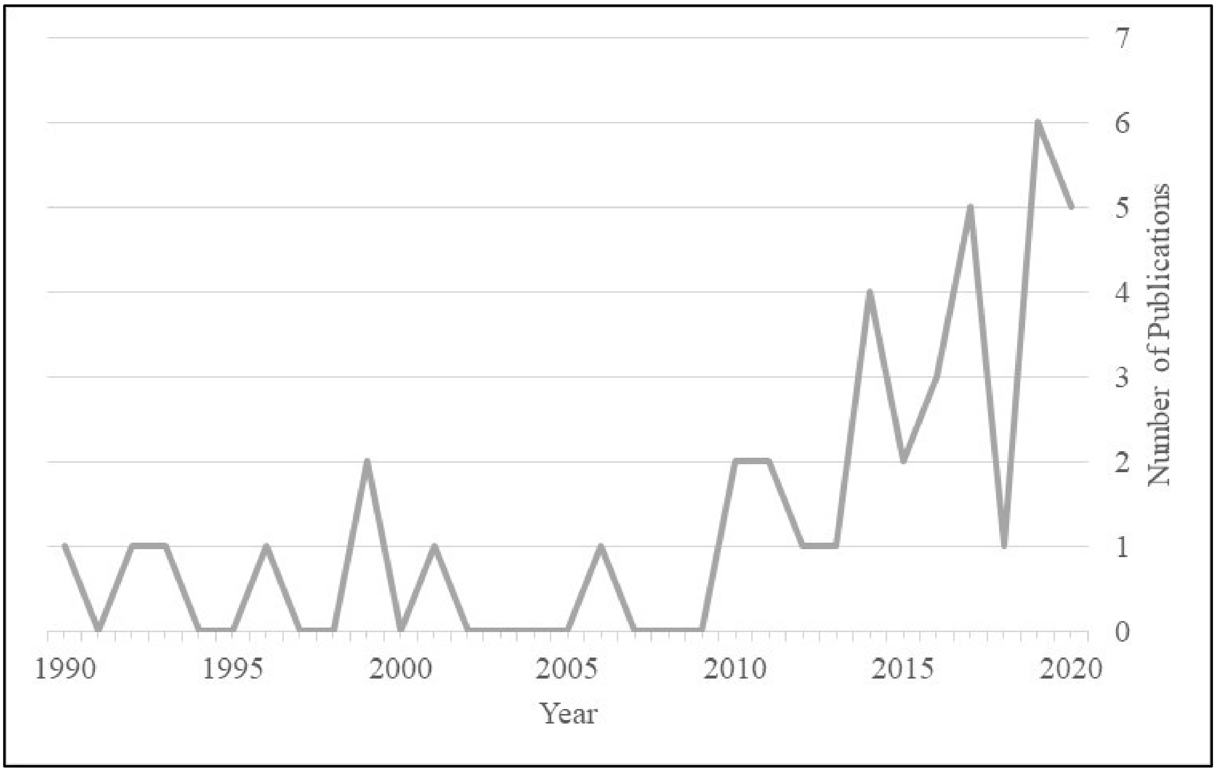
To excoriate curriculum development work in a construction context, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRIMSA) (cf. Moher *et al.*, 2009) was adopted (refer to Figure 3.3). The same Scopus search criteria used previously to obtain the MS Excel database were utilised, albeit focusing on the 'engineering' education sector for publications. Additionally, a secondary database (Web of Science) was introduced. Together, the Scopus and Web of Science databases would aggregate a complementary pool of literature for a more robust, complete and granular analysis (Gusenbauer and Haddaway, 2020). The search criteria for Web of Science were structured on the Scopus keyword search, but rearranged to accommodate the particulars of the Web of Science format, viz: "TOPIC: (curriculum development higher education) OR TOPIC: (curricula development university) Refined by: DOCUMENT TYPES: (ARTICLE) AND LANGUAGES: (ENGLISH) Timespan: All years. Indexes: SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI."

Figure 3.3 – PRISMA Flow Diagram for 'Construction Management Subset'



Results initially indicated that 41 publications out of 1,252 (3.27%) were focused on construction management. These publications were downloaded into a MS Excel database as a 'construction management subset' to the main database held. When comparing the number of publications per year, an inconsistent, but upward trending increase in published research was evident (refer to Figure 3.4); albeit this increase was small given a maximum of only six publications in a single year. The earliest publication date was 1990, which is quite some time after the development and formation of construction management degrees in the 1950s through to the 1970s (Hauck, 1998; Yang and Chang, 1998). Given 70 years of development, one would intuitively have anticipated a far greater volume of research endeavour (and by implication, publications) in this area.

Figure 3.4 – Publication by Year for 'Construction Management Subset'



Authors

Of the 100 different authors noted, 94 had a single publication and just six had two publications indicating that no clear 'leading authority' in the area can be readily identified. Interestingly, of the six authors with two publications, five of them exhibited an author-co-author relationship which negates the totality of the quantity of multiple publication authors. Consequently, only one author had published multiple articles, which confirms a lack of author leadership in the subset database. However, when comparing authors in the main database with authors in the sub-set database, two authors appear in both lists (Cotgrave, A.J. and Holdsworth, S.). While this overlap offers some interesting insight, the magnitude of publication impact (in terms of volume, not influence) is minimal. Specifically, the two overlapping authors combine for a total of three publications in the subset database (6.12%) and ten in the main database (0.11%).

Journals

Within the sub-set database, 21 different journals were identified. Eight of these journals included two or more publications; 26 articles in summation or 63.41% of the total publications. The top eight journals were reviewed at a granular level to ascertain the frequency and focus of construction management curriculum. This was completed by a generic keyword search using the terms 'curriculum / curricula' within the journal publications. Table 3.8 illustrates that the main construction management journal with a strong focus on education is the '*International Journal of Construction Education and Research*,' with four journal articles identified in the database subset and 64 articles containing curriculum identification.

Table 3.8 – Top Construction Management Journals with 'Curriculum' Data Focus

Journal	**Publications (*f*)**	**Total Journal Publications (*f*)**	**'Curriculum' Keyword Search Publications (*f*)**	**Ratio of Curriculum to Total Publications (%)**
Journal of Professional Issues in Engineering Education and Practice	7	1,830	419	22.90%
International Journal of Construction Education and Research	4	355	64	18.03%
International Journal of Construction Management	3	721	15	2.08%
Journal of Construction Engineering and Management	3	3,924	33	0.84%
Structural Survey	3	1,303	12	0.92%
Architectural Engineering and Design Management	2	421	21	4.99%
Journal of Computing in Civil Engineering	2	1,806	16	0.89%
Journal of Engineering, Design and Technology	2	635	39	6.14%

Table 3.9 reveals that the top eight journals include a broad range of CiteScores (1.0 – 7.6 range), signifying interest from other academics seeking to advance knowledge in the subject

area. However, of these eight top journals, only one includes an 'education' category and interestingly, the journal with the highest percentage of the 'curriculum' keyword does not appear in the 'education' category. This may be because the journal is more 'industry' vis-à-vis 'education' focused. Only one journal is ranked in both 'building and construction' and 'education' categories, which is the *International Journal of Construction Education and Research*. This journal is on the lower end of the CiteScore impacts range (1.9), ranking below the 50th percentile in 'building and construction' and the 34th percentile in 'education' categories. This signifies that there is a notable void in influential construction management education publication outlets. Furthermore, of the authors within the database sub-set who published more than one article, only one has published in the *International Journal of Construction Education and Research*; this further indicates the lack of a global community of practice in construction management education curriculum development.

Table 3.9 – Top Construction Management Journals with CiteScore and Discipline Rankings

Journal	**Total Pub (*f*)**	**CiteScore – 2019 (No.)**	**'*Building and Construction*' Category Ranking (No.)**	**'*Education*' Category Ranking (No.)**
Journal of Professional Issues in Engineering Education and Practice	1,830	3.1	Not Ranked	Not Ranked
International Journal of Construction Education and Research	355	1.9	84 / 174	431 / 1,254
International Journal of Construction Management	721	4.1	33 / 174	Not Ranked
Journal of Construction Engineering and Management	3,924	5.8	19 / 174	Not Ranked
Structural Survey	1,303	1.0	80 / 155	Not Ranked
Architectural Engineering and Design Management	421	3.9	36 / 174	Not Ranked
Journal of Computing in Civil Engineering	1,806	7.6	Not Ranked	Not Ranked
Journal of Engineering, Design and Technology	635	1.5	Not Ranked	Not Ranked

Specific Articles

Within the subset database, the publications exhibit varying degrees of applicability to HECD for construction disciplines. Furthermore, five stand out as having a very specific prominent focus (refer to Table 3.10) that illustrates a complete lack of a global community of practice in the area. Specifically, all five articles are published in different journals, there are no duplicate authors, various regions are represented and there are no duplicate institutions noted.

Table 3.10 – Five Specific Construction Management Curriculum Development Publications

Publication	Author(s)	Date	Journal	Institution(s) and *Region*
Initial Assessment of a Newly Launched Interdisciplinary Construction Engineering Management Graduate Program	Clevenger, C.M. Brothers, H. Abdallah, M. Wolf, K.	2017	Journal of Professional Issues in Engineering Education and Practice	University of Colorado – *United States*
Building and Construction Students' Skills Development for Employability – Reframing Assessment for Learning in Discipline-Specific Contexts	Ruge, G. McCormack, C.	2017	Architectural Engineering and Design Management	University of Canberra – *Australia*
Education for Sustainability in Construction Management Curricula	Lim, Y.S. Xia, B. Skitmore, M. Gray, J. Bridge, A.	2015	International Journal of Construction Management	Queensland University of Technology – *Australia*
Establishing New Graduate Competencies: Purdue University's Construction Management Curriculum Restructuring	Benhart, B.L. Shaurette, M.	2014	International Journal of Construction Education and Research	Purdue University – *United States*
Promoting Sustainability Literacy in Construction Students: Implementation and Testing of a Curriculum Design Model	Cotgrave, A.J. Kokkarinen, N.	2011	Structural Survey	Liverpool John Moores University – *United Kingdom*

DISCUSSION AND THEORY DEVELOPMENT

There are numerous practical applications of the results for both the HECD and construction management disciplines in particular. The prevailing HECD landscape depicts key regions, authors and publication outlets that are significant to curriculum development, but curriculum development per se is not clearly delineated in its own right. Rather, it is often intertwined with other discipline specific contexts (such as health professions, the social sciences and business). Even then, there is a notable lack of cohesion between disciplines at a macro (cross discipline) level, with individuals working in a largely isolated manner at a micro (institutional level) *vis-à-vis* sharing best practice via published research. Curriculum development clearly occurs (the notion of otherwise would be ridiculous) but anecdotal evidence suggests that the science behind the existing *modus operandi* supporting approaches adopted are rarely robustly advanced or tested in published research. For construction management disciplines, the much smaller and blurred curriculum development focus is further exacerbated by the lack of a notable global community of practice working in this distinctive and applied area of science. Hence, this mirrors the broader contextualisation of HECD literature. A global community of practice envisaged would include collaboration between stakeholders such as: professionals upholding quality standards; practitioners informing programme content; professional bodies approving programme design; but also, academics who are vigorously testing and evaluating the success or otherwise of their curriculum development process – perhaps using action research (cf. Edwards *et al.,* 2020) and publishing the results. Referee scrutiny in the publication process would further validate the research and publications would assist in dissemination of best practice (or perhaps practices to avoid) within the wider community – something that is currently not occurring in sufficient volume to engender a meaningful discourse.

Construction management curriculum development represents a sliver of the engineering discipline, which itself is only a small percentage of the overall HECD dialogue. From a duration and time standpoint, construction management research ebbs and flows without a clear path, albeit in an upward trend and often with low volumes of publications per annum. The first publication identified (Oglesby, 1990) was published decades after such programmes were recognized. Such indicates that bespoke programmes are developed from an individualistic (module tutor or programme leader) perspective with some influence from professional bodies (such as the CIOB or Royal Institute of Chartered Surveyors (RICS)) who may prescribe broad content. Furthermore, the range of authors discussing curriculum development is wide, yet extremely shallow in terms of the number of publications produced. An overwhelmingly significant portion of the authors published only one article in the field of study, signifying a 'drop-in/fly-by' approach to the subject and indicating a severe absence of a dedicated and/or consistent research effort. Moreover, the publication outlets for construction management are broad, yet those for construction management *education* are very narrow and compounded by the low overall ranking and impact, which further signifies the lack of focus, attention and importance of this field of study. Curriculum provides the very financial basis upon which HEIs are premised, so one would have intuitively presumed that research in this area would have been far more extensive.

The enigmatic dearth of curriculum development in a construction context is in stark contrast to a sector that is grappling with an inflow of new disruptive technologies and concepts that are radically transformative, for example: off-site manufactured modular construction (Nazir *et al.,* 2020); and digitally enabled industry 4.0 which embraces aspects of automation, artificial intelligence, bid data and the internet of things (cf. Edwards *et al.,* 2017; Newman *et al.,* 2020; Sepasgozar *et al.*, 2020). The sheer pace of innovative technological development is outstripping taught materials in the classroom and has led to the conceptualisation of a new theoretical notion of '*autoregressive curriculum development*' – that is, current educational provisions that are based upon an historical context and lack modernity. This new theory is born out of the lead researcher's own experiences as a practicing HEI tutor and is supported by the literature uncovered in this present study. Future research will be required to test this theory using deductive reasoning (cf. Aghimien *et al.,* 2020) to determine the extent to which the classroom lags behind practice on site and the needs of practitioners.

Since the landscape of construction management education curriculum development is disconnected and lacking in cohesion, future applied research set within case studies of HEIs will be needed to clarify and provide general direction for the field. Such work should aspire to analyse curriculum content and interview staff and other actors (such as professional bodies and those upholding quality standards) who develop programmes to better understand the rationale for those designs (in terms of content purpose, students' skills acquired etc.) and how the process is implemented in HEIs. Linked to the aforementioned, new HECD theories must be developed to guide future curriculum design and establish robust benchmarks for best practice (for student interpersonal and technical skills) that provide optimised avenues for student employability in the discipline. Anecdotal evidence suggests that although some HEIs boast high employability levels, many of the jobs secured by graduates outside of the discipline indicate either a volatile job market or an inappropriate set of graduate skills acquired. Future work is needed to test the validity of these claims, excoriate the employability conundrum and more accurately measure how many construction students secure a construction job.

CONCLUSIONS

Curriculum development research within HEIs is a disconnected assortment of intertwined disciplines, drop-in commentaries and broadly non-cohesive. This is evident in the failure to identify leading and key authors and global communities of practice engaged in this research. This setting is replicated and notably exacerbated within the construction management education domain, perhaps due to the lack of a recognisable body or centre of excellence championing research in the field.

This chapter has revealed that due to a lack of research on curriculum development, curricula may be growing organically and/or at the whim of individual programme leaders and/or module instructors within these programmes. It is suspected that there is a natural disposition for these individuals to write material that best reflects their historical knowledge and experience of the sector vis-á-vis contemporary methods that are at the cutting edge of practice – so called 'knowledge stagnation' that reflects the theory of '*autoregressive curriculum development*' proposed in this present research. This phenomenon (if proven via future deductive reasoning) may raise calls for more regular mini-sabbaticals for academics to periodically work in industry in order to maintain their contemporary knowledge and experience and subsequently take this back into the classroom. At present, students may be receiving an education from the past, obtained from textbooks or now distant workplace experience. These suspicions will require inputs from both staff and students on how best the curriculum maps industry requirements and the concomitant need to increase student employability. Part-time students perhaps offer an ideal opportunity to do this because many are already employed in the sector and can best reflect on whether their classroom experience fulfils industry needs.

It is apparent that the government and professional bodies rarely connect to devise optimum courses that are best fit for the classroom and if such work does occur, then it curiously lacks a scientific basis even though HEIs are the bastion of academic pursuit. Building upon this, there is a need to engender collaborative discourse amongst all sector stakeholders to ensure future educational provisions meet the industry demands of key knowledge, skills and attributes and also ensure that staff are adequately trained, motivated and remain at the cutting edge of practice.

Undergraduate and postgraduate students represent the future of any productive economy worldwide. It is logical to assume that a coalescence of key skills in a university setting will produce higher quality, more competent professionals to drive economies forward. If the sector does not vigorously engage in the scientific development of curricula (in additional to traditional approaches already adopted e.g., programme accreditation and validation), then it risks programmes becoming tangential to industry practice and in some respects, course content may become irrelevant or woefully dated. In conclusion, it is hoped that this work engenders wider polemic debate in this field of curriculum development science as programme relevance to industry practice should be at the heart of every HEI that seeks to deliver qualified graduates to the sector.

CHAPTER 4

DEVELOPMENT OF A CONCEPTUAL CONSTRUCTION MANAGEMENT CURRICULUM MODEL GROUNDED IN SCIENTOMETRIC ANALYSIS

INTRODUCTION

Despite the significant influx of automation and digitisation, at its core, the construction industry is a human-skilled discipline. An individual's knowledge, skills, abilities and competencies are fundamental to the success of the industry. According to the latest figures from the Office of National Statistics there are close to 291,000 construction firms employing approximately 1.28 million people in the UK (Office of National Statistics, 2021a). Whilst many of the priorities of the UK Government's Construction 2025 Strategy focus on the technological nature of the industry, the method for delivery is firmed rooted in the human side of the discipline: people, leadership, formal education/training and image of the discipline (HM Government, 2013). However, the same report identifies the lack of adequate training as a significant threat to the UK construction industry. Therefore, the importance of appropriate, focused and relevant education is paramount, not only to the current economy, but also to future economic and strategic endeavours.

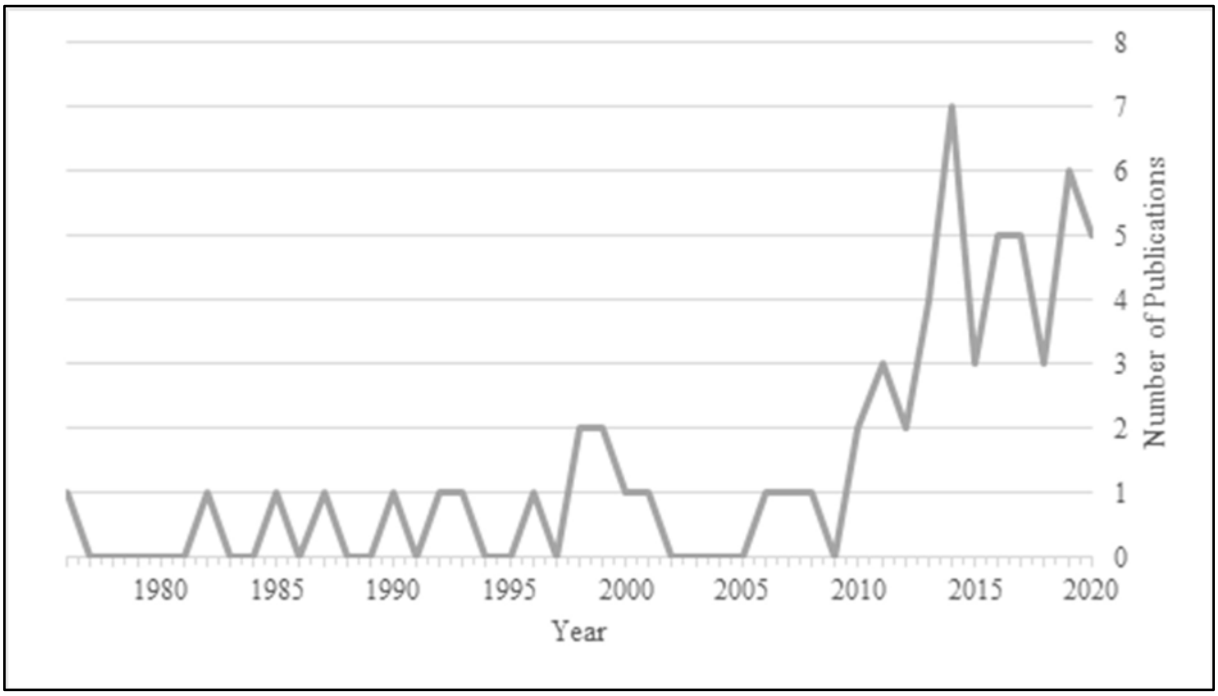
CMPs within HEIs are relatively new, technical-based programmes that emerged out of the post-war era need to rebuild infrastructure and assist in economic recovery (Charted Institute of Building, 2021a; Howell *et al.*, 2011). Similar to most technical-based disciplines, focus on industry practice and traditional academic rigour is sought, specifically the technical skills proficiency and interpersonal skills required to meet industry expectations (Magano *et al.*, 2020; Posillico *et al.*, 2021b). Consequently, curricula provide roadmaps and guidelines, indicating important content areas and educational themes that ultimately prepare students for an industrial career. Curriculum development is therefore essential to the success of students and programmes alike, yet curiously no established community of practice exists within the construction management education discipline. Specifically, the current CMCD landscape is fragmented across a disparate array of bespoke programmes developed by individual higher education establishments. Metaphorically, this landscape is akin to the train company timetables of the 19th and early 20th centuries: insular, largely non-communicative with other companies and without regard for the passengers (Crafts *et al.*, 2008; Esbester, 2009). Consequently, this present thesis argues that CMCD is progressing unharmoniously and without a unifying community of practice, which leads to poor comparability between alternative provisions and a lack of consistency in content.

Against this contextual backdrop, this chapter seeks to conduct a scientometric analysis of pertinent CMCD literature (in the spirit of *Bradshaw's Railway Companion* (Barrows, 2010)) in order to develop a unifying conceptual model and thereby offer a minimum baseline for curriculum development. Associated chapter objectives are to: reinvigorate wider academic debate in this important area that ultimately funds higher education research; contribute to improving the consistency of construction management provisions; and stimulate new insight into contemporary construction management educational practice.

RESULTS FOR SNOWBALL SAMPLING OF CONSTRUCTION MANAGEMENT CURRICULUM DEVELOPMENT LITERATURE

An inconsistent yet upward increase in published research is evident; however, this increase is minute given a maximum of only seven publications in a single year (refer to Figure 4.1). The earliest publication (Dietz Albert and Litle William, 1976) corresponds, albeit loosely, to the advent of construction management degrees in the 1950s through the 1970s (Hauck, 1998; Yang and Chang; 1998). With only one relevant publication (Dietz Albert and Litle William, 1976) towards the latter end of construction management degree development, it does underscore the lack of research and publication undertaken in this area.

Figure 4.1 – Publications by Year for 'Construction Management Subset'



Regions

The top three nations publishing CMCD research in ascending order are the USA, Australia and the UK, together representing $f = 62$ out of 83 (74.69%) of the publications (Table 4.1).

However, the USA has published an overwhelming majority of the total publications (*f* = 38 or 45.78%). The same three nations also host the highest number of different universities engaged in CMCD research. As Table 4.1 illustrates, the USA, Australia and the UK represent *f* = 46 of the 65 (70.77%) of the universities present in the snowballed database. However, when looking at each university and the number of publications associated with that university, there is a more scattered, disjointed view. For example, of the 26 different USA universities noted in the snowballed database, only six (23.07%) universities have more than one publication. A similar result is noted in Australian (*f* = 3 or 23.07%) and UK universities (*f* = 1 or 9.09%). This may demonstrate and substantiate the notion that there is no leading or 'go-to' university or set of universities for CMCD.

Table 4.1– Nations Represented in Snowballed Database with Publications and Universities

Country	Publications (*f*)	Percentage of Database (%)	Universities (*f*)	Percentage of Database (%)
United States of America	38	45.8%	26	40.0%
Australia	13	15.7%	10	15.4%
United Kingdom	11	13.3%	10	15.4%
South Korea	3	3.6%	3	4.6%
Spain	3	3.6%	3	4.6%
Israel	3	3.6%	1	1.5%
Canada	2	2.4%	2	3.1%
Peoples Republic of China	2	2.4%	2	3.1%
Columbia	1	1.2%	1	1.5%
Kingdom of Saudi Arabia	1	1.2%	1	1.5%
New Zealand	1	1.2%	1	1.5%
Pakistan	1	1.2%	1	1.5%
Poland	1	1.2%	1	1.5%
Republic of South Africa	1	1.2%	1	1.5%
Singapore	1	1.2%	1	1.5%
Turkey	1	1.2%	1	1.5%

Authors

Of the 147 different authors noted, *f* = 136 (92.52%) have a single publication with only eleven (7.48%) having two or more publications, further indicating that a 'leading authority' in CMCD cannot be identified. Of the eleven authors with two or more publications, seven (63.64%) of them exhibit an author-co-author relationship, which infringes upon the quantity of author publications frequency. Consequently, there are only four authors with two or more publications (a high of three publications), which reinforces that there is a lack of author leadership. Interestingly, one author (Hauck) had the highest quantity of publications (three) and was the only multiple publication author to publish solo. However, the timespan of the three publications was only two years and publications were at the turn of the century (1998-1999). This indicates a potential lack of modernity and relevance in modern CMCD, which embraces an eclectic range of contemporary topics ranging from sustainable development (Owusu-Manu *et al.,* 2020c) through to automation (Edwards *et al.,* 2019) and digital construction (Sepasgozar *et al.,* 2020).

Journals

Within the snowballed database, f = 26 different journals were identified. Thirteen of these journals included two or more publications, which represented f = 50 articles or 79.37% of the total publications. The top thirteen journals were reviewed granularly to determine the frequency and focus of construction management curriculum using a generic keyword search via the terms 'curriculum/curricula'. Table 4.2 illustrates that the main construction management journal with a strong focus on education is the *International Journal of Construction Education and Research*, which noted eight journal articles identified in the snowballed database. Two other notable journals were the *Journal of Professional Issues in Engineering Education and Practice*, with ten journal articles identified in the snowballed database and f = 419 (22.90%) containing curriculum identification and the *International Journal of Engineering Education,* with two journal articles identified from the snowballed database and 1,514 (45.73%) articles containing curriculum identification. Whilst the latter two journals do represent a higher percentage and journal article frequency than the *International Journal of Construction Education and Research*, the main focus of the two journals is general engineering education, rather than construction management education, a different subject discipline. Table 4.2 also identifies the CiteScores range (1.0 – 7.6) for the top thirteen journals; this records interest from other academics seeking to advance knowledge in the subject area (Zijlstra and McCullough, 2016). With regard to an 'education' category, just two of the thirteen journals are represented. Only one journal is ranked both in the 'building and construction' and 'education' categories, which is the *International Journal of Construction Education and Research*. This journal is on the lower end of CiteScore's impact range (1.9), ranks below the 50th percentile in 'building and construction' and the 34th percentile in 'education' categories. This could highlight a void in influential construction management education publication outlets in this field of science or it could indicate scant academic appetite to study this subject – maybe due to a lack of tangible impact for research assessment purposes? Future research will be required to investigate the reasons for this observed paucity in research.

Specific Articles

Within the snowballed database, publications inevitably have varying degrees of applicability to CMCD, albeit ten stood out (refer to Table 4.3). These articles were largely conducted in isolation to each other and were published in nine different journals; just one journal (*International Journal of Construction Education and Research)* being represented more than once. Furthermore, there are no duplicate authors represented in the ten publications. Cumulatively, these observations could signal a lack of a cohesive community of practice in the area.

Of the five regions represented within the specific articles, the USA has a clear frequency majority, which is unsurprising given that the USA accounted for f = 38 publications, or 45.80% of the database. Whilst this may suggest that the USA is a leading authority or a leading contributor to CMCD, closer attention may prove otherwise. Specifically, of the six publications associated with the USA, eleven different universities are noted only one of which is a duplicate (Colorado State University). However, the time span between the 'Colorado State University' publications is quite large (1998 – 2017). Again, further reinforcing the notion of a disjointed, scattered and frictionless community of practice for CMCD research.

Table 4.2 – Top Construction Management Journals with 'Curriculum' Data Focus

Journal	**Snowballed Publications (*f*)**	**Total Journal Publications (*f*)**	**'Curriculum' Keyword Search Publications (*f*)**	**Ratio of Curriculum to Total Publications (%)**	**CiteScore – 2019 (No.)**	**'*Building and Construction*' Category Ranking (No.)**	**'*Education*' Category Ranking (No.)**
Journal of Professional Issues in Engineering Education and Practice	10	1,830	419	22.90%	3.1	Not Ranked	Not Ranked
Journal of Construction Engineering and Management	9	3,924	33	0.84%	5.8	19 / 174	Not Ranked
International Journal of Construction Education and Research	8	355	64	18.03%	1.9	84 / 174	431 / 1,254
International Journal of Construction Management	3	721	15	2.08%	4.1	33 / 174	Not Ranked
Journal of Information Technology in Construction	3	588	33	5.61%	3.6	42 / 174	Not Ranked
Structural Survey	3	1,303	12	0.92%	1.0	80 / 155	Not Ranked
Architectural Engineering and Design Management	2	421	21	4.99%	3.9	36 / 174	Not Ranked
International Journal of Engineering Education	2	3,311	1,514	45.73%	1.9	Not Ranked	413 / 1,254
Journal of Computing in Civil Engineering	2	1,806	16	0.89%	7.6	Not Ranked	Not Ranked
Journal of Construction Education	2	Journal discontinued (1996 – 2003) Continued as *International Journal of Construction Education and Research*					
Journal of Engineering, Design and Technology	2	635	39	6.14%	1.5	Not Ranked	Not Ranked
Journal of the Construction Division	2	Journal discontinued (1971 – 1982) Continued as *Journal of Construction Engineering and Management*					
Practice Periodical on Structural Design and Construction	2	1,003	11	1.10%	1.1	112 / 174	Not Ranked

Table 4.3 – Ten Specific Construction Management Curriculum Development Publications

Publication	Author(s)	Date	Journal	Institution(s) and *Region*
Catching up with BIM: a curriculum re-design strategy.	Açikgöz, E.K.	2018	International Journal of Contemporary Urban Affairs	Başkent University – *Turkey*
Initial assessment of a newly launched interdisciplinary construction engineering management graduate program.	Clevenger, C.M., Brothers, H., Abdallah, M. and Wolf, K.	2017	Journal of Professional Issues in Engineering Education and Practice	University of Colorado – *United States*
Building and construction students' skills development for employability – reframing assessment for learning in discipline-specific contexts.	Ruge, G. and McCormack, C.	2017	Architectural Engineering and Design Management	University of Canberra – *Australia*
Education for sustainability in construction management curricula.	Lim, Y.S., Xia, B. Skitmore, M., Gray, J. and Bridge, A.	2015	International Journal of Construction Management	Queensland University of Technology – *Australia*
Key attributes and skills for curriculum improvement for undergraduate construction management programs.	Ahmed, S.M., Yaris, C., Farooqui, R.U. and Saqib, M.	2014	International Journal of Construction Education and Research	East Carolina University and Florida International University – *United States* NED Engineering University – *Pakistan*
Establishing new graduate competencies: Purdue University's construction management curriculum restructuring.	Benhart, B.L. and Shaurette, M.	2014	International Journal of Construction Education and Research	Purdue University – *United States*
The pace of technological innovation in architecture, engineering and construction education: Integrating recent trends into the curricula.	Becerik-Gerber, B., Gerber, D.J. and Ku, K.	2011	Electronic Journal of Information Technology in Construction	University of Southern California and Virginia Tech – *United States*
Promoting sustainability literacy in construction students: implementation and testing of a curriculum design model.	Cotgrave, A.J. and Kokkarinen, N.	2011	Structural Survey	Liverpool John Moores University – *United Kingdom*
Construction engineering and management undergraduate education.	Abudayyeh, O., Russell, J., Johnston, D. and Rowings, J.	2000	Journal of Construction Engineering and Management	Western Michigan University; University of Wisconsin; North Carolina State University and Iowa State University – *United States*
Construction management curriculum reform and integration with a broader discipline: A case study.	Hauck, A.J.	1998	Journal of Construction Education	Colorado State University – *United States*

Citation Documents

Table 4.4 denoted VOSviewer's visualisation parameters and Figure 4.2A presents a density visualisation map which focuses on the number of times authors cite one another. From the visualisation, there is a connected group revolving around 'Becerik-Gerber *et al*. (2011)' and another around 'Russell (2007), Tener (1996) and Tatum (1987).' The remaining publications lack shared author citation which is represented by the polka dot separation pattern in the visualisation map. Publications associated with the two groups are also over a decade old and may not reflect current practice. This again underscores the contention that fragmented research studies have been largely conducted in isolation of each other.

Figure 4.2B is a pinpointed view of a network visualisation map of the citation documents noted in Figure 4.2A, specifically of the 'Becerik-Gerber *et al.* (2011)' density group. This pinpointed view provides further insight into the largest group where it can be observed that two clusters exist, represented by the colours red and green. The red cluster represents publications that are predominately curriculum focused and the green cluster represents publications that are BIM focused. BIM inclusion primarily results from an academic trend towards integrating digitalisation and technology into educational materials and pedagogy (Besné *et al*., 2021; Khan, *et al*., 2021; Zhao, 2021). 'Becerik-Gerber *et al.* (2011)' is the link between the two clusters, however, only three curriculum publications have a direct citation link and only two BIM publications.

Figure 4.2C is a pinpointed view of a network visualisation map of the citation documents noted in Figure 4.2A, specifically of the 'Russell (2007), Tener (1996) and Tatum (1987)' density group. The group's overall theme hinges on the relevance and relationship of engineering disciplines within construction management, with small nuances between the three clusters. The links between the clusters are minimal and weak with just one publication in each cluster acting as this link. Consequently, while these groups may appear to be representing areas of relatedness and connectedness, upon closer inspection any relationships are tenuous.

Table 4.4 – VOSviewer Visualisation Parameter Information

Name	Visualisation Description	VOSviewer Visualisation Type	Type of Analysis	Unit of Analysis	Counting Method	Minimum Number of Occurrences	In Text Figure Reference
Citation Documents	Number of times authors cite one another	Density	Citation	Documents	Full Counting	10 [31 documents met the threshold]	4.2A
Citation Documents	Number of times authors cite one another	Network	Citation	Documents	Full Counting	10 [31 documents met the threshold]	4.2B and 4.2C
Co-Citation Cited References	Number of times authors are cited together	Density	Co-citation	Cited Reference	Fractional Counting	2 [12 cited references met the threshold]	4.4
Bibliographic Coupling Documents	Number of references journal articles share	Density	Bibliographic Coupling	Documents	Fractional Counting	20 [16 documents met the threshold]	4.5A
Bibliographic Coupling Documents	Number of references journal articles share	Network	Bibliographic Coupling	Documents	Fractional Counting	20 [16 documents met the threshold]	4.5B
Co-occurance All Keywords	Number of documents in which keywords occur together	Network	Co-occurance	All Keywords	Fractional	5 [19 keywords met the threshold]	4.6
Co-occurance All Keywords	Number of documents in which keywords occur together	Density	Co-occurance	All Keywords	Fractional	5 [19 keywords met the threshold]	4.7

Figure 4.2A-C – VOSviewer Density Diagram and Network Visualisation Maps for Citation Documents

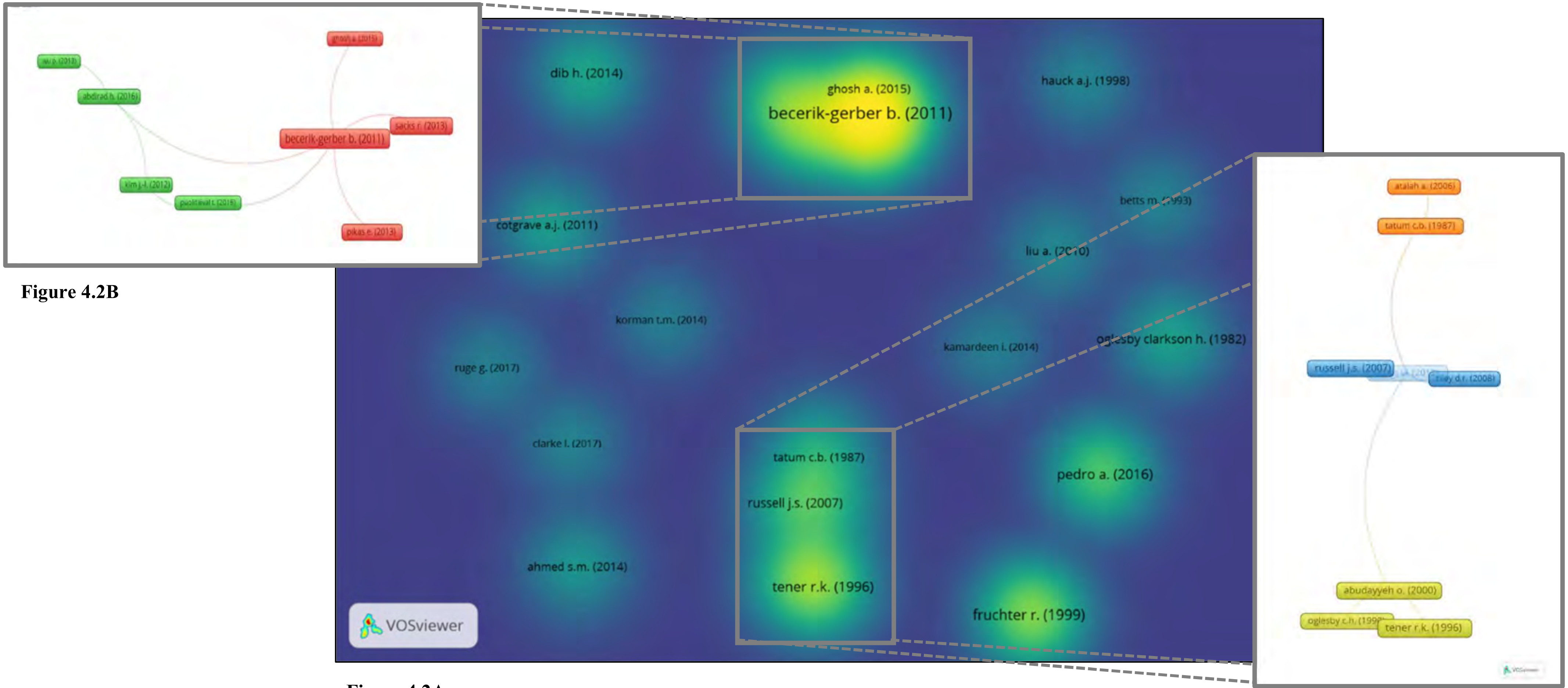


Figure 4.2B

Figure 4.2A

Figure 4.2C

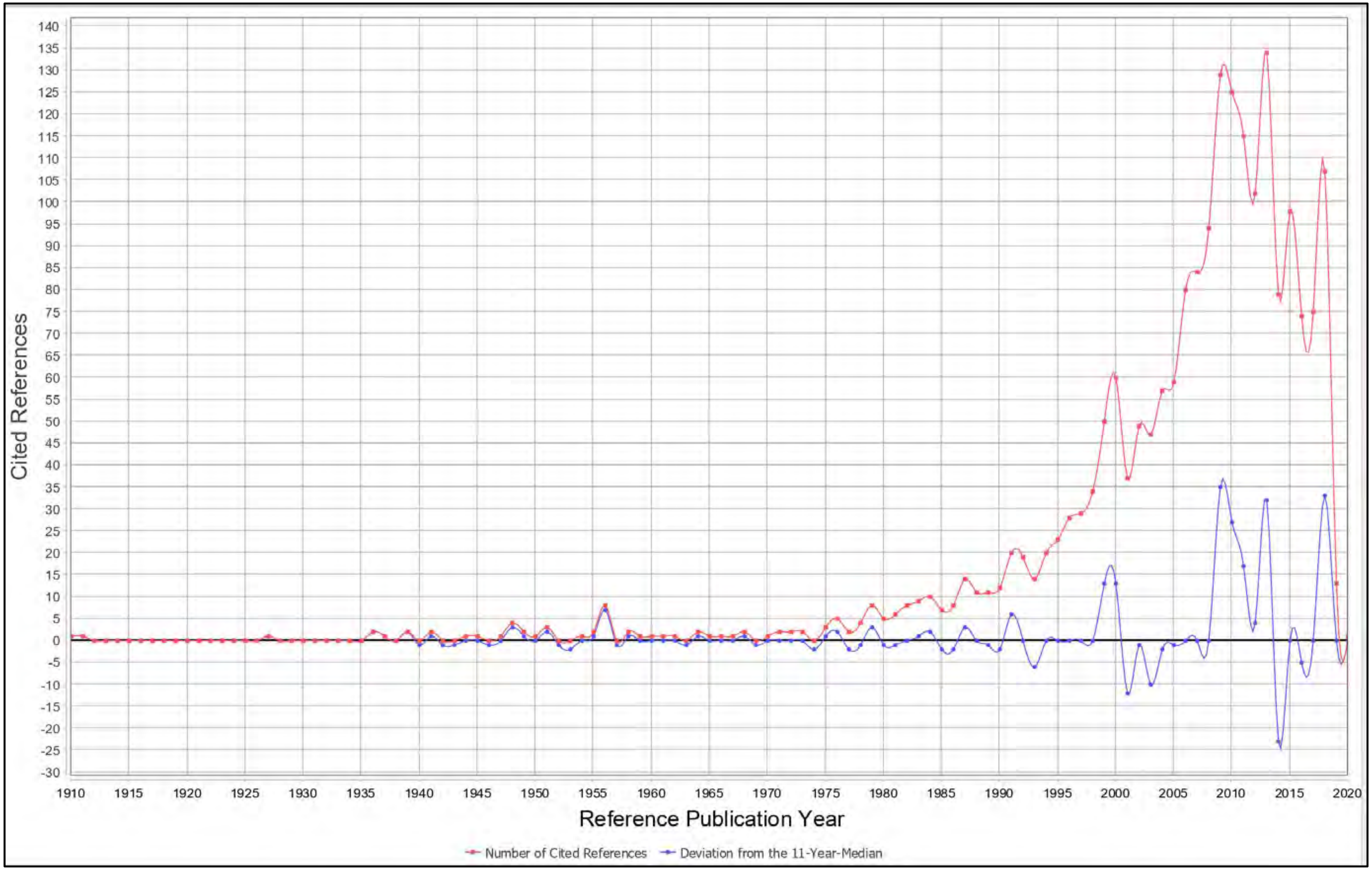
Cited References

Figure 4.3 is a longitudinal graph, created in CRExplorer, plotting the frequency and dates of cited references from the CMCD database. Whilst authors did reference publications from the first quarter of the 20^{th} century, yearly consistency in publication references did not take hold until 1935. This frequency (high of 8) kept consistent until 1984 when cited references began to increase in a loose, linear fashion. However, towards the late 1990s the trend began increasing in frequency and time, with a slightly exponential trend. Seemingly similar to Figure 4.1, which plots the frequency of publications by year of the CMCD database, Figure 4.3 exudes much more consistency with an increase in cited references. However, the trend peaks in 2013 (134 cited references) with a dramatic decrease until 2020. This appears to indicate that 2013 was a peak year for the publication of CMCD development research, which does align with the overall frequency of publication dates in the CMCD database. Specifically, 2014 noted seven publications (the largest quantity by year in the database), which, if authors were utilising and referencing recent research (i.e., the year 2013), would evidence a similar increase in the quantity of cited references. However, the drastic fall off of research in the last seven years (2013 – 2020) is indicative of a lack of focus or high research interest, which is mirrored in the downward trend in publication count noted in Figure 4.1.

Co-Citation Cited References

Figure 4.4 is a density visualisation map which focuses on the frequency that authors are cited together. From the visualisation, there are five groupings of co-citations, with a total of twelve citations. The largest grouping of 'Connor and Davidson (2003)' consists of four co-citations and the second largest grouping of 'Milosevic *et al*. (2007)' consists of three co-citations; both groups noting co-citations with latest publication dates of a decade old. The remaining three groupings had less than three co-citations. Not only from a visual standpoint is there a lack of connectedness between groups of co-citation, but also the quantity of co-citations is quite low. Whilst groups of authors are co-citing each other, the lack of any 'cross-over,' where authors are referencing other academics in different 'groups', reinforces the notion of individual, silo and insular practices in CMCD.

Figure 4.3 – CRExplorer Cited References Graph



Bibliographic Coupling Documents

Figure 4.5A presents a density visualisation map which focuses on the number of references that journal articles share. From the visualisation, the 'Becerik-Gerber *et al*. (2011)' group has a large presence. However, a polka dot scattered pattern is also present with non-existent links between the 'Becerik-Gerber *et al*. (2011)' group and the other six groupings.

Figure 4.5B is a pinpointed view of a network visualisation map of the bibliographic coupling documents noted in Figure 4.5A, specifically of the 'Becerik-Gerber *et al*. (2011)' density group. This pinpointed view provides further insight into the largest group where it can be observed that three clusters exist, represented by the colours red, green and blue. The overall theme of this group is the incorporation of BIM and technology into construction management education with small nuances between the three clusters. Unlike previous visualisations, there is a greater connectivity within the group, as represented by the numerous links between publications. However, similar to the other visualisations, the interconnectedness is isolated to one group - indicative of a lacking community of practice. Furthermore, the date range of this group [2011 – 2016, with an outlier of 2007] is again somewhat dated and alludes to a snapshot view of CMCD rather than a sustained longitudinal focus. Reasons for this may be due to the increased attention BIM received in the educational sector around this timeframe (Ghosh *et al*., 2015; Puolitaival and Forsythe, 2016; Zhao *et al*., 2015).

Figure 4.4 – VOSviewer Density Diagram for Co-citation Cited References

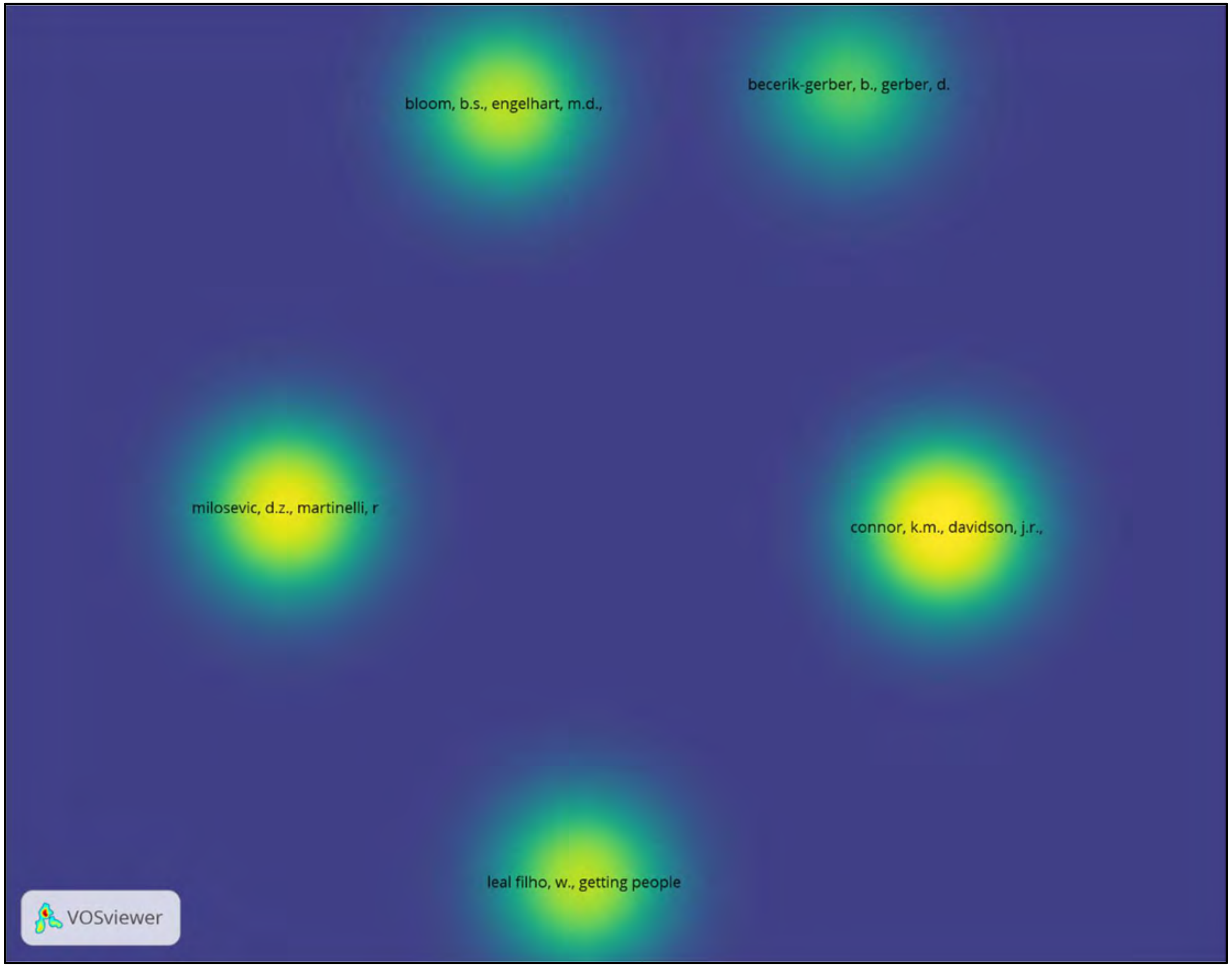


Figure 4.5A-B – VOSviewer Density Diagram and Network Visualisation Map for Bibliographic Coupling Documents

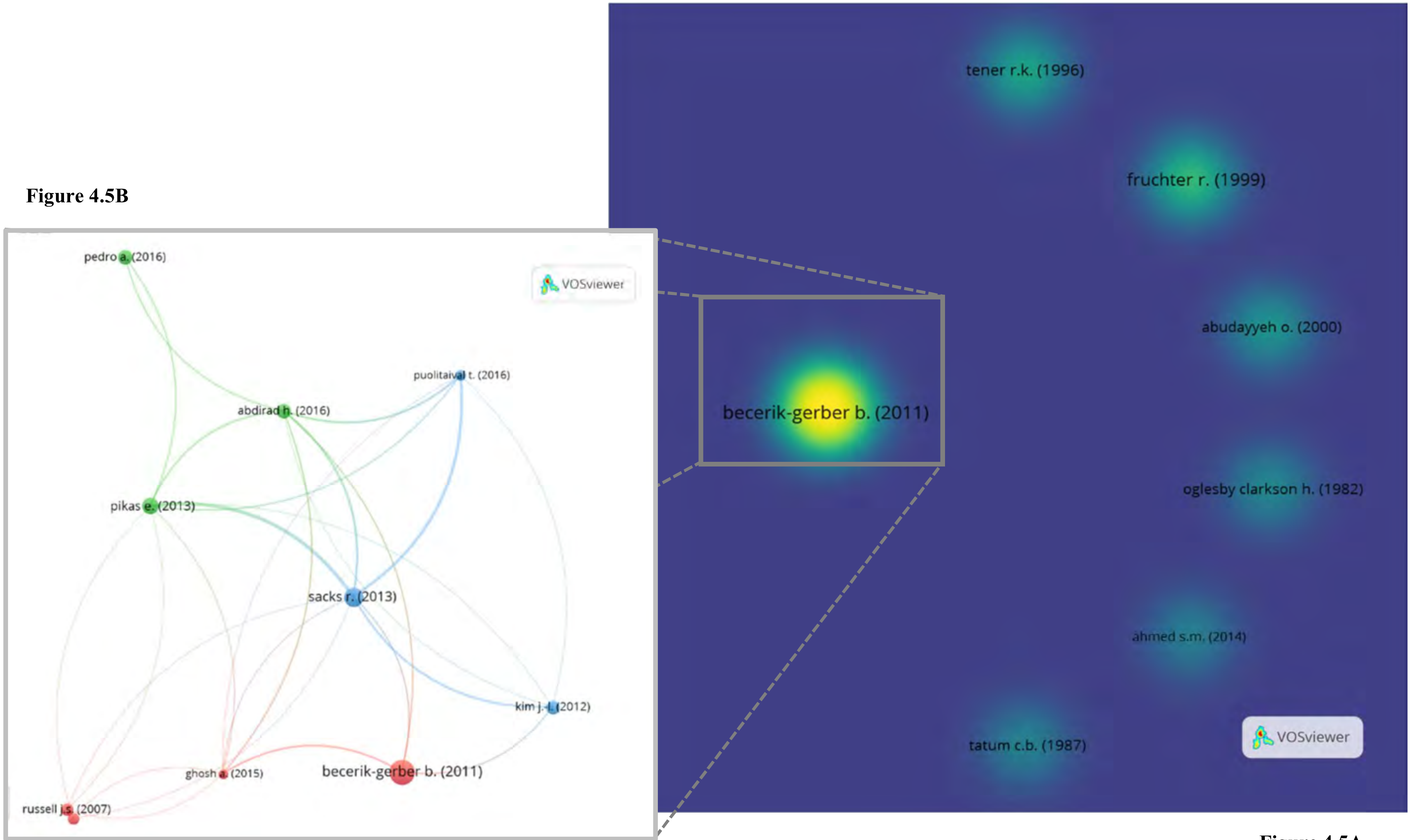


Figure 4.5B

Figure 4.5A

Co-occurrence All Keywords

Figure 4.6 is a network visualisation map which focuses on the number of documents in which keywords occur together. Of the $f = 435$ keywords noted, only nineteen (4.38%) of these were repeated five or more times (Table 4.6). This low percentage of keyword frequency also supports the lack of a defined community of practice in CMCD. Specifically, the authors do not have a defined vernacular. From a linguistics standpoint, Steels (2011) notes that as individuals begin coordinating their language systems (i.e., vocabulary) through alignment and arrangement, groups emerge that use the newly 'arranged' language. As demonstrated in the keyword frequency, the authors only use aligned keywords less than 5.00% of the time, which alludes to a lack of unity within the group of authors.

Four clusters of keywords are apparent from the network diagram as represented by the colours red, blue, green and yellow. Whilst each cluster is different, the four clusters can be divided into two general themes. Referencing Table 4.5, the red and blue clusters appear to have a general theme of education and the internal factors influencing a higher education environment (i.e., curricula, students, teaching and education). The green and yellow clusters are more aligned with the construction or built environment industry and the external factors influencing a technical course of study in a HEI (i.e., construction industry, construction management, project management and professional aspects).

Figure 4.6 presents an interconnected web of key word linkages, with a key word from one cluster being connected to keywords from the other three clusters as further emphasised by the $f = 272$ total cluster links between the four clusters in Table 4.5. However, in further examining the keyword metrics, there does not appear to be a dominant set of keywords. Specifically, as Table 4.5 notes, keyword *occurrences* depict a median of 9 with an average of 11.26; keyword *links* depict a median of 14 with an average of 14.32; and keyword *link strength* depicts a median of 9 with an average of 10.79. This represents an even spread of keyword metrics throughout the set.

Figure 4.6 – VOSviewer Network Visualisation Map for Co-occurrence All Keywords

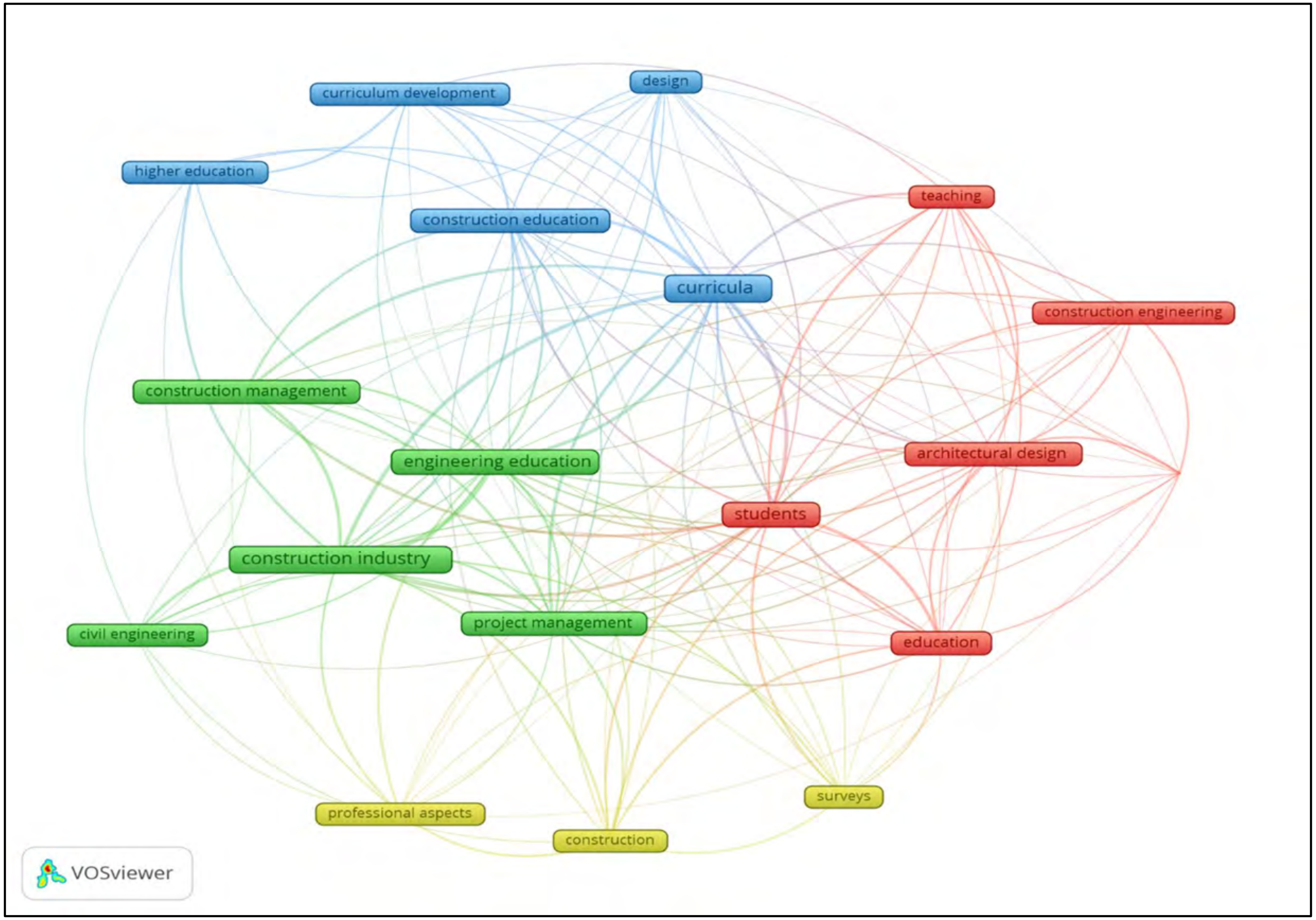


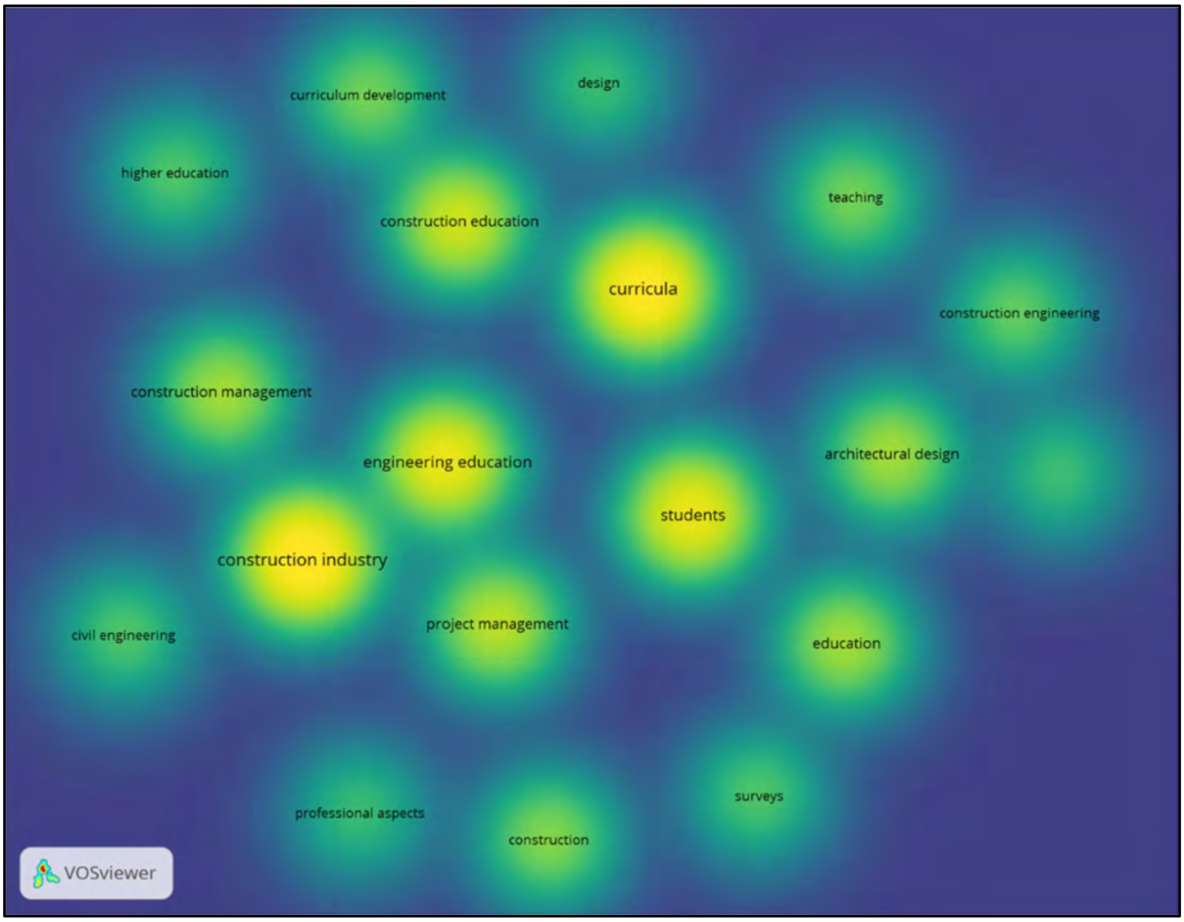
Table 4.5 – Keywords Identified Within Clusters

Cluster Theme	Cluster Colour	Keyword(s)	Occurrences (*f*)	Links (*f*)	Link Strength (No.)	Cluster Total Occurrences (*f*)	Cluster Total Links (*f*)	Cluster Average Link Strength (No.)
Internal Factors	Red	Students	19	17	19	61	89	10.00
		Education	11	16	11			
		Architectural Design	11	16	11			
		Teaching	8	14	8			
		Construction Engineering	7	13	6			
		Building Information Model – BIM	5	13	5			
	Blue	Curricula	24	18	24	58	68	10.40
		Construction Education	15	15	12			
		Curriculum Development	8	12	6			
		Higher Education	6	8	5			
		Design	5	15	5			
External Factors	Green	Construction Industry	26	17	25	75	76	14.60
		Engineering Education	19	18	19			
		Project Management	13	17	13			
		Construction Management	11	13	11			
		Civil Engineering	6	11	5			
	Yellow	Construction	9	13	9	20	39	6.67
		Surveys	6	13	6			
		Professional Aspects	5	13	5			
		Median	9	14	9			
		Average	11.26	14.32	10.79			

Additionally, examining keywords in aggregate (per cluster), demonstrates little difference between the clusters in terms of total keyword occurrences, total keyword links and average keyword link strength. Furthermore, whilst one cluster may have the largest total keyword occurrences of the clusters (green cluster), another may have the largest number of keyword links (red cluster), indicating a lack of a dominant cluster.

When visualisation of the same data is changed from a network diagram to a density diagram (shown in Figure 4.7), the lack of a dominant keyword is pronounced. This density diagram displays a gradient of colour to indicate the strength of connectedness between items, in this example keywords. Whilst the intensity of warm colours varies slightly, the more important aspect to note is the cooler (blue) colours that distinctly separate the keywords, similar to a polka dot pattern. There are very few, if any, warm colours intersecting to form an engrossed grouping of keywords. This indicates that whilst there are common linkages between the keywords, these links are tenuous, further reinforcing and bolstering the results noted in Figure 4.3A.

Figure 4.7 – VOSviewer Density Diagram for Co-occurance All Keywords



CONCEPTUAL MODEL OF CURRICULUM DEVELOPMENT IN CONSTRUCTION MANAGEMENT CONTEXT

The lack of a coherent community of practice on CMCD is conspicuous by its absence and various reasons may be apparent for this, for example, the knowledge boundaries of an individual programme leader driving a curriculum design that fails to extend these boundaries. Additional work is needed to further explore this phenomenon in greater detail. So, in an attempt to progress knowledge forward, literature analysis (Chapters 3 and 4), anecdotal evidence and the personal experiences of the authors (in CMCD) are used as the premise for the conceptual model development. Within the classrooms and campuses of HEIs, generic and bespoke forces push, pull, twist and exert their influence on CDCM. Regardless of the type of business or sector, *internal forces* are present and can cause both positive and negative disruption. Whilst the HEI sector is unique in a host of ways (e.g., structure, purpose, customer base and societal impact), it is also similar to traditional business organisations which are subject to the internal forces of overheads and profit margins, human resource efforts and marketing advancements. Other more specific internal forces include: course leadership experience; a sense of academic individuality; staff research skills; the university itself; and student enrolment and retention. Similarly, just as *internal forces* exert their influence within the classrooms of HEIs, so too do *external forces*, albeit on the outside walls of the classroom. External forces are omnipresent and shape, both positively and negatively, courses of study in HEIs. Typical external forces include: programme accreditation and their subsequent competency requirements and education frameworks by professional bodies; periodic internal reviews of curricula; and in the UK, the Teaching Excellence Framework (TEF), Research Excellence Framework (REF) and the Condition B3 of the Office for Students' (OfS's) regulatory framework.

Table 4.6 displays a representation of significant *internal* and *external factors* affecting a construction management course in an HEI, whilst Figure 4.8 presents the conceptual model characterised as a building where student 'skills and competencies' (technical and interpersonal) provide the foundation for CMCD, which must withstand both internal and external forces. The extent to which each of these forces interacts with each other amplifies or nullifies each other and/or impacts most upon the CMCD requires further research.

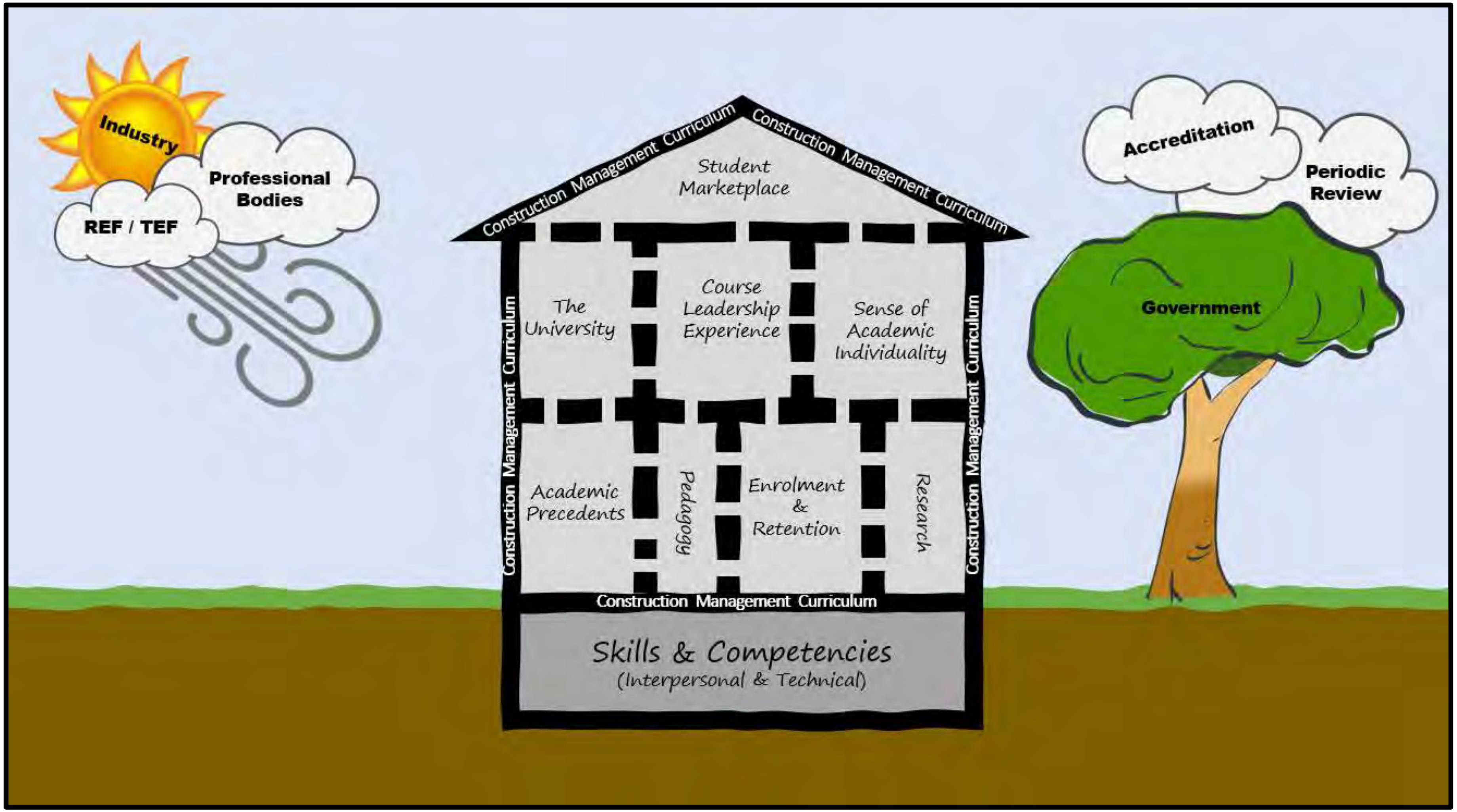
Table 4.6 – Componential Analysis of Internal and External Factors

Factor		Factor Description / Definition	Benefits / Positives	Drawbacks / Negatives	References
	Student Marketplace & Course Offerings	The total number of individuals interested in, or actively engaged in, pursuing an advanced degree or certificate.	- Theoretically no upper limit on potential student pool. - Students are the lifeblood of the university and are essential for the community to exist.	- University reputation can limit student interest. - Degree/course offerings inherently narrow student interest	Kaushal *et al*., 2021 Sagynbekova *et al*., 2020 Yusran *et al*., 2021
	Sense of Academic Individuality	The balance between conforming to the policies/procedures/regulations of the University and/or educational provision(s) and the academic freedom of the faculty to pursue/engender/develop educational/research content.	- Academic creativity is embraced and celebrated. - Potential for educational/research advancements at the University/faculty level.	- Can easily lead to silos within faculties; no team communication. - Can lead to an increase in egotistical, team destruction.	Karran *et al*., 2022 Sever *et al*., 2021 Zhao *et al*., 2020
	Research	A detailed study of a subject, especially to discover information or reach an understanding (Cambridge Dictionary, 2021).	- Leads to an increase in financial resources to the university or programme. - Assists with programme recognition and knowledge generation.	- Unbalanced view can lead to an overemphasis in research and lack of teaching/education. - Academic research can filter into the classroom in modules where research may not be the focus.	Al-Saeed *et al*., 2020 Gefen, 2019 Roberts *et al*., 2019
	The University	An educational, business organisation comprised of academic programmes, research programmes, management, human resources, marketing, finance, infrastructure, facilities and student services (Hussin and Ismail, 2009).	- Collective forum and body for knowledge generation, exchange and collaboration - Can operate as a business unit, which can be used for leverage in financial, industry and educational goals.	- Operating as a business can be very hierarchical to a detriment. - Competing priorities (enrolment, finances, reputation) impact the main focus of the institution; education.	Bauer *et al*., 2020 Kooli, 2019 Puaca, 2021
Internal	Academic Precedents	An action, situation, or decision that has already happened and can be used as a reason why a similar action or decision should be performed or made (Cambridge Dictionary, 2021).	- A guide/process to follow. - Creates a sense of tradition and esprit de corps.	- Can be detrimental to process improvement. - Potentially stifles developments in courses of study	Graubard, 2001 Kirkwood-Tucker, 2009 Maskell and Robinson, 2012

	Course Leadership	[Course] leadership is the name given to leadership in an academic setting or organization as a special subdivision of overall leadership. [Course] leadership is a leadership that includes such roles as creating vision and mission based on science and research data for the organization, setting up creative ideas, doing and providing teamwork (Fidan, 2019).	- Training and further education can allow for leadership development. - High impact role within a programme to help direct and promote advancement.	- Academic skill does not necessarily translate to academic leadership - High impact role within a programme which, when used incorrectly, can leave lasting damage	Goldman *et al*., 2021 Militello *et al*., 2021 Samuel *et al*., 2021
	Pedagogy	Pedagogy, the study of teaching methods, including the aims of education and the ways in which such goals may be achieved (Peel, 2021).	- Academics are able to express and employ a wide range of techniques to connect with students. - Backed by research as appropriate methods for teaching specific content.	- Very wide ranging topic where conflict over 'best practices' easily emerges. - Can act as a prescribed method rather than a tool.	Fwu and Lee, 2020 Klockner *et al*., 2021 Tchoukaleyska *et al*., 2021
	Enrolment and Retention	The process of students selecting a course of study and confirming their place within the course. The total number of students continuing to study on a particular course or module from one year to the next (Cambridge Dictionary, 2021).	- One of the main revenue sources for the university. - Creates the student environment within the university (academically and diversity).	- Can be a major source of decision making that places revenue goals above educational goals. - Is used as a subjective metric for university to university comparison with large rewards/penalties.	Dela Cruz *et al*., 2020 Maldonado *et al*., 2021 Tight, 2019
External	Periodic Reviews	Periodic review is [an HEI's] mechanism for evaluating programmes and subjects holistically... [inclusive of] taking a view of the quality and standards of the provision, allowing for external and independent confirmation. (De Montfort University, 2021).	- Enables new approaches and current practices to be developed and enhanced and for good practice to be recognised and disseminated. - Continuous improvement process	- Scope creep can occur which can expand the extent of the review. - Hidden agendas and bias from review leadership can dictate direction of the review.	Chen *et al*., 2018 De Montfort University, 2021 Jesus-Silva *et al*., 2018
	Government	A particular system or method, as well as the group of people responsible for controlling a country or a state (Oxford Learner's Dictionary, 2021).	- Main national decision-making authority which controls the arena in which the built environment conducts business. - Representative in nature so as to include the different voices	- Main national decision-making authority which controls the arena in which the built environment conducts business. - Political at its core, which can favour individuals (and	Chonpitakwong *et al*., 2021 Sampaio, 2021 Schofield-Georgeson, 2021

		of the nation when making decisions or determining courses of action.	specific industry groups) over the whole of the nation.	Smirnova *et al.*, 2021
Accreditation	Official approval given by an organization stating that someone or something has achieved a required standard (Oxford Learner's Dictionary, 2021).	- Efficient tool for comparing programmes against a set standard(s) - Link between industry and academia.	- Bias in terms of the accreditation structure and foundation - Accreditation organisations fill multiple roles which can impact agenda(s).	Brooks *et al.*, 2021 Danlad, 2020 Komotar, 2021 McDonnell *et al.*, 2021
Construction Industry	The business sector comprised of construction managers, quantity surveyors, subcontractors, trade/craft workers, building material vendors and ancillary built environment professions (design, planning, engineers, owners, facility management).	- The arena in which universities prepare students for employment; the main reason for course existence. - Responsible for the construction of the built environment, which impacts citizens on a daily basis (enjoyment, revenue, identity).	- Can be rigid and set in an outdated fashion, relative to other industries. - Diversity and equality struggles representative to the population as a whole and other industries.	Benachio *et al.*, 2020 Gamil and Alhagar, 2020 Salleh *et al.*, 2020
Industry Professional Bodies	Professional bodies seek to 1) serve the public by hosting a register of practitioners and ensuring that specific standards are met; 2) serve members by providing venues for knowledge sharing; and 3) serve the profession by acting as a unified voice on pertinent issues (Browne, 2020).	- Link between different subsectors of the same industry; connecting for harmonious communication and knowledge sharing. - Act as a unified voice on issues relevant to the profession.	- Professional bodies fill multiple roles which can impact true agenda(s). - Can have a very narrow (not holistic) view of the industry as a whole, which can impact decisions and stances.	Browne, 2020 Chartered Institute of Building, 2021a Royal Institute of Chartered Surveyors, 2021
Teaching Excellence and Student Outcomes Framework (TEF) and Research Excellence Framework (REF)	Assesses excellence in teaching at universities and colleges and how each higher education provider ensures excellent outcomes for their students in terms of graduate-level employment or further study (Office for Students, 2021). REF is the UK's system for assessing the quality of research in UK HEIs (Research Education Framework, 2021).	- Provides a standard amongst universities for teaching and research - Quality control and assurance can be easily achieved.	- Rigid and narrow view of what teaching/research is or what teaching/research should be. - Governmental influence which can incorporate bias into the framework.	Kneale, 2018 Kinsey, 2019 Shattock, 2018

Figure 4.8 – Construction Management Curriculum Development Conceptual Model



DISCUSSION

There are various practical applications of the study results for construction management higher education. First, the current environment for CMCD is barren and individual academics (or academic teams) toil in relative isolation, i.e., they are not referencing each other and when they do, the links are weak. Moreover, academic teams are minimal in frequency, shallow in curriculum depth and narrow in breadth. This again underscores the fractured, silo nature of the current landscape. There was (and is) very little tangible engagement with the study and history of curriculum development in a construction management context. Perhaps this is due to a paucity in publication outlets which support and echo developments in CMCD, compared to other education and construction publication arenas. Appetite for this niche subject is lacking, falling to the popularity powerhouses of technology, human resources and digitalisation which are often seen by haughty academics as more impactful – yet teaching is the raison d'être of HEIs and provides future generations of trained and competent construction managers.

Explanations for this puzzling lack of cohesive CMCD are in direct contrast to the relatively strong construction management (as well as general built environment) course enrolment trends (Higher Education Statics Agency, 2020). Furthermore, robust employability after graduation (Yussof *et al*., 2021) and increasing entry-level position salaries for the construction industry (Gajjar *et al*., 2019) have placed construction management in the limelight. With such attractive current course trends and a promising industry outlook (Office of National Statistics, 2021a), it is shocking that a passive, 'happy-go-lucky' mind-set exists amidst the fragmented, insular landscape of CMCD. The conceptual model presented provides a broad overview of the CMCD topology and the internal and external factors that impact upon such. Quantification of these factors is now needed to explore: the extent of impact; the interconnectedness between factors; and perhaps more importantly, how individual HEIs optimise the content of their programmes but also share best practice with the wider community for HEIs.

Since the construction management curriculum model constitutes a conceptual stage, future applied research will examine existing HEI curricula in order to refine and provide clear direction for the field. Such work should aspire to analyse course specifications, learning outcomes, module topics and key course metrics to better understand the mechanisms and internal-external forces impacting upon the design of current CMPs. This could be achieved by examining current construction management curricula and speaking with HEI staff involved with curriculum development (refer to Chapter 5).

CONCLUSIONS

CMCD lacks a cohesive community of practice which would serve to guide the educational framework for the discipline through rapidly changing industry conditions. Applying the personal experiences of the research team, a conceptual model for construction management curriculum is developed, based on interpersonal and technical skills and competencies, both within internal university forces and external industrial-governmental forces.

This chapter has revealed that not only does CMCD lack a community of practice, but it is also apparent that curricula are developing organically and at the impulse of individual programme leaders. Therefore, it is alleged that these programmes mirror their programme leaders' individual perceptions, predilections for subject content and boundaries of tacit knowledge accrued. Alternatively, subject content may be more influenced by the vision of 'senior' authorities in the school or faculty (some of whom may not have construction management knowledge or experience). At present, construction management education is influenced by internal and external factors which are not equal in weight, for example, a government intervention will always take precedence over HEI preferences. While these factors are omnipresent and add character to the construction discipline, they are not guiding or foundational factors. Interpersonal and technical skills and competencies are the foundation which supports the framework of a construction management curriculum. These suspicions will require input from industry and current HEIs with regards to how the curriculum foundation and framework maps can best map to industry requirements and the concomitant need to increase student employability.

It is apparent that neither construction management education practitioners nor programmes connect to amplify a collective body of knowledge for curriculum development. In the rare event that this does occur, the connectedness is surface deep and lacks robustness or longevity. From this, there is a need to develop a unifying curriculum model to help focus educational content relative to the internal and external factors of the construction industry as well as ensure that staff/students remain at the forefront of industry developments.

Collaboration, connectedness and community are the factors of a dynamic, healthy educational programme that leads to high performing graduates, cutting edge research and far reaching, applied innovation: all positive results for any economy. Construction management education is currently failing its health check. Not only is it logical to assume that this unhealthy trend is not sustainable but also that drastic negative impacts will stretch well beyond the educational discipline. Through the development of a conceptual model premised upon literature discourse, this chapter provides the basis upon which HEIs will be able to begin building a community of practice, not only for the reputation of the discipline, but for the benefit of future construction management students and practitioners, and ultimately the economy and society that benefits from it.

CHAPTER 5

PROFESSIONAL SKILLS DEVELOPMENT: FOUNDATIONAL CURRICULUM SKILLS AND COMPETENCIES OF UK CONSTRUCTION MANAGEMENT PROGRAMMES

INTRODUCTION

Since its earliest prehistoric form, the act of construction has involved an inextricable linked relationship between people and technology (Campbell *et al.*, 2016; Mascarenhas-Mateus and Pires, 2021; Randall and Randall, 1999). From novices to craft workers and from primitive edge tools to innovative building materials and/or revolutionary digital technology, the bond between people and technology is instinctive. This relationship, united in the delicate balance of technical and human knowledge, skills, abilities and competencies has shaped the built environment for millennia: prominent exemplars of human achievements range from the assembly of Stonehenge to the erection of the Empire State Building (Pearson and Stonehenge Riverside Project, 2012; Tauranac, 2014; Wouters *et al*, 2018). Human ingenuity and technical prowess were needed to imagine and build increasingly complex and elaborate structures, but also interpersonal competence to inspire, motivate, persuade and lead 'collective' construction teams to undertake such feats (Bowen, 2022). As structures became more and more intricate (requiring more specialist craft workers), a master builder who possessed prerequisite technical insight and interpersonal awareness was needed to manage and oversee project development (Chiu, 2010; Freire-Lista, 2021). Culminating and emerging out of the post-war era, CMPs carried forth this sentiment where concentrations in technical and interpersonal skills coalesced in a university setting (Haas *et al.*, 2007).

A construction management programme's curriculum represents the chart to which a course is set and provides a route to a specified end destination – in this instance a Bachelor's honours degree (Fung, 2017; White, 2004). Therefore, the development, and more importantly, the foundation of the curriculum are indispensable to the achievement of the students and programme. Curriculum designs for construction management must hinge upon the technical-interpersonal skills relationship and transference of this knowledge to the student. However, Posillico *et al.* (2021a) recently questioned whether a cohesive and collaborative community of practice existed within the construction management discipline and whether teaching provisions were homogeneous in terms of technical-interpersonal skills. Subsequently, this present research argues that a defined, common understanding and awareness of the technical and interpersonal skills and competencies is needed to provide a solid foundation for a programme's curriculum development. Specifically, the research question posed is: "What are the key skills and competencies inherent in UK CMP?"

Against this contextual backdrop, this chapter seeks to conduct a textual and statistical secondary data analysis of existing UK CMP to ascertain the skills and competencies that serve as the curriculum's foundation. Chapter objectives are to: strengthen academic discourse in higher education's role of career preparedness and employability; contribute to cultivating CMCD knowledge and awareness; and provide future avenues for industry-partnered curriculum focused research.

RESULTS OF UK CONSTRUCTION MANAGEMENT PROGRAMMES

Of the *f* = 19 programmes reviewed, two main course structures were identified which subsequently follow a split along 'home nation' country boundaries within the UK. The overwhelming majority of programmes (*f* = 17 or 89.47%) utilised a three-year course structure and were located in England and Wales. The two remaining programmes conducted their course of study in a four-year structure and were situated in Scotland – this could be because Scottish students do not have tuition fees unlike their English and Welsh counterparts. Northern Ireland is not included because a CMP with publicly available information was not found. The number of modules each programme offers, specifically the number of required and elective modules illustrates large variations between programmes offered. More specifically, the range of modules offered on programmes can be anywhere between *f* = 12 or *f* = 32 modules (range = 20), demonstrating a vast array of module structures within the *f* = 19 programmes reviewed. The bulk of the module structure falls within the *f* = 17 or *f* = 18 module quantity (*f* of 17 modules = 6 programmes and *f* of 18 modules = 4 programmes). Eight programmes indicated module quantities above the 'bulk 17-18 frequency' ranging from *f* = 19 to *f* = 32 modules.

Throughout all of the *f* = 19 programmes, most modules were classified as either 'compulsory' or 'required.' Of the *f* = 19 programmes only six (or 31.57%) offered at least one 'elective' module within the programme structure; where the term elective is defined as a mandatory module that a student has choice in the topic(s). For programmes that did offer elective modules, five of the six programmes (83%) included more than one elective and had total programme module quantities higher than the 'bulk 17-18 frequency.' Furthermore, Table 5.1 illustrates that when comparing the number of elective modules to the total number of modules in the programme, a ratio of 'student personalisation' can be viewed; indicative of how much (or little) a student has a voice in individualising their own study. This is perhaps an enigmatic finding given that students are widely perceived as 'customers,' and premised upon this, there is a natural proclivity to assume that a wider choice would be available.

As revealed in Table 5.2, a significant majority of the programmes noted have kept to a consistent number of modules per year, with very slight modifications ($f = 14$ with 'greatest frequency distribution' ≤ 0). Programmes that had fluctuations in yearly module frequencies were also closely associated with programmes that offered elective modules. For example, Universities *Kilo* and *Tango* offered elective modules for students and had varying module frequencies per academic year. Whilst not directly correlated, there is a loose connection between the number of total modules and the fluctuations in modules per academic year. For example, the $f = 11$ programmes that had fewer than 18 total modules, averaged a 'greatest frequency distribution' of 0.55 modules. However, the eight programmes with ≥18 total modules, averaged 2.00 modules in the same metric. The greater the number of total modules the greater the likelihood that the frequency of modules per academic year will vary.

Table 5.1 – Required and Elective Module Structure

University	Course Duration (No. of Years)	Breakout of Required and Elective Modules per Year								Total Modules (*f*)	Ratio of Student Choice (%)
		Year 1 Modules (*f*)		Year 2 Modules (*f*)		Year 3 Modules (*f*)		Year 4 Modules (*f*)			
		Required	**Elective**	**Required**	**Elective**	**Required**	**Elective**	**Required**	**Elective**		
Foxtrot	3	4	0	4	0	4	0	-	-	12	0.00%
Alfa	3	6	0	6	0	5	0	-	-	17	0.00%
Golf	3	6	0	6	0	5	0	-	-	17	0.00%
November	3	5	0	6	0	5	1	-	-	17	5.88%
Papa	3	6	0	6	0	5	0	-	-	17	0.00%
Uniform	3	6	0	6	0	5	0	-	-	17	0.00%
Whiskey	3	6	0	5	0	6	0	-	-	17	0.00%
Juliet	3	6	0	6	0	6	0	-	-	18	0.00%
Mike	3	6	0	6	0	6	0	-	-	18	0.00%
Sierra	3	6	0	6	0	6	0	-	-	18	0.00%
Victor	3	6	0	6	0	6	0	-	-	18	0.00%
Romeo	3	7	0	7	0	5	0	-	-	19	0.00%
Hotel	3	7	0	7	0	6	0	-	-	20	0.00%
Kilo	3	6	0	6	0	7	3	-	-	22	13.64%
Lima	3	8	0	7	1	5	1	-	-	22	9.09%
Charlie	4	6	0	6	0	6	0	3	2	23	8.70%
Bravo	3	9	0	9	0	6	0	-	-	24	0.00%
Tango	3	9	0	11	0	3	5	-	-	28	17.86%
Echo	4	8	0	6	2	6	2	8	0	32	12.50%

Table 5.2 – Overall Module Structure

University	Course Duration (No. of Years)	Total Modules (Required and Elective) per Year				Total Modules (*f*)	Greatest Frequency Difference (No. of Modules)	Average of Greatest Frequency Difference (No. of Modules)
		Year 1 Modules (*f*)	Year 2 Modules (*f*)	Year 3 Modules (*f*)	Year 4 Modules (*f*)			
Foxtrot	3	4	4	4	-	12	0	
Alfa	3	6	6	5	-	17	1	
Golf	3	6	6	5	-	17	1	
*November	3	5	6	6	-	17	1	
Papa	3	6	6	5	-	17	1	
Uniform	3	6	6	5	-	17	1	0.55
Whiskey	3	6	5	6	-	17	1	
Juliet	3	6	6	6	-	18	0	
Mike	3	6	6	6	-	18	0	
Sierra	3	6	6	6	-	18	0	
Victor	3	6	6	6	-	18	0	
Romeo	3	7	7	5	-	19	2	
Hotel	3	7	7	6	-	20	1	
*Kilo	3	6	6	10	-	22	4	
*Lima	3	8	8	6	-	22	2	
*Charlie	4	6	6	6	5	23	1	2.00
Bravo	3	9	9	6	-	24	3	
*Tango	3	9	11	8	-	28	3	
*Echo	4	8	8	8	8	32	0	

'*' denotes programmes with elective options.

Learning Outcomes

'Learning outcome' is a generic term used within education and teaching disciplines to describe the abilities and information a student will have obtained upon the completion of a course, programme or module of study (Malechwanzi, 2020; Sinha, 2021). From this, learning outcomes serve as a fundamental curriculum development component that (together with grades awarded) confirm that student progress and concomitant knowledge accumulated (Arnold *et al.*, 2020).

Structure and Organisation

Two approaches appear to be evident for a programmes' learning outcomes structure and organisation: 1) alignment with The Quality Assurance Agency for Higher Education (QAA) Subject Benchmark; and 2) no or ad hoc alignment. The QAA Subject Benchmark for Land, Construction, Real Estate and Surveying, as it describes itself:

> *"...defines the academic standards that can be expected of a graduate, in terms of what they might know, do and understand at the end of their studies, and described the nature of the subject" (The Quality Assurance Agency for Higher Education, 2019, p. 1).*

Regarding learning outcomes, the QAA Subject Benchmark notes two main categories viz. 1) subject-specific knowledge and understanding; and 2) generic skills. The generic skills are then further subdivided into seven groupings, namely: 1) intellectual; 2) practical; 3) analytical and data interpretation; 4) communication; 5) digital literacy; 6) interpersonal and teamwork; and 7) self-management and professional development skills. Of the f = 19 programmes, f = 13 (81.25%) broadly fit into the QAA Subject Benchmark model. The remaining six programmes (18.75%) either do not indicate learning outcomes or were structured in completely different formats. Table 5.3 depicts that when comparing the f = 13 QAA Subject Benchmark model programmes to the total number of learning outcomes, a wide range (min = 10; max = 56; and range = 46) of learning outcomes is evident. Furthermore, there does not appear to be a connection to the quantity of modules in a programme; for example, University *Echo* has f = 10 learning outcomes and f = 32 modules whilst University *Uniform* has f = 56 learning outcomes and f = 17 modules. Interestingly, only three of the six (50.00%) programmes that offered electives also utilised the QAA Subject Benchmark model for developing learning outcomes.

Table 5.3 – Learning Outcomes

University	Learning Outcome Structure and Alignment with QAA Subject Benchmark	Total Number of Learning Outcomes from Course Specification (*f*)	Total Number of Modules to Complete Degree (*f*)	Learning Outcomes per Module (*f*)
*Echo	Yes	10	32	0.3
Alfa	Yes	20	17	1.2
Papa	Yes	22	17	1.3
Romeo	Yes	22	19	1.2
Sierra	Yes	24	18	1.3
Whiskey	Yes	24	17	1.4
Juliet	Yes	25	18	1.4
*Kilo	Yes	26	22	1.2
*November	Yes	26	17	1.5
Victor	Yes	26	18	1.4
Foxtrot	Yes	48	12	4.0
Mike	Yes	48	18	2.7
Uniform	Yes	56	17	3.3

‘*’ denotes programmes with elective options.

Table 5.4 outlines the headings and vernacular utilised by the *f* = 19 programmes for categorising learning outcomes. As depicted, there is a strong alignment and connection with the content and structure for those programmes aligned with the QAA Subject Benchmark model. For those programmes not aligned with the QAA Subject Benchmark (*f* = 6), there is a mixed approach: four programmes indicated their learning outcomes in a list format sans category headings; one university used five custom headings and; one university did not list or indicate any learning outcomes.

Mapping within the Course Curriculum

Eight of the 19 programmes (42.11%) included a visual/figure of how the courses' learning outcomes were mapped to the various modules within the programme. Of the eight programmes, seven (87.50%) utilised the QAA Subject Benchmark model. The visual display of the curriculum-learning outcomes map varied drastically. Some programmes utilised a matrix type figure whilst others created hierarchy lists. Regardless of these differences, the eight programmes appeared to have noted the importance of displaying this information visually.

Table 5.5 depicts the number of learning outcomes per module as noted in the eight programmes' curriculum maps. High, low, range and median values were obtained for the number of learning outcomes for each programme. Whilst most programmes utilised the QAA Subject Benchmark (*f* = 7 or 87.50%), there is a wide display of learning outcome application. Specifically, when viewing the highest and lowest numbers of learning outcomes associated with a module, the range between the eight programmes is noteworthy (high range = 18 and low range = 8). This depicts that while a standard template or format has been consulted, the customisation and tailoring for a specific programme remains heavily dominant. Surprisingly, when examining the median of learning outcomes per programme, four of the eight programmes (50%) identified a range of 11 or 11.5 learning outcomes per module.

Table 5.4 – Learning Outcome Headings

University	Learning Outcome Structure and Alignment with QAA Subject Benchmark	Total Number of Learning Outcomes from Course Specification (*f*)	Learning Outcomes Heading Vernacular			
Alfa	Yes	20	Technical Knowledge	Cognitive	Communication	Interpersonal
Bravo	No	8	No Headings (List Format)			
Charlie	No	10	No Headings (List Format)			
Echo	Yes	10	Subject Mastery *Understanding, Knowledge & Cognitive Skills*		Personal Abilities *Industrial, Commercial and Professional Practice*	
Foxtrot	Yes	48	Knowledge and Understanding	Intellectual Skills	Subject Practical Skills	Key Skills *Self Awareness, Communication, Interpersonal, Research & Information Literacy, Numeracy, Management & Leadership, Creativity & Problem Solving*
Golf	No	5	No Headings (List Format)			
Hotel	No	40	No Headings (List Format)			
Juliet	Yes	25	Knowledge and Understanding	Intellectual Skills	Practical Skills	Transferable Skills
Kilo	Yes	26	Knowledge and Understanding	Subject-Specific - Cognitive Skills	Subject-Specific - Practical Skills	Key Transferable Skills

Lima	No	16	Academic Literacy	Research Literacy	Critical Self-Awareness and Personal Literacy	Digital and Information Literacy	Active Citizenship
Mike	Yes	48	Knowledge and Understanding	Intellectual Skills	Subject Practical Skills	Key / Transferable Skills	
November	Yes	26	Knowledge and Theory	Intellectual Skills	Discipline-Specific Skills	Transferable Skills	
Papa	Yes	22	Knowledge	Thinking Skills	Skills for Life and Work (General Skills)		
Romeo	Yes	22	Knowledge and Understanding	Subject Specific Intellectual Skills	Subject Specific Practical Skills	Transferable Skills and Attributes	
Sierra	Yes	24	Knowledge and Understanding	Cognitive and Intellectual Skills	Key Transferable Skills	Employment Related Skills	Practical Skills
Tango	No	3	No Learning Outcomes Noted				
Uniform	Yes	56	Knowledge and Understanding	Intellectual Skills	Subject Practical Skills	Transferable Skills	
Victor	Yes	26	Knowledge and Understanding	Graduate Attributes	Professional and Personal Practice	Key Transferable Skills	
Whiskey	Yes	24	Knowledge and Understanding	Intellectual Skills	Subject Skills	Practical, Professional and Employability Skills	

Table 5.5 – Curriculum Mapped Learning Outcomes per Module

University	Learning Outcome Structure and Alignment with QAA Subject Benchmark	Total Number of Learning Outcomes from Course Specification (*f*)	Learning Outcomes per Module from Curriculum Map (*f*)			
			High	Low	Range	Median
Bravo	No	8	7	3	4	5
Romeo	Yes	22	14	3	11	7
Whiskey	Yes	24	20	4	16	11
Juliet	Yes	25	7	2	5	5
*November	Yes	26	25	0	25	11
Foxtrot	Yes	48	16	8	8	11.5
Mike	Yes	48	14	4	10	9
Uniform	Yes	56	19	6	13	11

'*' denotes programme with elective options.

Distribution of Learning Outcomes (Technical vs. Interpersonal)

Continuing to use the eight courses that have mapped learning outcomes to specific modules, Table 5.6 analyses the 'technical' versus 'interpersonal' characteristics of the learning outcomes; where the term 'technical' is defined as particular skills and abilities unique to a niche discipline or set of disciplines (Cambridge Dictionary, 2022). The term 'interpersonal' is defined as common skills and abilities applicable to a wide spectrum of career and life disciplines (Cambridge Dictionary, 2022). Of the eight courses, seven exhibited a majority of 'technical' learning outcomes; with the eighth course representing an equal number of both 'technical' and 'interpersonal' learning outcomes. Interestingly, University *Foxtrot*, whilst indicating a total of $f = 48$ learning outcomes in their course specification, only $f = 18$ (37.50%) were actually mapped to the curriculum. Specifically, of those $f = 18$ mapped learning outcomes, only two were 'interpersonal' whilst the remaining were 'technical.' Furthermore, the outstanding $f = 30$ (62.50%) learning outcomes were completely interpersonal related – e.g., self-awareness skills, communication skills, leadership skills and problem-solving skills. It appears that University *Foxtrot* was concerned with mapping the technical skills to specific modules rather than interpersonal skills.

Table 5.7 reveals that all eight courses have a substantial majority of modules mapped to both 'technical' and 'interpersonal' learning outcomes. In fact, five of the courses have designed both types of learning outcomes for every module in the programme. When calculating the ratio of 'technical' to 'interpersonal' learning outcomes for modules with both learning outcomes addressed, the statistical central tendencies offer another layer of analysis. Specifically, there is a lack of consistency and pattern within the eight courses relative to the above metrics; the 'range' spans from 1.16 to 10.00 within courses of similar module quantities. Interestingly, two of the eight courses have a 'median' below 0, which represents that there are more 'interpersonal' than 'technical' learning outcomes; however, the remaining six courses are all above 1 with a high of 5.50.

Table 5.6 – Distribution of Learning Outcomes (Technical vs. Interpersonal)

University	Total Number of Modules (*f*)	Total Number of Learning Outcomes from Course Specification (*f*)	Total Number of 'Technical' Learning Outcomes (*f*)	Total Number of 'Interpersonal' Learning Outcomes (*f*)	Total Number of Learning Outcomes Not Mapped (*f*)	Total Number of Learning Outcome Occurrences (*f*)
Bravo	24	8	7	1	0	113
Romeo	19	22	16	6	0	142
Whiskey	17	24	18	6	0	184
Juliet	18	25	16	9	0	83
*November	17	26	13	13	0	213
Foxtrot	12	48	16	2	30	142
Mike	18	48	26	22	0	166
Uniform	17	56	38	18	0	200

'*' denotes programme with elective options.

Table 5.7 – Distribution of Learning Outcomes per Module (Technical vs. Interpersonal)

University	Modules (*f*)	Learning Outcomes from Course Specification (*f*)	Learning Outcome Occurrences (*f*)	'Technical' Learning Outcome Occurrences (*f*)	'Interpersonal' Learning Outcome Occurrences (*f*)	Modules with Both 'Technical' and 'Interpersonal' Learning Outcomes (*f*)	For Modules with both 'Technical and 'Interpersonal' Learning Outcomes: Ratio of 'Technical' to 'Interpersonal' (No.)			
							High	Low	Range	Median
Bravo	24	8	113	95	18	18	6.00	2.00	4.00	5.00
Romeo	19	22	142	90	52	19	6.00	0.33	5.67	1.75
Whiskey	17	24	184	136	48	17	11.00	1.00	10.00	3.00
Juliet	18	25	83	38	45	16	3.00	0.00	3.00	0.67
*November	17	26	213	113	100	15	3.00	0.17	2.83	1.00
Foxtrot	12	48	142	120	22	12	13.00	3.00	10.00	5.50
Mike	18	48	166	66	100	18	1.33	0.17	1.16	0.65
Uniform	17	56	200	137	63	17	4.00	0.50	3.50	2.17

'*' denotes programme with elective options.

Table 5.8 compares the ratios of ‘technical’ to ‘interpersonal’ learning outcomes from the module specification to specific modules. From the analysis of Table 5.8, with the exception of three courses, there is a deficiency in consistency. Specifically, the modules are bearing more of an ‘interpersonal’ learning outcome burden than that expressed in the module specification. For example, University Bravo noted a 7:1 ratio of ‘technical’ to ‘interpersonal’ learning outcomes in their module specification. However, the same ratio measured 5:1 (median) for modules with both sets of learning outcomes. This difference of -2.00 indicates that there are approximately two more ‘interpersonal’ learning outcome occurrences applied to each module than alluded to in the module specification. It appears that ‘interpersonal’ learning outcomes are recognised as important within the course (as expressed by frequency of occurrences); however, a more ‘technical’ image has been portrayed in the publicly available module specifications. This may be for marketing purposes to attract students onto the programme, but further work is required to explore this finding.

Table 5.8 – Technical vs. Interpersonal Learning Outcome Ratio Comparisons

University	**Modules (*f*)**	**Ratio of ‘Technical’ to ‘Interpersonal’ Learning Outcomes from the Module Specification (No.)**	**For Modules with both ‘Technical and ‘Interpersonal’ Learning Outcomes: Ratio of ‘Technical’ to ‘Interpersonal’ (No.)**				**Ratio Delta (No.)**
			High	**Low**	**Range**	**Median**	
Bravo	24	7.00	6.00	2.00	4.00	5.00	-2.00
Romeo	19	2.67	6.00	0.33	5.67	1.75	-0.92
Whiskey	17	3.00	11.00	1.00	10.00	3.00	0.00
Juliet	18	1.78	3.00	0.00	3.00	0.67	-1.11
*November	17	1.00	3.00	0.17	2.83	1.00	0.00
Foxtrot	12	8.00	13.00	3.00	10.00	5.50	-2.50
Mike	18	1.18	1.33	0.17	1.16	0.65	-0.53
Uniform	17	2.11	4.00	0.50	3.50	2.17	0.06

‘*’ denotes programme with elective options.

Textual Analysis of Learning Outcomes and Educational Aims

Together, learning outcomes and educational aims serve as fundamental curriculum development components and act as a barometer for the curriculum's educational and industrial vitality (Bush, 2020; Ozoliņš, 2018; Reiss and White, 2013; Schinkel, 2021). The vernacular used in crafting these components can offer insight into the essence of a course's curriculum.

Frequency and Clustering

The learning outcomes and educational aims from each of the $f = 19$ courses were uploaded into Voyant Tools to identify the most frequently occurring ($f \geq 3$), unique (and less common construction management) keywords such as: 'construction', 'management', 'course', 'learning outcomes', 'built environment' and 'building'. These keywords were then recorded and aligned with their respective courses (refer to Table 5.9). Once the 'top' keywords for each course were recorded, an aggregate list was compiled. The complied list consisted of 200 keywords in total; however, manual cleansing of the data removed duplicates and different grammatical forms of the same word to generate a total of 68 unique keywords. Within the 68 unique keywords, $f = 20$ (29.4%) occurred at least three times with $f = 12$ (17.6%) occurring at least six times (refer to Table 5.9). Furthermore, based on an interpretation of each keyword's definition, each keyword can be assigned either a 'technical,' 'interpersonal,' 'both' or 'neutral' theme. The clustering of keywords into themes allows for further comparison and analysis with the frequency metrics.

Ranking and Correlation – Computation One

The first computation compares the frequency of keywords to the quantity of universities where that specific keyword occurs. The reason for the comparison of these two variables is to help determine if there is a significant correlation between them. More specifically, are the higher frequency keywords present in a large number of universities thus indicating that those keywords are important. The data for the first computation is noted in Table 5.10. The Rs calculated was 0.991, which is extremely close to 1.0, indicating an almost perfect positive correlation and significance for the two variables. For the keywords noted in Table 5.10, it can be generally noted that the higher the frequency of the keyword, the greater the number of universities will be using that keyword. Keywords with a high frequency of use appear to be generally and widely accepted as important elements of conveying the goals and abilities of a course's curriculum.

Table 5.9 – Textual Analysis Frequency and Clustering of Learning Outcomes and Educational Aims

Keyword (In Order of Frequency High to Low)	Frequency (*f*)	Theme	University																			Total Occurrences
			Alpha	Bravo	Charlie	Echo	Foxtrot	Golf	Hotel	Juliet	Kilo	Lima	Mike	November	Papa	Romeo	Sierra	Tango	Uniform	Victor	Whiskey	
skills	18	Both			✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓		14
professional	16	Both				✓	✓	✓	✓		✓	✓	✓	✓	✓		✓		✓	✓	✓	13
develop(ment)	9	Both			✓				✓	✓				✓		✓				✓	✓	7
demonstrate	8	Both	✓				✓		✓			✓	✓	✓	✓				✓			8
students	8	Neutral		✓	✓			✓				✓	✓	✓					✓	✓		8
knowledge	7	Both				✓	✓		✓				✓	✓			✓			✓		7
use	7	Neutral	✓				✓		✓	✓	✓					✓			✓			7
appropriate	6	Both		✓									✓	✓	✓				✓		✓	6
evaluate	6	Both		✓									✓				✓		✓	✓	✓	6
information	6	Neutral	✓				✓			✓	✓					✓			✓			6
provide	6	Neutral		✓	✓	✓			✓		✓										✓	6
understand(ing)	6	Both				✓	✓	✓	✓								✓			✓		6
project(s)	5	Both						✓	✓			✓		✓					✓			5
industry	4	Technical								✓	✓					✓					✓	4
related(ing)	4	Neutral				✓		✓									✓	✓				4
application / apply	3	Both							✓										✓		✓	3
design	3	Technical												✓					✓	✓		3
principles	3	Both	✓										✓								✓	3
technology	3	Technical						✓			✓					✓						3
graduates	3	Neutral					✓			✓										✓		3
		Total Occurrences	4	4	4	6	8	7	10	6	7	5	8	8	4	6	6	1	11	9	8	

Table 5.10 – Keyword Frequencies to the Number of Universities Where the Word Occurs

Keyword	Frequency of Keyword (*f*)	Rank	Frequency of Universities where the Keyword Occurs (*f*)	Rank	d	d²
skills	18	1	14	1	0	0
professional	16	2	13	2	0	0
develop(ment)	9	3	7	6	-3	9
demonstrate	8	4.5	8	3.5	1	1
students	8	4.6	8	3.5	1.1	1.21
knowledge	7	6.5	7	6	0.5	0.25
use	7	6.5	7	6	0.5	0.25
appropriate	6	10	6	10	0	0
evaluate	6	10	6	10	0	0
information	6	10	6	10	0	0
provide	6	10	6	10	0	0
understand(ing)	6	10	6	10	0	0
project(s)	5	13	5	13	0	0
industry	4	14.5	4	14.5	0	0
related(ing)	4	14.5	4	14.5	0	0
application / apply	3	18	3	18	0	0
design	3	18	3	18	0	0
principles	3	18	3	18	0	0
technology	3	18	3	18	0	0
graduates	3	18	3	18	0	0
					$\sum d^2 =$	11.71

Ranking and Correlation – Computation Two

Very similar to the first computation, the second compares the frequency of assigned themes to the quantity of universities where that theme occurs. The reason for the computation of these two variables is to help determine if there is a significant correlation between the two; are the higher frequency themes present in a large number of universities thus indicating that those themes are important. The data for the second computation is noted in Table 5.11.

Table 5.11 – Frequency of Assigned Themes to the Number of Universities Where the Theme Occurs

Theme	Frequency of Theme (*f*)	Rank	Frequency of Universities where the Theme Occurs (*f*)	Rank	d	d²
Interpersonal	0	4	0	4	0	0
Technical	3	3	8	3	0	0
Both	11	1	18	1.5	-0.5	0.25
Neutral	6	2	18	1.5	0.5	0.25
					$\sum d^2 =$	0.5

The R_s was 0.950, which again is close to 1.0 and indicates an almost perfect linear correlation. It was noted that the higher the themes with a higher frequency will correlate to a greater number of universities. As noted in Table 5.11, the 'Both' theme (i.e., interpersonal and technical) can be identified as the primary theme used to help further identify the important elements of a course's curriculum.

Top Keywords

The top three keywords emergent from the analysis above are: 'skills,' 'professional' and 'develop(ment)'. It is interesting that these three words, re-ordered to 'professional skills development,' depict a shared focus of more profession-based higher education programmes. Whilst important, this still does not provide the detailed level of specificity to pinpoint skills and competencies that form the foundation of a construction management programme's curriculum. However, the identification of the 'professional skills development' keywords, however vague and ambiguous, does provide a common link between the higher education CMPs.

DISCUSSION

Three main practical application of these results can be viewed for CMP. First, there is an erratic irregularity in the structure of the programmes. Whilst some guiding signposts are utilised (such as QAA), the programmes have, in keeping with their silo-based and limited-collaborative nature, largely developed their curricula independently. Second, the technical and interpersonal skills and competencies embedded into the curricula show a conscious realisation that both of these skills and competency themes are essential to CMP. However, a more ‘technical-based skill’ image is portrayed publicly whilst the ‘interpersonal skills’ carry a larger burden throughout the curriculum. Finally, when trying to ascertain specific skills and competencies that serve as the foundation for the programmes’ curricula from university information, only a portion of the picture comes into focus. The keyword phrase ‘professional skills development’ is both wide in content breadth and shallow in content specificity.

Whilst the importance of both technical and interpersonal skills in CMP has been widely accepted and noted (cf. Bolpagni *et al*., 2022; Tender *et al*., 2022), it is perplexing why programmes portray a more ‘technical’ image publicly than an interpersonal-skills-dominant image of the discipline. Perhaps this stance is due to the digital and technology excitement that grasps the students and industry partners of today (Feng *et al*., 2022) or perhaps the marketing and ‘business-nature’ of higher education to increase enrolment is continuing to infringe and impact educational development and instruction (Martin-Sardesai *et al*., 2021). Furthermore, the authorship of the curricula documentation is unknown; was this completed by the programme leader, by a select committee or was industry consulted or involved? The importance of the educational aptitude of individuals behind the curriculum development and publication should not be underestimated; for other individualistic interests and agendas can easily overtake the spirit of the curriculum (Rahimi *et al*., 2010). Additionally, many universities (including the ones identified for analysis above) delineate graduate attributes regardless of course of study. Whilst the specific course and module specifications were analysed, the university-wide graduate attributes could influence a students’ skills development. Quantification of these assumptions is needed to explore: 1) the relationship between education and business practice in programmes; 2) the qualifications and experience of those involved with curriculum development; and 3) perhaps more importantly, to what extent is the construction industry involved in curriculum development and evaluation.

Although the findings of foundational skills and competencies, which resulted in the phrase 'professional skills development,' were distinct, they were nonetheless vague in pinpointing the tangible, specific proficiencies of construction management curricula. Future applied research will scrutinise the meaning and composition of professional skills in order to provide a more precise view of the finite skills and competencies needed (refer to Chapters 6 and 7). Industry practitioners could serve as a viable and well-informed population for obtaining additional perceptions of professional skills (refer to Chapter 6). This in turn, would complement the current 'academic' vein research to help paint a more complete picture of the skills and competencies needed in curriculum development (refer to Chapter 7).

CONCLUSIONS

A spattering to the structure of undergraduate CMP is evident; although fragments of cohesiveness exist, the individualistic nature of the programmes resonates profoundly. To ascertain the key skills and competencies that serve as the foundational element for the curriculum, keywords from publicly available curricular documents were obtained and qualitatively and quantitatively analysed. The concept of 'professional skills development,' from both technical and interpersonal viewpoints, was the underlying foundational motif. This chapter discovered that, whilst construction management curricula is developed largely independently, the foundational building blocks of 'professional skills development,' provide a commonality to the programmes. It can, therefore, be suspected that although the curricula are discussed, debated and developed individually, a collective understanding of the importance of professional skills preparation resonates. However, whilst a general consensus of 'professional skills development' is noted, the structure, intent and focus of the curricula are still largely erratic and scattered. Currently, construction management curricula are being authored at the whim of individual departments and/or programme leaders who may or may not have the requisite culmination of educational, industrial, pedagogical and/or administrative experience. In turn, the foundational employability notion remains consistently vague as to reasonably justify the individual agenda(s) of the curriculum's authors. For example, if a university is trying to increase enrolment, perhaps a more VR enhanced learning platform is promoted to entice perspective students. Or, if a programme leader is experienced in civil infrastructure projects, an emphasis on this content over commercial construction may be evident. These suspicions will require further exploration and input from industry regarding pinpointing the specific foundational 'professional skills,' irrespective to internal factors (as investigated in the next Chapter 6).

It is clear that CMP are offering different routes, with varying degrees of focus, for students to obtain a degree. The publicly available information a student can view (mainly the learning outcomes, educational aims and course specification) paints the dominant view of the programme for which very important and expensive decisions are made. From this, key skills and competencies that serve as the foundation of a curriculum need to be unearthed so they can be viewed on their own accord not with the surrounding predisposition of the university or department.

Successful employability of graduates is a goal of any technical programme, let alone university. This is commonly recognised within construction management education; however, the skills and competencies necessary for employability are sole subject to the writers of the curriculum. It is only reasonable to assume that this can lead to woeful inadequacies and scant comprehensiveness within the curriculum (or indeed, the converse). Through the uncovering of the foundational skills and competencies of construction management curricula, it is hoped that these act as a springboard for future academic/industry collective research can take place to identify the specific employability components. This is needed not only for the accuracy and reputation of construction management education but for the discipline as a whole.

CHAPTER 6

DEFINING THE KEY 'PROFESSIONAL DEVELOPMENT SKILLS' OF CONSTRUCTION MANAGERS FROM INFLUENTIAL UK CONSTRUCTION ORGANISATIONS

INTRODUCTION

The UK construction sector, according to HM Government (Rhodes, 2019), comprises around 343,000 companies (13% of UK businesses), which employs approximately 2.4 million individuals (7% of UK jobs). These companies and individuals are responsible for £117 billion or 6% of the UK's economic output (Rhodes, 2019). At the heart of this national economic engine is the construction manager – responsible for the financial, safety, quality, schedule and holistic project success (Walker, 2015). Metaphorically, a construction manager constitutes the glue that holds not only the construction project, but also the construction team together (Fewings, 2013; Harris *et al*., 2021). Without proper management and leadership of the complex teams responsible for these key attribute areas, a project's overall success is severely jeopardised (Nicholas and Steyn, 2021). Therefore, the skills and competencies of a construction project manager must be complementary to the role.

This present research aims to inductively observe, measure and record what interpersonal and technical skills and competencies are required by practicing construction managers. Specifically, the research question posed is: "What are the key 'professional development skills' UK construction organisations are looking for in construction project managers?" Given this question, this chapter seeks to conduct a textual secondary data analysis of UK construction project manager job advertisements to determine the specific 'professional development' skills and competencies that practicing construction organisations are pursuing in their managers. Job adverts were used because they constitute a snapshot of industry practitioners employability requirements and also offers an opportunity to compare these against curricular developed. Chapter objectives are to: identify and categorise skills and competencies of project managers into themes to differentiate those that are technical and those that are interpersonal in nature; contextualise the current state of professional skills requirements in UK construction organisations so as to act as a barometer for specific preferred skills and competencies; and help identify routes to incorporate these findings into construction management curriculum design and so ensure that contemporary HEI programmes offer the optimal employability opportunities for graduate students.

DATA AND DEMOGRAPHICS

Utilising a host of construction industry publication company's rating and ranking indices (e.g., *The Construction Index*, *Construction News*, *Construction Global* and *Construction Review Online*), the top ten construction companies with a noteworthy impact (minimum construction revenue of £700 million, minimum of 1,600 UK employees) were identified. The ten companies in aggregate, according to their 2020/2021 Annual Reports, are responsible for £34.3 billion in global revenue and employ over 56,000 employees in the UK. Complete job advertisements for the role of 'Construction Manager' or 'Project Manager' were located within each of the companies' career/Human Resources portal and downloaded.

The following analysis was conducted during the COVID-19 pandemic (2022 specifically). The UK office locations of the ten companies (f = 106) were recorded and categorised by country and region (refer to Table 6.1). The UK is an aggregate of four countries (England, Scotland, Wales and Northern Ireland) with each country instituting their own hierarchical subdivisions to serve various administrative purposes such as: local government, emergency services, postal services, etc. For the purposes of this research, general geographical and statistical regions were used to help provide an appropriate level of granularity and consistency amongst the four nations.

England is the dominate region for the ten companies with a total of f = 91 (85.85%) office locations and minimum of six companies occupying each region of the nine regions (refer to Figure 6.1). Scotland and Wales represent f = 14 (13.21%) different office locations across the two nations and are host of seven of the ten companies; however, there are regions of each nation that are not represented. Northern Ireland represents f = 1 (0.94%) office location across the nation and hosts three of the ten companies. However, similar to Scotland and Wales, there are regions of Northern Ireland that are not represented.

Table 6.1 – Regional Office Locations Ranked by Number of Companies

Country	Region	Office Locations (*f*)	Companies Present (*f*)	Region Population (ONS Mid-2020 Estimate)	Population % of Country	Population % of UK
England	South East	21	9	9,217,265	16.30%	13.74%
England	North West	12	9	7,367,456	13.03%	10.98%
England	West Midlands	5	9	5,961,929	10.54%	8.89%
England	East	17	8	6,269,161	11.09%	9.35%
England	London	3	8	9,002,488	15.92%	13.42%
England	South West	11	7	5,659,143	10.01%	8.44%
England	East Midlands	10	7	4,865,583	8.60%	7.25%
England	Yorkshire and the Humber	6	7	5,526,350	9.77%	8.24%
England	North East	6	6	2,680,763	4.74%	4.00%
Scotland	Edinburgh and Glasgow	4	6	2,920,250	53.43%	4.35%
Scotland	Highlands and Islands	3	6	892,750	16.33%	1.33%
Wales	South East Wales	3	5	1,552,527	48.98%	2.31%
N. Ireland	Belfast	1	3	342,560	18.07%	0.51%
Wales	North Wales	2	2	703,361	22.19%	1.05%
Wales	South West Wales	1	1	707,773	22.33%	1.06%
Scotland	Southern Scotland	1	1	631,520	11.55%	0.94%
Wales	Mid-Wales	0	0	205,925	6.50%	0.31%
Scotland	South Highlands	0	0	1,021,480	18.69%	1.52%
N. Ireland	Remainder of N. Ireland	0	0	1,552,950	81.93%	2.32%

Figure 6.1 – Regional Map of the United Kingdom - Modified

Modified UK Regional Map – "Location map of the United Kingdom with NUTS 1 areas" by NordNordWest is licensed under CC-BY-SA-3.0. Available at: https://commons.wikimedia.org/wiki/File:United_Kingdom_NUTS_location_map.svg

From a population standpoint, utilising the Office of National Statistics (ONS) latest regional population data (Office of National Statistics, 2022b), regions with at least five offices ($f = 12$; $f = 9$ in England, $f = 2$ in Scotland and $f = 1$ in Wales) account for 92.30% of the UK inhabitant population. This also accounts for $f = 101$ of the $f = 106$ (95.28%) of the office locations of the ten companies in the UK. This, in combination with the above, demonstrates that the ten companies selected, in aggregate, represent and can be attributed to a cross-sectional view of the UKs major contractors. This of course is also a limitation of the research in that only major contractors are included in the analysis. There are perhaps two sides to this limitation viz. 1) small-to-medium enterprises which perhaps comprise of 90% of the market (Office of National Statistics, 2022c) are excluded and so future work may be required to review their job adverts; and 2) for micro businesses (the small one man 'white van' bands of trades people), there is anecdotal evidence that adverts are often not used to employ managers and that rather an informal means of recruitment is often used. Moreover, management within such businesses is a multi-skills occupation where trades people double up to manage finance, a trade, the project and so forth. For this reason, future work may be required to examine micro-businesses in the future as it is suspected that their skills and competencies requirements may be very different to the major project's construction manager.

The specific construction sectors were also recorded for the ten companies (Table 6.2). The specific sectors help to display the range of services offered by the company. The number of different sectors of a specific company does not necessarily signify correlate to a 'better' company. However, the aggregate quantity of different sectors does help to demonstrate the wide net the ten companies cast over the construction industry domain. Specifically, the ten companies are engaged with $f = 28$ different sectors within five main industry categories. The ten companies participate in an average of $f = 11$ sectors ($f = 10.9$ specifically) with an overall range of eight to $f = 16$ sectors. Furthermore, at least three or more companies share over half of the industry sectors (53.57%).

Table 6.2 – Ten Companies Construction Sector Classifications

Category	Sector	Company 001	Company 002	Company 003	Company 004	Company 005	Company 006	Company 007	Company 008	Company 009	Company 010	TOTAL
Government	Defence	✓	✓	✓	✓			✓		✓		6
	Emergency Services					✓						1
	Judicial	✓	✓	✓				✓		✓	✓	6
Commercial	*General Commercial*	✓	✓	✓	✓	✓		✓	✓	✓	✓	9
	Retail					✓			✓	✓	✓	4
	Healthcare	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	10
	Heritage			✓					✓	✓		3
	Hospitality			✓								1
	Cultural							✓			✓	2
	Life Sciences / Technology									✓	✓	2
	Leisure / Community				✓	✓			✓	✓	✓	5
	Pharmaceutical			✓								1
	Education	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	10
Civil / Infrastructure	*General Civil / Infrastructure*				✓							1
	Aviation	✓	✓	✓			✓		✓			5
	Roads / Highways	✓	✓	✓			✓	✓	✓			6
	Rail	✓	✓	✓	✓		✓	✓	✓			7
	Ports / Coastal			✓			✓		✓			3
	Tunnels						✓					1
	Water / Wastewater	✓		✓			✓	✓				4
	Utilities									✓		1
	Data Centres / TeleComm			✓						✓		2
	Gas / Oil	✓								✓		2
Residential	*General Residential*	✓		✓	✓	✓	✓	✓	✓	✓	✓	9
Environment / Energy / Industrial	Nuclear	✓		✓								2
	Mining / Metals									✓		1
	Renewable Energy	✓					✓					2
	Power									✓		1

Within the spectrum of sectors noted, four appear to be dominant – where at least eight of the ten companies (80.00%) are engaged in: 'general commercial,' 'healthcare,' 'education' and 'general residential.' It should be noted that three of the four dominant sectors fall under the 'commercial' category. Of further note, the main 'civil' category sectors of 'rail' and 'roads / highways' represent seven and six companies each. These metrics are in line with governmental agendas, inclusive of financial backing, to promote and enhance the built environment in these sectors (HM Treasury, 2021).

ANALYSIS OF UK CONSTRUCTION MANAGEMENT JOB ADVERTISEMENTS

Ten job advertisements for the role of 'Construction Manager' or 'Project Manager,' (depending on the specific vernacular of the construction organisation) were identified. While there may be slight differences between the two roles, for the purposes of identifying the professional skills needed for the role, the two titles are aligned (Walker, 2015). The term 'Construction Manager' will be used hereafter. The job advertisements were located on the specific construction organisation's Human Resources or Careers webpage. Whilst some very specific job advertisements were noted (e.g., Electrical Construction Manager or Civil Infrastructure Construction Manager), generic Construction Manager job advertisement was sought which would represent the widest spectrum of attributes of the role. Additionally, the construction organisations, when advertising for the Construction Manager role, utilised an open or broad job advertisement. Similar to academic postings (e.g., Lecturer, Senior Lecturer, Associate Professor), whilst the specific project or location can change, the core components of the role are firmly rooted. Thus, the ten job advertisements represent an appropriate sample size for analysis (Fusch and Ness, 2015; Robinson, 2021).

The description of the 'key responsibilities / accountabilities,' 'role duties,' 'competencies,' 'personal requirements / qualities,' 'qualifications' and/or 'desirable criteria' for each of the ten job advertisements were uploaded into Voyant Tools to identify frequently occurring ($f \geq 4$) keywords. A summative list was assembled and then manual cleansing was performed to remove duplicates and different grammatical forms of the same word which resulted in $f = 101$ keywords. Within the $f = 101$ keywords, $f = 68$ (67.32%) occurred six or more times with $f = 28$ (27.72%) occurring at least ten times. This suggests that there is a degree of commonality between job descriptions. Although the job descriptions were crafted by different individuals from different organisations, an interpretation of the analysis suggests that common linkages exist.

In addition to measuring the keyword frequencies, identifying the frequency of job advertisements in which the keywords are used, can provide a supplementary viewpoint. Of the f = 101 keywords, f = 89 (88.12%) appeared in at least three job advertisements. Of those f = 89 keywords, f = 24 (23.76%) appeared in at least six of the job advertisements. Only three (1.88%) keywords (viz. '*deliver*,' '*project'* and '*manage'*) appeared in all ten job advertisements.

Of the f = 101 keywords, a manual review was completed to identify words that were related and/or associated with the phrase '*professional skills development*' with a view to deriving thematic clusters which could house these words. Emergent themes transpiring from this manual review were two dichotomous groups of 'technical' and 'interpersonal' skills and competencies – these were then applied when manually reviewing the keyword list; excluding any 'neutral' words, which resulted in a final list of f = 17 themed keywords. The keywords were ranked twice: once according to work frequency and once according to advertisement frequency. Average rankings were calculated for each keyword to determine the keyword magnitude, as noted in Table 6.3.

From Table 6.3, it is apparent that not only are there more 'interpersonal' themed words than 'technical' themed words (70.59% to 29.41%), but the overall impact of 'interpersonal' keywords is much greater than 'technical' keywords. The top six keywords are 'interpersonal' themed and account for 64.63% of the total word frequency and 48.91% of the job advertisement frequencies of the f = 17 themed keywords.

Table 6.3 – Themed Keyword Ranking

Keyword (Root)	**Theme**	**Keyword Frequency (*f*)**	**Rank (No.)**	**Advertisement Frequency (*f*)**	**Rank (No.)**	**Mean Rank (No.)**
Manage	Interpersonal	58	1	10	1	1
Team	Interpersonal	26	3	8	2	2.5
Ensure	Interpersonal	27	2	7	4	3
Lead	Interpersonal	16	6	7	4	5
Understand	Interpersonal	21	4.5	6	7	5.75
Communicate	Interpersonal	11	8	7	4	6
Build	Technical	8	9	6	7	8
Plan	Interpersonal	21	4.5	4	12.5	8.5
Engineering	Technical	7	10.5	6	7	8.75
Appropriate	Interpersonal	12	7	4	12.5	9.75
Relationship	Interpersonal	6	13	5	9	11
Cost	Technical	7	10.5	4	12.5	11.5
Budget	Technical	6	13	4	12.5	12.75
Decision	Interpersonal	5	15.5	4	12.5	14
Discipline	Interpersonal	5	15.5	4	12.5	14
Technical	Technical	6	13	3	16.5	14.75
Contribute	Interpersonal	4	17	3	16.5	16.75

Of the five technical keywords noted (refer to Table 6.3), only two would be considered granular in description: '*cost*' and '*budget*'. The remaining three ('*build*,' '*engineering*' and '*technical*') are surprisingly vague in description.

With a momentous focus and push for digital and technology skills in construction academic literature (cf. Li *et al*., 2022; Schiavi *et al*., 2022; Zhang *et al*., 2022), it is perplexing that ten of the UK's most impactful construction companies did not mention: 'BIM,' 'VR,' 'AR' or 'digital.' In fact, of the over 550 keywords, the only digital-esque phrase was 'Microsoft Excel' which was used just twice.

Another interesting observation noted when analysing the keywords of the job advertisements was the mention of each main construction industry participant. Specifically, the keywords '*client*', '*company*', '*stakeholder*', '*business*', '*contractor*' and '*customer*' were used an average of eight times (minimum = 6 and maximum = 14) in an average of four job advertisements (minimum = 3 and maximum = 6). From this analysis, there appears to be a stout awareness that the construction manager's role is intrinsically linked with the owner(s) of a construction project. The prominence of this interrelationship between construction manager and owner, directly impacts the types of preferred skills and competencies essential for the role.

DISCUSSION

There are three main practical applications of the Chapter results. First, interpersonal skills have a high level of importance to the construction manager's role. Interpersonal skill such as leadership, communication, teamwork and understanding are frequently references throughout a large majority of the construction organisations (refer to Table 6.3). Second, there is a vagueness regarding the technical skills required and/or sought after for a construction manager role, such as '*build*,' '*engineering*' and '*technical*.' Moreover, the deafening silence of the job advertisements regarding general or specific digital skills is in direct opposition to that of current academic digital pursuits (cf. Schiavi *et al*., 2022; Zhang *et al*., 2022). Finally, and along a similar vein, current education provision and industry practice are misaligned about the core foundational skills needed for the construction management profession. Construction management curricula is currently pursuing elevating digital 'everything' within the curriculum whilst current, practising industry professionals are explicitly noting the opposite – a strong focus on interpersonal skills.

The importance of a complementary set of interpersonal and technical skills with the construction manager role has been generally accepted in both wider (non-construction) academia and industry (Englund and Bucero, 2012; Wasson, 2020; Wong, 2018). However, it is confounding that, when viewing specific skill vernacular of job advertisements, an interpersonal skill set profoundly takes centre stage. Perhaps this shift in view is based on the management-esque aspects of the role rather than the niche construction/technical skills – a construction manager is responsible for managing the project, not physically designing or building it (Benator and Thumann, 2020; Sears *et al*., 2008). Additionally, the absence of digital skills, under the larger umbrella of technical skills, further illustrates the industry's overriding preference on interpersonal skills for managing projects. The expertise of digital skills appears to be outside the remit of (or at best in the fringes of) a construction manager and lies within a new subsidiary position specifically fixated on and limited to digital, (BIM Manager, Virtual Design Construction Manager) aiding the management team's wholistic running of a project (Baldwin, 2019; Holzer, 2016). Instead, it appears that the construction manager needs an appreciation of digital skills only so that they may interact with others within the team (for example designers) but do not need to be adept in implementation of technology per se. Often, technology applications is another team member's job and so familiarisation is needed only. Endorsement of these assumptions is needed to investigate: 1) the connection between academia and industry practice to determine if and to what extent, gaps exist as this would directly impact taught educational provision; 2) perceptions of academics on industry stated preferred skills to observe if there is consensus or discord between educators'' perceptions and that of industry (refer to Chapter 7) 3) to determine to what degree are practicing industry professionals are embedded in the development of curricula. A harmonious relationship between academia and industry is vital to ensure that educational curriculum is not only academically sound, but also current with industry practices and the skills and competencies required for those practices.

Limitations

With all research conducted, there are inherent limitations. With this specific secondary data research, one of the main limitations is the researcher bias that is closely linked to an interpretivist philosophy. To that end, the use of a quantitative-esque approach (Voyant Tools) was implemented to counterbalance this philosophical limitation (Roberts *et al*., 2019). Additionally, the secondary data being analysed may be inherently flawed, incomplete and/or imprecise. Specifically, regarding the content of a job advertisement, the research must take the published content at face value given the seriousness and outward publicity of the document. Finally, the research analysis was conducted purely on the information provided in the job advertisements. Potentially speaking with the construction organisations' Human Resources Departments about the information within the job advertisement and/or provide additional pertinent information could further increase the validity of the secondary data and its analysis.

Whilst the textual analysis findings of specific keywords associated with 'professional skills development' yielded many results, it was the frequency and themes of the keywords which uncovered the explicit skills current construction organisations are seeking in construction managers. Future primary data research will help to bring forth the current industry findings into an academic and curriculum development setting to establish a steadfast connection between industry and academia. Built environment academics will serve as a practical and well-placed sample for obtaining this primary data (as investigated in the next Chapter 7).

CONCLUSIONS

The construction industry plays a principal role within the UK economy. At the core of this industry lies the construction manager – responsible for delivering an infrastructure project within its stated objectives. To determine the key skills/competencies of this role, 'professional skills development' keywords within publicly available construction manager job advertisements from ten influential UK construction organisations were obtained. The keywords were qualitatively and quantitively examined through manual and electronic means. The overwhelming presence of interpersonal skills, the vagueness of technical skills and the absence of digital themes were the main keynotes. This research uncovered that different construction organisations who are engaged in different categories/sectors of work throughout similar and different parts of the UK share a steadfast commonality in the preferred skill set of construction managers – interpersonal skills. Furthermore, the ambiguity regarding specific technical skills and an absence of digital skills reference, further reinforce the construction organisations' weight behind the importance of interpersonal skills for the construction manager.

It is strikingly clear that influential construction organisations in the UK are seeking strong interpersonal skills for construction managers – and in many ways this makes perfect sense. The role is after all to manage people not technology per se, and/or people using technology and so an appreciation of advanced technology is required only. A luddite view is not being proposed here – advanced technology has progressed and become infused in the skills and competencies of construction managers – the mobile phone, laptop, project management software and internet access being but several examples that have transformed the role over previous decades. But the role of a manager (indeed, any manager not just a construction manager) is to manage first and foremost – for example, they need to interpret a BIM model, not develop it. This is a fine but important distinction and perhaps presents a moment for pause and reflection of curriculum content development – are HEIs heading in the right direction and are HEIs providing employable graduates? The publicly available job advertisements, in which perspective applicants (practicing professionals), future applicants (students) and associated partners (academia) paints, in vivid colours, a very humanistic, people-oriented landscape. From this, CMPs should, at the very least, perk up and take notice – for this is the role in which the programme is preparing students for.

Fruitful construction projects bolstering a productive industry is an objective of any nation's economy in which construction plays an influential role. The adequate education and preparation of students entering the construction management profession is generally understood by academia and industry alike. However, there is a divergence between the two entities as to exactly what skills/competencies support adequate instruction. Through unearthing the specific 'professional skills development' skills/competencies of construction managers it is hoped that these can actively inform CMCD. This is essentially needed, not only for the relevancy of a programme but for the future of the profession.

CHAPTER 7

DEVELOPING A PROOF-OF-CONCEPT CURRICULUM FOUNDATION MODEL: A PRIMARY DATA SURVEY OF BUILT ENVIRONMENT ACADEMICS

INTRODUCTION

Whilst it has been noted that the current construction management curricula environment is largely fragmented and non-cohesive, there does remain a consensus that both interpersonal and technical skills are vital to a healthy curriculum (Posillico *et al*., 2022a). Furthermore, the interface with and integration of industry into the curriculum has been overwhelmingly supported by CMPs (Goulart *et al*., 2022). This may be due to governmental initiatives, private financial incentives and/or a strong focus on increasing employability outputs; regardless of the driving force, HEIs have recognised the importance of this relationship (Doherty and Stephens, 2020; Okolie *et al*., 2020). However, the degree of importance to which interpersonal and technical skills and competencies play within a curriculum is just as fragmented as the curricula it sits within (Posillico *et al*., 2022a).

Against this landscape, this chapter seeks to conduct descriptive and inferential statistical analyses of primary data from built environment academics to develop a proof-of-concept model of construction management curriculum foundation. Chapter objectives are to: underscore the importance of interpersonal skills and competencies of construction managers to accentuate their inclusion within curricula; verbalise and formulate a foundational set of core interpersonal skills for construction management curricula for the purpose of providing a solid starting point for the building of a programme curriculum; and stimulate pathways for industry and academic informed, contemporary curriculum development research that augments graduate employability.

DEVELOPMENT OF LIKERT-SCALE SURVEY INSTRUMENT

Based upon the data collected from the job advertisement textual analysis reported upon in Chapter 6, a Likert-scale survey data collection instrument was developed (Appendix 1 and 2). The key sections within the Likert-scale survey instrument were: preliminary notations such as general information and ethical statements, demographics (i.e., age range, role, years in academia, built environment programme affiliation and years in industry), Likert-scale questions, overall skill and competency ranking and open-ended questions. Beside five general demographic questions (noted above), the survey instrument was limited to four sections with a collective total of 23 questions. The questions were based upon the incremental analysis of extant literature (Chapters 3 and 4) and secondary data (Chapter 5), culminating in a final list of skills and competencies (Chapter 6). Specifically, Table 7.1 notes where the survey instrument questions were derived from. The question limit was based primarily upon ease of use relative to the high-paced and high-demand nature of academia which, in turn, would help with obtaining a healthy response rate (Yan *et al*., 2011). The style and user interface of the questions was also considered, primarily rating and ranking with open-ended question opportunities. This again, was utilised to dovetail with an academics' daily work constraints so that the survey could be completed quickly, easily and/or on a mobile device (Harrison *et al*., 2019). This said strategy has been utilised by several other researchers (cf. Hassanain *et al*., 2022; Pidgeon and Dawood, 2022; Saleh and Bista, 2017) – thus justifying this selection and method in this present thesis.

Distribution of Likert-scale Survey Instrument

The base questionnaire, as noted in Appendix 1, was easily adapted to an online survey platform, namely Jisc Online Surveys (see Appendix 2). Specifically, the Co-operative Network of Building Researchers (CNBR), the Associated Schools of Construction (ASC), International Council for Research and Innovation in Building and Construction (CIB) and LinkedIn were utilised as the main platforms for the distribution of the survey due to their high membership concentrations of built environment academics. The online survey was open from 9 April 2022 to 25 May 2022.

Sample Size Determination

Utilising Cochran's Formula (n_0) (refer to Equation 1): With an unknown population ($p = 0.5$), a confidence level of 95% (Z = z-score = 1.960) and a margin of error of 5% ($e = 0.05$), the needed sample size for the Likert-scale survey instrument is 385 construction professionals. At the time the Likert-scale survey instrument closed for responses (25 May 2022), a total of 99 academic professionals had provided a response. After reviewing the responses for completeness, six were identified as incomplete and were removed from analysis. A final total of $f = 93$ surveys were noted. There is a discrepancy between the sample size goal ($f = 385$) and the actual number of respondents. However, current literature published does support similar research with a smaller sample size than then intended goal (cf. Al Mawli *et al*., 2021; Fatayer *et al*., 2021; Shaharuddin *et al*., 2021).

Table 7.1 – Survey Instrument Questions with References to Findings/Literature

Question Number	Question Language	Reference
Section One: Demographics		
1	What is your age range?	Saunders *et al*. (2016)
2	What is your current role?	Chapter 5
3	How many years have you worked in academia?	Chapter 5
4	What Built Environment programme are you most closely affiliated with?	Chapter 5
5	How many years of Built Environment industry experience do you have?	Chapter 6
Section Two: Interpersonal Skills and Competencies		
6	How important to the role of a construction / project manager is written / typed communication?	Table 6.3
7	How important to the role of a construction / project manager is verbal communication?	Table 6.3
8	How important to the role of a construction / project manager is non-verbal communication?	Table 6.3
9	How important to the role of a construction / project manager is authentic leadership?	Table 6.3
10	How important to the role of a construction / project manager is effective team management?	Table 6.3
11	How important to the role of a construction / project manager is emotional intelligence (*the ability to monitor one's own emotions*)?	Table 6.3
12	How important to the role of a construction / project manager is effective team / group work?	Table 6.3
13	How important to the role of a construction / project manager is empathy towards others?	Table 6.3
14	How important to the role of a construction / project manager is effective listening and understanding?	Table 6.3
15	Please give brief reasons for your answers (optional).	Saunders *et al*. (2016)
Section Three: Technical Skills and Competencies		
16	How important to the role of a construction / project manager is effective budgeting and cost control?	Table 6.3
17	How important to the role of a construction / project manager is effective estimating?	Table 6.3
18	How important to the role of a construction / project manager is proficiency in creating building information models (BIM)?	Table 6.3
19	How important to the role of a construction / project manager is proficiency in reading / interpreting building information models (BIM)?	Table 6.3
20	How important to the role of a construction / project manager is proficiency in digital technologies (e.g., laser scanning, 3D printing)?	Table 6.3
21	How important to the role of a construction / project manager is proficiency in structural engineering?	Table 6.3
22	How important to the role of a construction / project manager is proficiency in civil engineering?	Table 6.3
23	How important to the role of a construction / project manager is proficiency in critical path method (CPM) scheduling?	Table 6.3
24	How important to the role of a construction / project manager is proficiency in workflow / work sequence?	Table 6.3
25	Please give brief reasons for your answers (optional).	Saunders *et al*. (2016)
Section Four: Ranking		
26	Please rank the following skills and competencies in order of importance to the role of construction / project manager…	Table 6.3
27	Please give brief reasons for your answers (optional).	Saunders *et al*. (2016)
Section Five: Further Comments		
	Do you have any other comments or feedback on the skills and competencies of construction / project managers that you feel have not been covered in this questionnaire?	Saunders *et al*. (2016)

Moreover, a sample size of *f* = 93 is reflective of similar research conducted within construction management literature. For example, Chithambo *et al*. (2022) did research involving stakeholder perceptions on disclosing greenhouse gas emissions; Matin *et al*. (2021) researched the role of personal protective equipment knowledge and attitude in safety outcomes; and Folorunso (2021) researched the effectiveness of wood floor finishes in Nigeria. Hence, it was decided that although imperfect, sufficient data had been collected via which to draw inference from the wider population of practicing construction management academics.

Reliability of Likert-scale Survey Instrument

To establish the reliability of the Likert item section of the survey instrument, Cronbach's alpha was utilised (Information Resources Management Association, 2022). Cronbach's alpha measures the internal consistency of a scaled survey instrument and is recognised as a determinant of a scale reliability (Information Resources Management Association, 2022). A survey scale is generally noted as reliable if the Cronbach's alpha value is > 0.700 (Al-Emran and Shaalan, 2021; Belkhamza and Wafa, 2012).

The Cronbach's alpha value, as calculated via SPSS, for the present survey is 0.839, which is > the benchmark of 0.700. It can therefore be noted that the present survey is considered reliable.

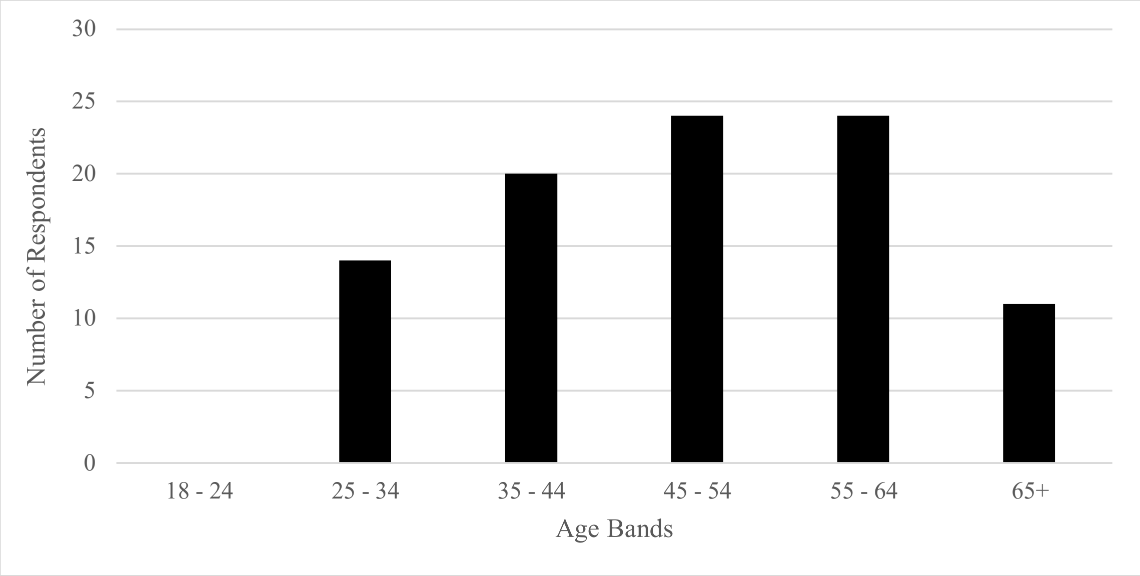
RESULTS AND ANALYSIS OF LIKERT-SCALE SURVEY INSTRUMENT

The completed survey results were formatted to both Microsoft Excel and SPSS compatible files from Jisc Online Surveys. These files were then inputted in Microsoft Excel and SPSS Statistics software for statistical analysis.

Demographics – Overall

As noted in Figure 7.1, just over 73% (73.21%) of the survey respondents were aged between 35 and 64, with a similar spread between the three age-group bands: 35-44 (*f* = 20 or 21.51%), 45-54 (*f* = 24 or 25.81%) and 55-64 (*f* = 24 or 25.81%). Respondents aged 65 and over accounted for 11.83% (*f* = 11) whilst respondents aged between 25 and 34 accounted for 15.05% (*f* = 14). This has demonstrated a sufficient respondent age range to complete the questionnaire and add informed knowledge; not one age range dominated the survey.

Figure 7.1 – Respondent's Age



The respondents predominately were in an Associate Professors / Professors role with 46.24% (*f* = 43) with Assistant Lecturer / Lecturer the second most frequently categorised (*f* = 27 or 29.03%); refer to Figure 7.2. Senior Lecturers and Senior Leadership / Department Heads were a distant third and fourth with *f* = 16 or 17.20% and *f* = 7 or 7.53% respectively. This demonstrates a good breadth of academic standing which is indicative of a like breadth of discipline knowledge and understanding.

Figure 7.2 – Respondents Academic Role

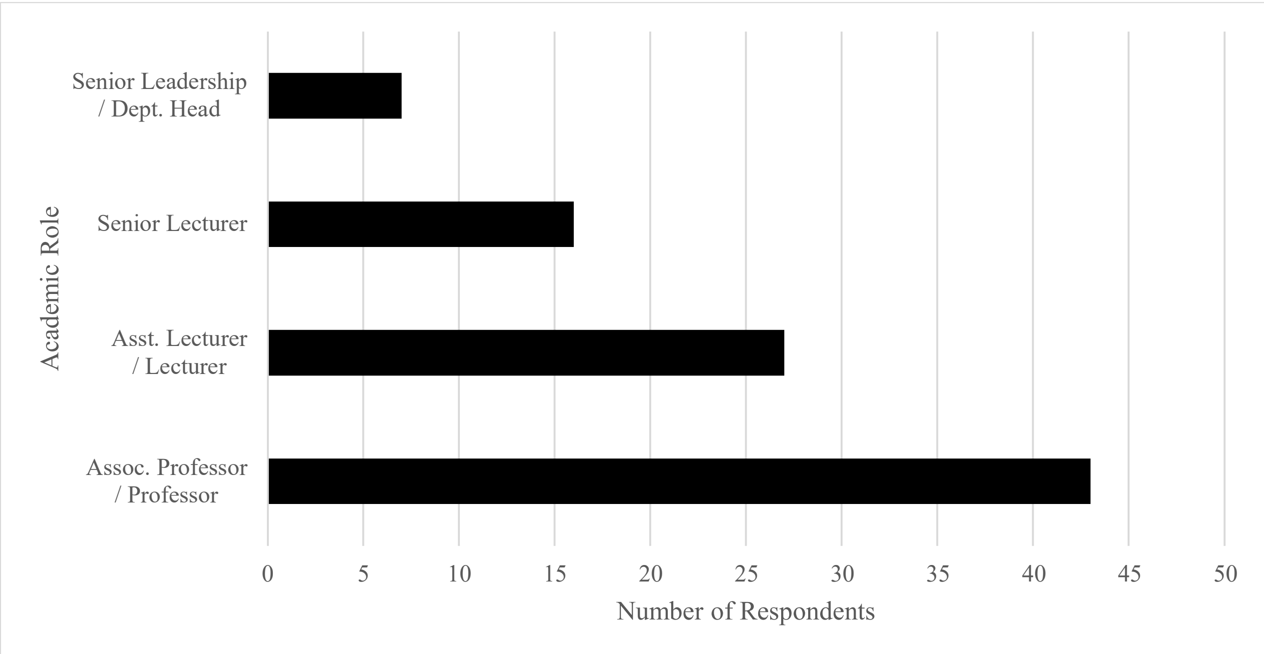


Figure 7.3 looks at respondents both from the amount of time (experience) they have in a time academia and the construction industry. Slicing both year spectrums in half, a comparison of the percentages of respondents can occur. A 60%-40% split regarding years in academia is visible, with 60.22% of the respondents falling within the first half of the year spectrum (0 – 14 years). For years in industry, a 23%-77% split is viable, with 77.42% of the respondents falling within the second half of the year spectrum (6 – 10+). There is a strong industry practice tenure with a slightly less robust academic tenure within the respondents. From a broad view, this does appear reasonable as construction industry experience usually precedes academic experience.

Regarding the affiliated course of study with the respondents – the course they are most closely associated with – the overwhelming majority indicated Construction Management (f = 68 or 73.12%). Quantity Surveying was a distant second (f = 14 or 15.05%) with an aggregate of Building Surveying, Architectural Technology, Civil Engineering and Other at the bottom of the table (f = 11 or 11.38%). Table 7.2 displays the aggregate demographic data for the respondents. This aggregate view of the respondent's demographics suggests a good sample population – a good span of age ranges (not one age range dominates), nice breadth of academic standing (entry level to senior leadership), extensive industry experience (77.42% with more six plus years of experience) and a strong focus on the construction management discipline (73.12% of respondents).

Figure 7.3 – Respondents Time in Academia and Industry

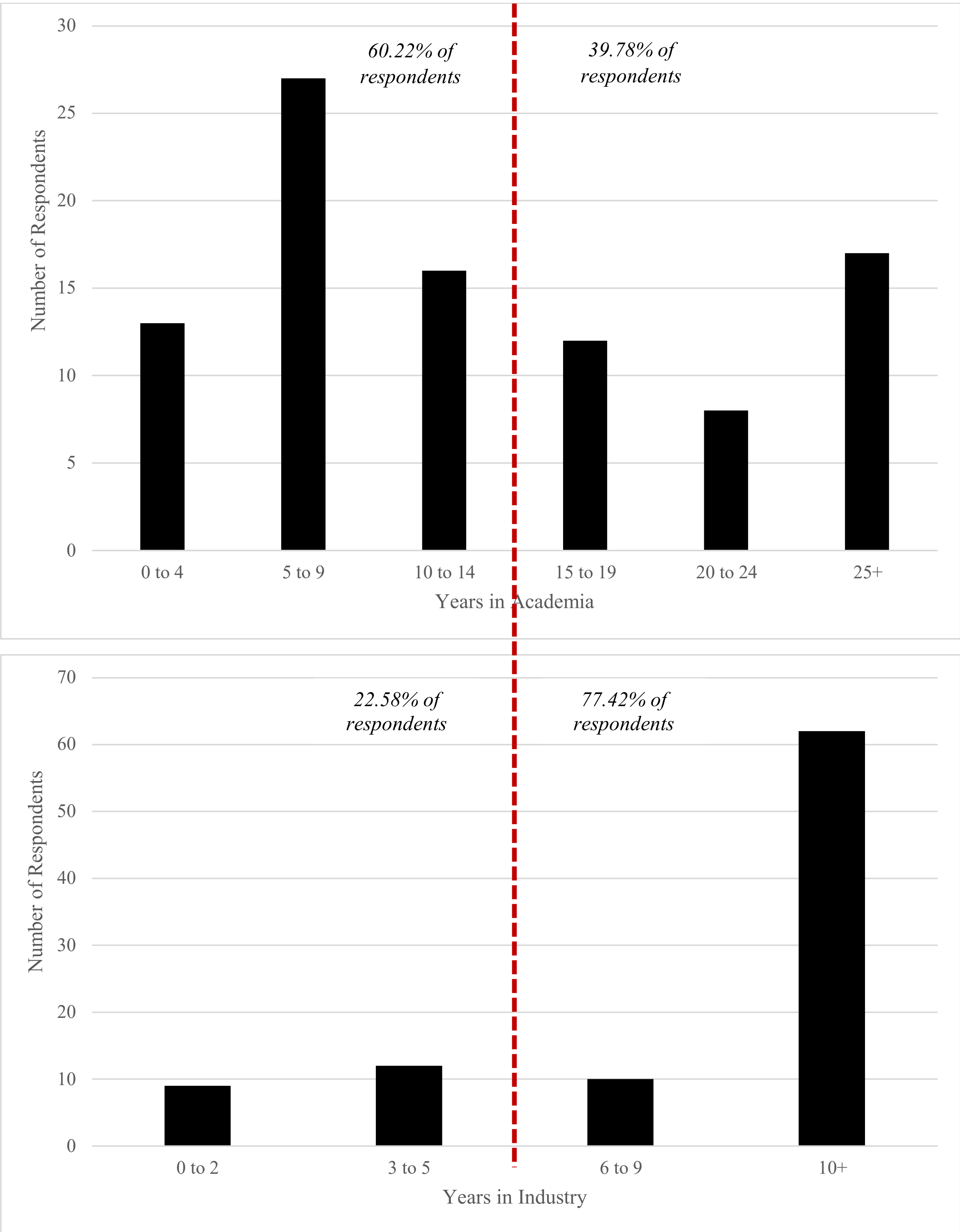


Table 7.2 – Aggregate Demographics of Survey Respondents

Keyword (Root)	**Options**					
Age Range	18 - 24	25 - 34	35 - 44	45 - 54	55 - 64	65+
	0 *(0.00%)*	14 *(15.05%)*	20 *(21.51%)*	24 *(25.81%)*	24 *(25.81%)*	11 *(11.83%)*
Current Role	Assist. Lecturer / Lecturer	Senior Lecturer	Assoc. Professor / Professor	Senior Leadership / Department Head		
	27 *(29.03%)*	16 *(17.20%)*	43 *(46.24%)*	7 *(7.53%)*		
Years Worked in Academia	0 - 4	5 - 9	10 - 14	15 - 19	20 - 24	25+
	13 *(13.98%)*	27 *(29.03%)*	16 *(17.20%)*	12 *(12.90%)*	8 *(8.60%)*	17 *(18.28%)*
Course / Programme Affiliation	Construction Management	Quantity Surveying	Building Surveying	Civil Engineering	Architectural Technology	Other
	68 *(73.12%)*	14 *(15.05%)*	2 *(2.15%)*	6 *(6.45%)*	2 *(2.15%)*	1 *(1.08%)*
Years Works in Industry	0 - 2	3 - 5	6 - 9	10+		
	9 *(9.68%)*	12 *(12.90%)*	10 *(10.75%)*	62 *(66.67%)*		

Demographics – Specific Academic Role

Looking specifically at the 27 Assistant Lecturer / Lecturer respondents, the most frequently occurring age range was 25-34 (*f* = 11 or 40.74%) followed closely by 45-54 (*f* = 8 or 29.63%). Around half of the respondents have spent 5 to 9 years in academia (*f* = 13 or 48.15%) and 10+ years in the construction industry (*f* = 14 or 51.85%). The Construction Management course of study is by far the most associated course with 70.37% (*f* = 19) of respondents indicating such.

For the 16 Senior Lecturers, the 45-54 and 55-64 age ranges were both equally represented as the most frequent (*f* = 5 or 31.25%). Likewise, the 25-34, 35-44 and 65+ age ranges were equally represented (*f* = 2 or 12.50%). A total of six respondents have spent 5 to 9 years in academia (*f* = 6 or 37.50%) with a quarter of the respondents (*f* = 4 or 25.00%) spending less than four years. Six respondents (*f* = 6 or 37.50%) had between 10 to 25+ years of academic experience. Three quarters (*f* = 12 or 75.00%) had over ten years of industry experience with all but one respondent indicating between 6 to 9 years of industry experience. Half of the respondents (*f* = 8 or 50.00%) identified most closely with the Construction Management course of study with a fairly equal distribution spread throughout the remaining five course options (f = X for Quantity Survey, Building Surveying and Architectural Technology; f = 1 for Civil Engineering and Other).

Almost half (f = 43 or 46.24%) of all survey respondents identified their role as either Associate Professor or Professor. Close to 80% (79.07% or f = 34) were within the 35-44, 45-54 and 55-64 age bands. From time spent in academia, a very even spread across year ranges is evident. Specifically, 25+ years (f = 11 or 25.58%), 10 to 14 and 15 to 19 (f = 9 or 20.93%) each and 5 to 9 years (f = 8 or 18.60%). In contrast, the overwhelming majority of respondents (f = 30 or 69.77%) indicated 10+ years of construction industry experience. Likewise, Construction Management was the large majority course identified by respondents (f = 34 or 79.07%).

As for Senior Leadership / Department Head role, this ranked as the lowest frequency of respondent identification (f = 7). Age range for these respondents focused on 45–54 and 55–65 bands (f = 3 or 42.86%) each. All respondents identified with the Construction Management course of study. Similarly, all respondents had over 10+ years in academia and all but one respondent had over 10+ years in the construction industry.

From the above demographic statistical analysis, the respondents, as a whole, are very reflective of both academic and industry practice. The balance and spread of roles, ages and experiences of the respondents indicates an even keel within the sample.

Descriptive Statistics for Survey

Descriptive statistics are utilised to describe and contextualise basic information of the dataset (Holcomb, 2017). Descriptive statistics also help to provide a high-level summary of the dataset, without trying to reach pinpoint statistical conclusions (Lacort, 2014). This type of analysis forms the basis for more advance statistical analysis – inferential statistics (Holcomb, 2017). For this research the mean, median and WA, along with general mathematics, were the descriptive statistic methods utilised. These relatively basic mathematical computations are aligned with the purpose of descriptive statistics – high-level contextualisation of the data

Interpersonal Skills and Competencies

The mean and median values for each of the nine interpersonal skills and competencies questions were calculated and plotted in Figure 7.4. All nine skills and competencies were within the 5.00 to 4.00 mean and median. Corresponding the quantitative value to the indicated qualitative description, this ranged from ‘important’ to ‘very important.’

As depicted in Figure 7.5, there is a consistent rating of 4.00 and 5.00 across all nine skills and competencies. The ratings of ‘important’ to ‘very important,’ in total comprised 93.31% of the ratings given by the 93 respondents. Only 5.50% and 1.19% were given to ratings of 3.00 (neutral) and 2.00 (low importance). This suggests that, on the whole, the spectrum of interpersonal skill and competencies were sought of as being important to the role of construction manager.

Analysis of the interpersonal skills and competencies can also occur based on the current identified role of the respondents. As depicted in Figure 7.6, there is very little difference between the ratings given for each skill and competency based on the role of the respondent; all four roles appear to agree on the level of importance for the interpersonal skills and competencies. Specifically, the two largest rating differences, based on the four role categories for a skill/competency was 0.30 (‘verbal communication’) and 0.29 (‘listening and understanding’), or just less than one third of a rating score. Elaborating further, this indicates that throughout academic positions/standings in HEIs, there is general agreement as to the level of importance of the interpersonal skills and competencies.

Figure 7.4 – Mean and Median Values for Interpersonal Skills and Competencies

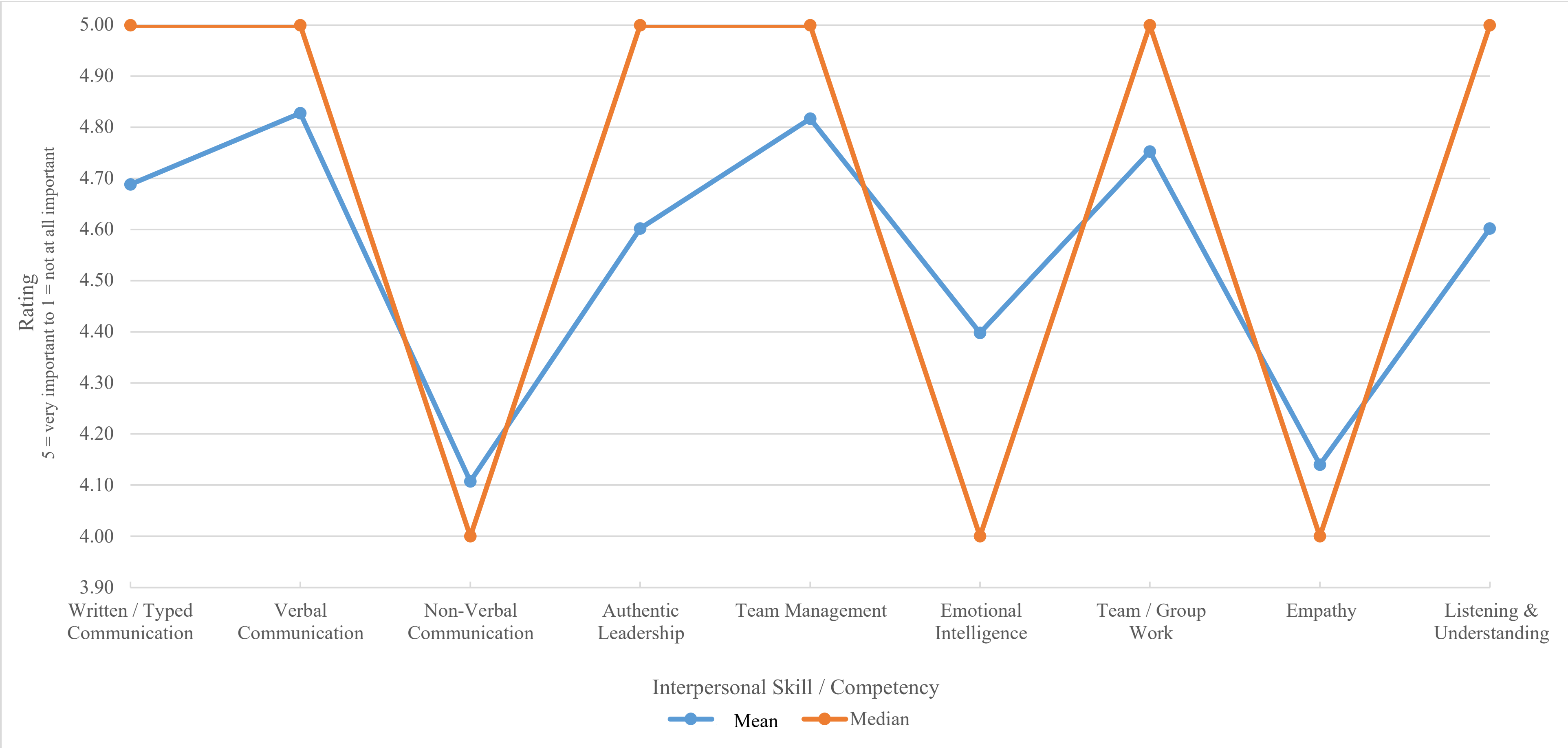


Figure 7.5 – Rating Percentages for Interpersonal Skills and Competencies

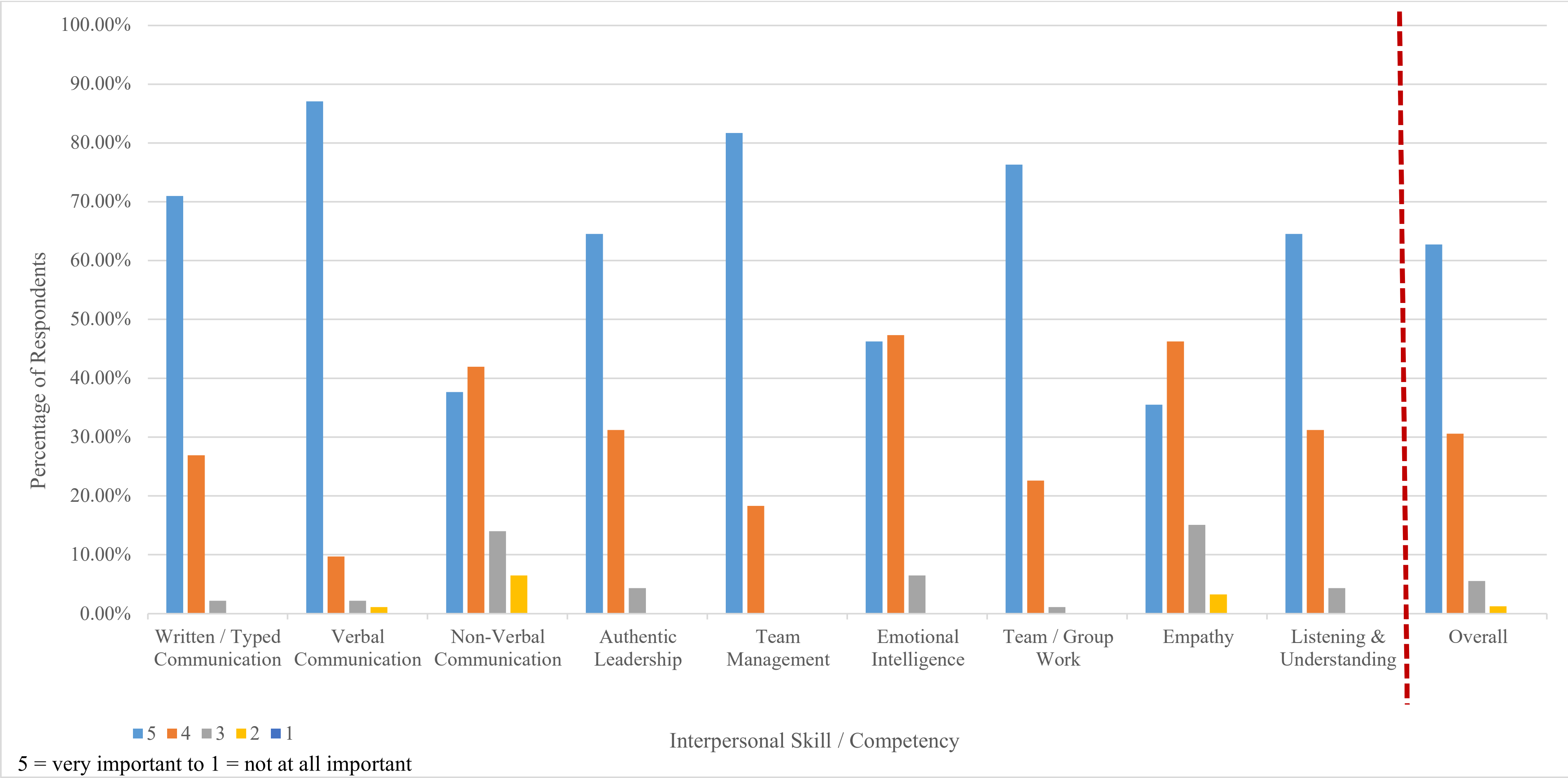
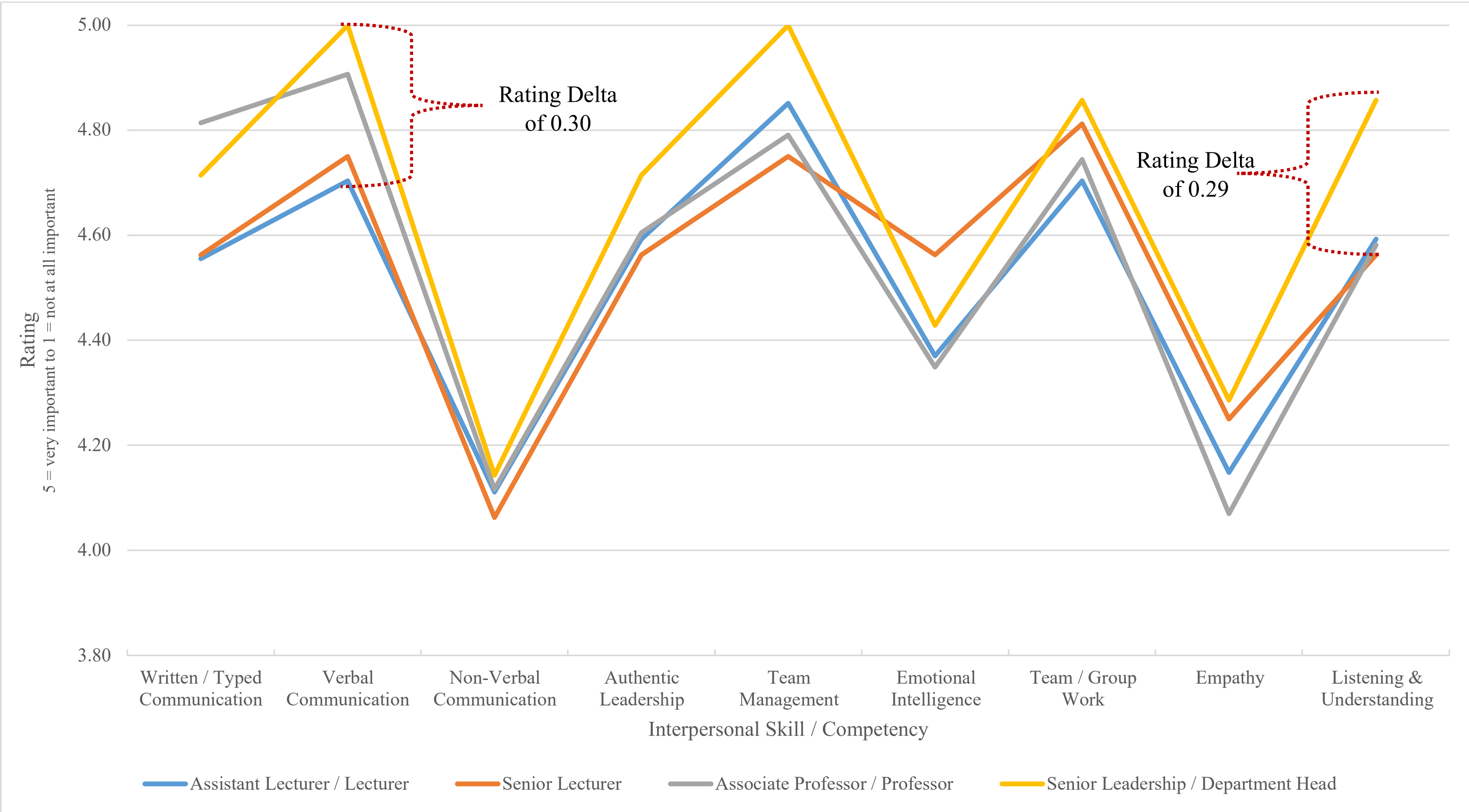


Figure 7.6 – Ratings of Interpersonal Skills and Competencies based on Respondent Role



Utilising a WA (refer to Equation 2), where the rating score is multiplied by the frequency of respondents selecting that specific rating score, a level of importance ranking can be visualised. As noted in Table 7.3, the top-rated interpersonal skill was '*verbal communication'* (WA total = 449) with '*team management'* an extremely close second (WA total = 448). The difference in WA totals between the top-rated skill to the sixth-rated skill was only 21 points. This indicates that top six (66.67%) skills and competencies are closely knit in terms of importance. There is a large void between the top six skills and competencies and the bottom three – 19 points from 6th ('*authentic leadership'* and '*listening & understanding')* to 7th ('*emotional intelligence*'), 24 points from 7th ('*emotional intelligence*') to 8th ('*empathy*') and 3 points from 8th ('*empathy*') to 9th ('*non-verbal communication*').

Technical Skills and Competencies

The mean and median values for each of the nine technical skills and competencies questions were calculated and plotted in Figure 7.7. All nine skills and competencies were within the 5.00 to 3.00 mean and median. Corresponding the quantitative value to the indicated qualitative description, this ranged from 'neutral' to 'very important.'

As depicted in Figure 7.8, just under 85% (f = 79 or 84.95%) of the ratings for all nine skills and competencies range from 3.00 to 5.00 (neutral to very important). A rating of 2.00 (low importance) comprised 12.31% and the lowest rating (1.00) which signifies no importance was noted 2.75%.

Table 7.3 – Weighted Averages of Interpersonal Skills and Competencies

Rating	Verbal Communication		Team Management		Team / Group Work		Written / Typed Communication		Authentic Leadership		Listening & Understanding		Emotional Intelligence		Empathy		Non-Verbal Communication	
	f	WA	*f*	WA	*f*	WA	*f*	WA	*f*	WA	*f*	WA	*f*	WA	*f*	WA	*f*	WA
5	81	405	76	380	71	355	66	330	60	300	60	300	43	215	33	165	35	175
4	9	36	17	68	21	84	25	100	29	116	29	116	44	176	43	172	39	156
3	2	6	0	0	1	3	2	6	4	12	4	12	6	18	14	42	13	39
2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	3	6	6	12
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		449		448		442		436		428		428		409		385		382
Diff. Between			1		6		6		8		0		19		24		3	

Figure 7.7 – Mean and Median Values for Technical Skills and Competencies

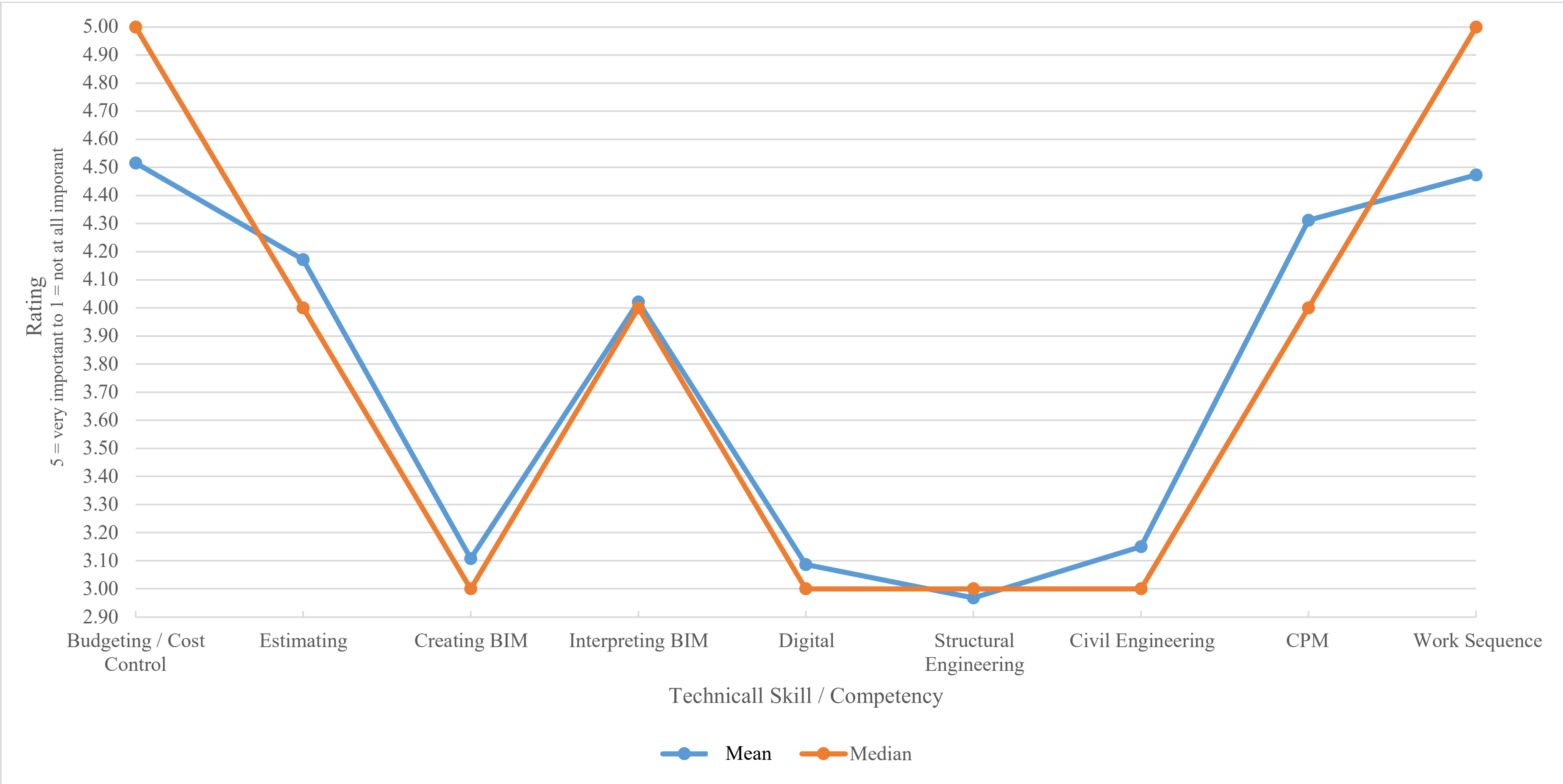
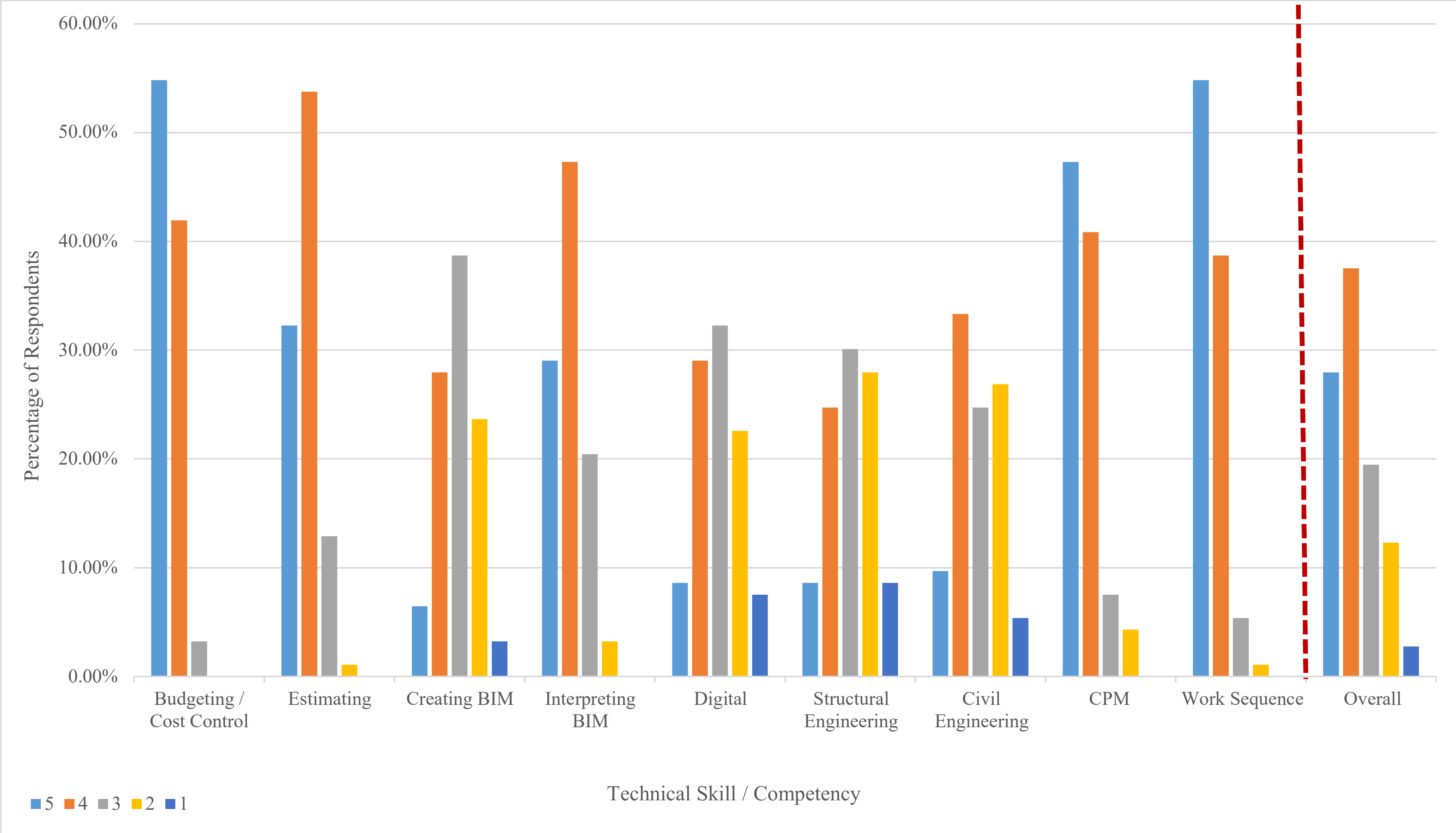


Figure 7.8 – Rating Percentages for Technical Skills and Competencies



Analysis of the technical skills and competencies can also occur based on the current identified role of the respondents. As depicted in Figure 7.9, there is a wide range of difference between the ratings given for some skills and competencies based on the role of the respondent. Specifically, the two largest rating differences, based on the four role categories for a skill/competency was 1.21 (‘*structural engineering’*) and 1.05 (‘*civil engineering’*). Similarly, four additional skills and competencies depicted a smaller, yet still large, rating difference – 0.87 (‘*creating BIM’*), 0.63 (‘*work sequence’*), 0.57 (‘*interpreting BIM’*) and 0.40 (‘*digital technologies’*). However, the four roles do appear to agree on the level of importance for some of the technical skills and competencies. Specifically, the three smallest rating differences, based on the four role categories for a skill/competency was 0.15 (‘*critical path method’*), 0.30 (‘*estimating’*) and 0.34 (‘*budgeting and cost control’*). This agreement may be because those three skills and competencies could be considered traditional, non-digital technical construction management aptitudes which suggests a possible preference for tenured skills rather than entrant skills.

As noted in Table 7.4, the top-rated technical skill was ‘budgeting / cost control’ (WA total = 420) with ‘work sequence’ a close second (WA total = 416). The difference in WA totals between the five technical skills is around 13 – 15 points. However, there is an extremely large void between the fifth-rated skill (‘interpreting BIM’) and the sixth-rated skill (‘civil engineering’) – 81 points. In summary, the top five skills are fairly dispersed in terms of importance and the respondents are in agreement regarding the bottom four technical skills.

Figure 7.9 – Ratings of Technical Skills and Competencies based on Respondent Role

Table 7.4 – Weighted Averages of Technical Skills and Competencies

Rating	Budgeting / Cost Control		Work Sequence		Critical Path Method		Estimating		Interpreting BIM		Civil Engineering		Creating BIM		Digital Technologies		Structural Engineering	
	f	WA	*f*	WA	*f*	WA	*f*	WA	*f*	WA	*f*	WA	*f*	WA	*f*	WA	*f*	WA
5	51	255	51	255	44	220	30	150	27	135	9	45	6	30	8	40	8	40
4	39	156	36	144	38	152	50	200	44	176	31	124	26	104	27	108	23	92
3	3	9	5	15	7	21	12	36	19	57	23	69	36	108	30	90	28	84
2	0	0	1	2	4	8	1	2	3	6	25	50	22	44	21	42	26	52
1	0	0	0	0	0	0	0	0	0	0	5	5	3	3	7	7	8	8
Total		420		416		401		388		374		293		289		287		276
Diff. Between			4		15		13		14		81		4		2		11	

Inferential Statistics for Survey

Inferential statistics are utilised to help draw conclusions, or inferences, about a dataset (Asadoorian and Kantarelis, 2005). Building off descriptive statistics, inferential statistics takes the reached conclusion(s) and apply it to a more overall population (Boslaugh, 2013). This type of analysis includes various mathematical tests, formulas and models to help pinpoint robust conclusions about a dataset (Asadoorian and Kantarelis, 2005).

Relative Importance Index (RII)

Table 7.5 notes the relative importance (refer to Equation 3) for each survey question. Of the 18 questions noting skills and competencies, four (22.22%) fall below the threshold of 0.700 relative importance. Interestingly, the four skills and competencies that do not meet the RII threshold are all from the technical skills section of the questionnaire: *'creating BIM,' 'digital technologies,' 'structural engineering'* and *'civil engineering.'* This suggests that the spectrum of interpersonal skills have been deemed relatively important whilst some of the technical skills, as noted above, are considered less important to their counterparts. Interestingly, of the four technical skills that fall below the RII threshold, two of them (*'creating BIM'* and *'digital technologies'*) are in the same skill and competency vein that many HEIs have highlighted as fundamental to their programmes (refer to Chapter 5).

Table 7.5 – Relative Importance Index for Survey Questions

Question	Frequency of Respondents Selecting… 5	4	3	2	1	Total [Σ*W*]	*N*	*A* * *N*	RII
6_i – Written / Typed Communication	66	25	2	0	0	436	93	465	0.938
7_i – Verbal Communication	81	9	2	1	0	449	93	465	0.966
8_i – Non-Verbal Communication	35	39	13	6	0	382	93	465	0.822
9_i – Authentic Leadership	60	29	4	0	0	428	93	465	0.920
10_i – Team Management	76	17	0	0	0	448	93	465	0.963
11_i – Emotional Intelligence	43	44	6	0	0	409	93	465	0.880
12_i – Team / Group Work	71	21	1	0	0	442	93	465	0.951
13_i – Empathy	33	43	14	3	0	385	93	465	0.828
14_i – Listening & Understanding	60	29	4	0	0	428	93	465	0.920
16_t – Budgeting / Cost Control	51	39	3	0	0	420	93	465	0.903
17_t – Estimating	30	50	12	1	0	388	93	465	0.834
18_t – Creating BIM	6	26	36	22	3	289	93	465	0.622
19_t – Interpreting BIM	27	44	19	3	0	374	93	465	0.804
20_t – Digital Technologies	8	27	30	21	7	287	93	465	0.617
21_t – Structural Engineering	8	23	28	26	8	276	93	465	0.594
22_t – Civil Engineering	9	31	23	25	5	293	93	465	0.630
23_t – Critical Path Method Schedule	44	38	7	4	0	401	93	465	0.862
24_t – Work Sequencing	51	36	5	1	0	416	93	465	0.895

$_i$ = interpersonal, $_t$ = technical

Table 7.6 places the skills and competencies in order of relative importance. Only viewing the 14 skills and competencies that have a RII above 0.700, two bands or groupings can be assigned. Specifically, Band 001 are the are seven skills and competencies that have a RII above 0.900 (e.g., *verbal communication, team management, team / group work, written/typed communication, authentic leadership, listening & understanding and budgeting / cost control*). Band 002 are the remaining seven skills and competencies where their RIIs happen to fall between 0.900 and 0.800 (e.g., *work sequencing, emotional intelligence, critical path method schedule, estimating, empathy, non-verbal communication and interpreting BIM*).

Similarly, the mean value for Band 001 falls above a score of 4.5 out of 5.0, while the mean rating value of Band 002 is from 4.5 to 4.0 out of 5.0. Furthermore, looking at the standard deviation (SD) values for each skill/competency, Band 001's SD values are below 0.6 and Band 002's SD values are from 0.6 to 0.88. The SD values of both Bands indicate, to a degree, that the ranking values are more bunched around the mean ranking value – with Band 001 having a better SD spread. Specifically, there are greater levels of agreement with less variability amongst the survey respondents, particularly regarding Band 001.

The interquartile range was also calculated for the mean rating scores for each question to give a deeper and richer summary statistical analysis of the data. The interquartile range was determined to be 0.58 (Q_3 = 4.60 and Q_1 = 4.02), which indicates that half of the rating scores fall with the range of 4.02 to 4.60. From this analysis, it can be comfortably noted that the data is skewed towards a higher rating of importance.

Looking at the entire set of 14 skills and competencies, there are nine interpersonal skills (100% of interpersonal skills) and five technical skills (55.56% of technical skills). Of Band 001s seven skills and competencies all but one (85.71%) are interpersonal skills and of Band 002s seven skills and competencies, three (42.86%) are interpersonal skills.

Table 7.6 – Relative Importance Index for Survey Questions – Ranked

Question	Frequency of Respondents Selecting…					Total	*N*	*A* * *N*	RII	Mean	SD
	5	4	3	2	1	[Σ*W*]					
7_i – Verbal Communication	81	9	2	1	0	449	93	465	0.966	4.83	0.503
10_i – Team Management	76	17	0	0	0	448	93	465	0.963	4.82	0.389
12_i – Team / Group Work	71	21	1	0	0	442	93	465	0.951	4.75	0.458
6_i – Written / Typed Communication	66	25	2	0	0	436	93	465	0.938	4.69	0.510
9_i – Authentic Leadership	60	29	4	0	0	428	93	465	0.920	4.60	0.574
14_i – Listening & Understanding	60	29	4	0	0	428	93	465	0.920	4.60	0.574
16_t – Budgeting / Cost Control	51	39	3	0	0	420	93	465	0.903	4.52	0.564
24_t – Work Sequencing	51	36	5	1	0	416	93	465	0.895	4.47	0.653
11_i – Emotional Intelligence	43	44	6	0	0	409	93	465	0.880	4.40	0.610
23_t – Critical Path Method Schedule	44	38	7	4	0	401	93	465	0.862	4.31	0.794
17_t – Estimating	30	50	12	1	0	388	93	465	0.834	4.17	0.686
13_i – Empathy	33	43	14	3	0	385	93	465	0.828	4.14	0.788
8_i – Non-Verbal Communication	35	39	13	6	0	382	93	465	0.822	4.11	0.878
19_t – Interpreting BIM	27	44	19	3	0	374	93	465	0.804	4.02	0.794
22_t – Civil Engineering	9	31	23	25	5	293	93	465	0.630	3.15	1.093
18_t – Creating BIM	6	26	36	22	3	289	93	465	0.622	3.11	0.949
20_t – Digital Technologies	8	27	30	21	7	287	93	465	0.617	3.09	1.080
21_t – Structural Engineering	8	23	28	26	8	276	93	465	0.594	2.97	1.108

$_i$ = interpersonal, $_t$ = technical

One Sample T-Test

One Sample T-Tests (refer to Equation 4) were conducted on the 18 interpersonal and technical skills and competencies. A One Sample T-Test is a statistical tool used to compare mean values of a variable (Likert scale rating of a skill/competency in this study) to that of a conjectured mean (Likert scale rating of 3.50 in this study). The null hypothesis (H_0) notes, *"the mean value is not a statistically important skill/competency"* The alternative hypothesis (H_a) notes, *"the mean value is a statistically important skill/competency."*

The results of a One Sample T-Test for the nine interpersonal skills and competencies are depicted in Table 7.7. All nine skills had mean values > the conjectured mean (3.50). Looking at the p-values for each skill/competency, which measures the probability of a set of observations would occur by random change (Hayter, 2012), a value <0.001 is noted for all. The null hypothesis (H_0) is disproven for the nine interpersonal skills and competencies indicating that these are statistically significant.

Furthermore, the results of a One Sample T-Test for the eight technical skills and competencies are noted in Table 7.8. Five of the nine (55.56%) of the technical skills and competencies had mean values > the conjectured mean (3.50). The remaining four (44.44%) skills and competencies had mean values < the conjectured mean. Looking at the p-values for each skill/competency, all by one ('civil engineering') indicate a value of <0.001, whereas 'civil engineering' notes a p-value of 0.001. For the technical skills and competencies, the null hypothesis (H0) is disproven, indicating that these are statistically significant.

Table 7.7 – One Sample T-Test for Interpersonal Skills

Question and Skill/Competency	Test Value = 3.50						99% Confidence Interval of the Difference	
	t	df	One-Sided p	Two-Sided p	Mean	Mean Difference	Lower	Upper
6 – Written/Typed Communication	22.454	92	< 0.001	< 0.001	4.69	1.188	1.05	1.33
7 – Verbal Communication	25.476	92	< 0.001	< 0.001	4.83	1.328	1.19	1.47
8 – Non-Verbal Communication	6.673	92	< 0.001	< 0.001	4.11	0.608	0.37	0.85
9 – Authentic Leadership	18.527	92	< 0.001	< 0.001	4.60	1.102	0.95	1.26
10 – Team Management	32.689	92	< 0.001	< 0.001	4.82	1.317	1.21	1.42
11 – Emotional Intelligence	14.185	92	< 0.001	< 0.001	4.40	0.898	0.73	1.06
12 – Team/Group Work	26.367	92	< 0.001	< 0.001	4.75	1.253	1.13	1.38
13 – Empathy	7.826	92	< 0.001	< 0.001	4.14	0.640	0.42	0.85
14 – Listening and Understanding	18.527	92	< 0.001	< 0.001	4.60	1.102	0.95	1.26

Table 7.8 – One Sample T-Test for Technical Skills

Question and Skill/Competency	Test Value = 3.50						99% Confidence Interval of the Difference	
	t	df	One-Sided p	Two-Sided p	Mean	Mean Difference	Lower	Upper
16 – Budget/Cost Control	17.386	92	< 0.001	< 0.001	4.52	1.016	0.86	1.17
17 – Estimating	9.453	92	< 0.001	< 0.001	4.17	0.672	0.49	0.86
18 – Creating BIM	-3.987	92	< 0.001	< 0.001	3.11	-0.392	-0.65	-0.13
19 – Interpreting BIM	6.336	92	< 0.001	< 0.001	4.02	0.522	0.31	0.74
20 – Digital Technologies	-3.696	92	< 0.001	< 0.001	3.09	-0.414	-0.71	-0.12
21 – Structural Engineering	-4.633	92	< 0.001	< 0.001	2.97	-0.532	-0.83	-0.23
22 – Civil Engineering	-3.084	92	0.001	0.003	3.15	-0.349	-0.65	-0.05
23 – Critical Path Method Schedule	9.864	92	< 0.001	< 0.001	4.31	0.812	0.60	1.03
24 – Work Sequencing	14.380	92	< 0.001	< 0.001	4.47	0.973	0.80	1.15

Chi-Square Test

Because the data is non-parametric in distribution, the One Sample T-Test, which is parametric, may not provide a suitable method of statistical analysis alone. The use of a similar statistical testing, but based non-parametrically, can help support the statistical findings. A Chi-Square Test (refer to Equation 5) was conducted on the 18 skills and competencies and the results are noted in Table 7.9. As depicted, the asymptotic significance, or p-value, for all 18 skills and competencies is <0.001. This, in conjunction with the One Sample T-Tests confirm a statistical significance in the skills and competencies.

Kruskal-Wallis Test

Additionally, a Kruskal-Wallis Test (refer to Equation 6), which is also a non-parametric test, was performed to see if there was a difference in ratings of interpersonal and technical skills across several respondent variable. As depicted in Table 7.10, there is not a significant difference in rating of interpersonal and technical skills and competencies across the respondents: age, academic role, number of years in academia, number of years in industry and/or course affiliation. This signifies that the rating distribution for the interpersonal and technical skills and competencies are not significantly impacted by respondents' variables – the ratings are collectively aligned.

Table 7.9 – Chi-Square Test for Interpersonal and Technical Skills

Question and Skill/Competency	Chi-Square	df	Asymp. Sig. (p-value)
6_i – Written/Typed Communication	67.806[a]	2	<0.001
7_i – Verbal Communication	192.892[b]	3	<0.001
8_i – Non-Verbal Communication	33.925[b]	3	<0.001
9_i – Authentic Leadership	50.774[a]	2	<0.001
10_i – Team Management	37.430[c]	1	<0.001
11_i – Emotional Intelligence	30.258[a]	2	<0.001
12_i – Team/Group Work	83.871[a]	2	<0.001
13_i – Empathy	42.183[b]	3	<0.001
14_i – Listening and Understanding	50.744[a]	2	<0.001
16_t – Budget/Cost Control	40.258[a]	2	<0.001
17_t – Estimating	59.473[b]	3	<0.001
18_t – Creating BIM	41.462[d]	4	<0.001
19_t – Interpreting BIM	37.538[b]	3	<0.001
20_t – Digital Technologies	24.366[d]	4	<0.001
21_t – Structural Engineering	20.817[d]	4	<0.001
22_t – Civil Engineering	26.409[d]	4	<0.001
23_t – Critical Path Method Schedule	55.172[b]	3	<0.001
24_t – Work Sequencing	75.731[b]	3	<0.001

a. 0 cells (0.00%) have expected frequencies less than 5. The minimum expected cell frequency is 31.0

b. 0 cells (0.00%) have expected frequencies less than 5. The minimum expected cell frequency is 23.3

c. 0 cells (0.00%) have expected frequencies less than 5. The minimum expected cell frequency is 46.5

d. 0 cells (0.00%) have expected frequencies less than 5. The minimum expected cell frequency is 18.6

$_i$ = interpersonal, $_t$ = technical

Table 7.10 – Kruskal-Wallis Test Results

Group	Null Hypothesis	Test Statistic	Degree of Freedom	Asymptotic Sig. [a, b] (p-value)	Decision on the Null Hypothesis
Academic Role	The distribution of Interpersonal Skills is the same	1.334 [a, b]	3	0.721	Retain
	The distribution of Technical Skills is the same	4.203 [a, b]	3	0.240	Retain
Age	The distribution of Interpersonal Skills is the same	7.814 [a, b]	4	0.099	Retain
	The distribution of Technical Skills is the same	7.198 [a, b]	4	0.126	Retain
Years in Academia	The distribution of Interpersonal Skills is the same	7.459 [a, b]	5	0.189	Retain
	The distribution of Technical Skills is the same	5.283 [a, b]	5	0.382	Retain
Years in Industry	The distribution of Interpersonal Skills is the same	2.562 [a, b]	3	0.464	Retain
	The distribution of Technical Skills is the same	6.286 [a, b]	3	0.098	Retain
Course Affiliation	The distribution of Interpersonal Skills is the same	5.337 [a, b]	5	0.376	Retain
	The distribution of Technical Skills is the same	9.659 [a, b]	5	0.086	Retain

a. The test statistic is adjusted for ties.

b. Multiple comparisons are not performed because the overall test does not show significant differences across samples.

Comparison Between Interpersonal and Technical

The mean and median values for the 18 interpersonal and technical skills and competencies were overlayed in Figure 7.10 which clearly depicts a higher rating trend for interpersonal skills and competencies rather than technical skills and competencies. Table 7.11 depicts the WA for the 18 skills and competencies were placed in order from highest to lowest. Looking at the top ten skills and competencies, based on WA, which also correspond to a weight average total of >400, seven are interpersonal skills (70.00%). The three technical skills and competencies within the top ten fall into two categories: cost control and time control. Specifically, '*budgeting / cost control*', '*work sequencing*' and '*critical path method schedule*' are the three technical skills. Conversely, only two interpersonal skills and competencies are in the bottom eight – '*empathy*' and '*non-verbal communication'*. However, six, or 66.67% of the technical skills and competencies are located within the bottom eight when ranked based on WA. This clearly demonstrates that interpersonal skills and competencies have a greater level of importance to the role of construction manager than technical skills and competencies. Furthermore, the skills and competencies, when ranked, provide a clear hierarchy of aptitudes that can be used during module and programme curricula development – specifically a proof-of concept curriculum foundation model presented in the section below. Qualitative data from the questionnaire supported the quantitative findings; this data is not included within the thesis.

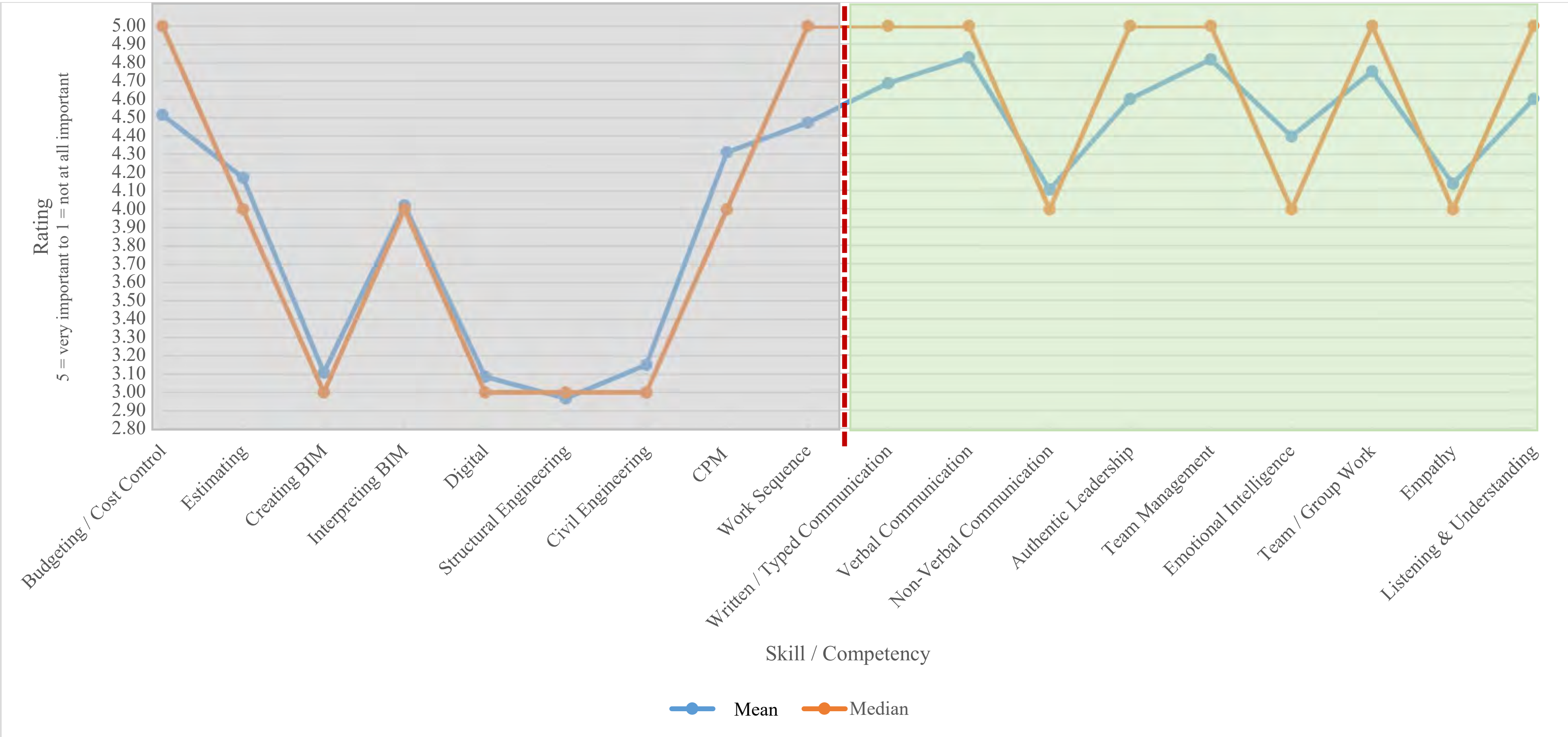
Table 7.11 – Weighted Averages of Interpersonal and Technical Skills and Competencies

Rank	Question	Weighted Average
1	7_i – Verbal Communication	449
2	10_i – Team Management	448
3	12_i – Team / Group Work	442
4	6_i – Written / Typed Communication	436
5	9_i – Authentic Leadership	428
	14_i – Listening & Understanding	
7	16_t – Budgeting / Cost Control	420
8	24_t – Work Sequencing	416
9	11_i – Emotional Intelligence	409
10	23_t – Critical Path Method Schedule	401
11	17_t – Estimating	388
12	13_i – Empathy	385
13	8_i – Non-Verbal Communication	382
14	19_t – Interpreting BIM	374
15	22_t – Civil Engineering	293
16	18_t – Creating BIM	289
17	20_t – Digital Technologies	287
18	21_t – Structural Engineering	276

$_i$ = interpersonal, $_t$ = technical

Figure 7.10 – Mean and Median Values Overlay for Interpersonal and Technical Skills and Competencies

Note: Left hand side of figure (grey) are technical skills and competencies. Righthand side of figure (green) are interpersonal skills and competencies.



PROOF-OF-CONCEPT CURRICULUM FOUNDATION MODEL

A proof-of-concept model is presented in Figure 7.11A-B which is the culmination of work undertaken hitherto. Specifically, Chapters 3 and 4 contextualised the HEI and CMCD landscape, which is baren, disjointed and lacking a defined community of practice. A theorical model was developed from the chapters' analyses noting internal and external factors influencing the curriculum and its development. Chapter 5 has explored specific UK CMPs which depicts a siloed and non-cohesive curriculum basis with an underlying vagueness for the specific skills and competencies inherent in the construction manager role. Chapter 6 reviewed and analysed job advertisements (for the role of construction manager) sourced from UK construction organisations to help provide granularity to the research results of the previous chapter. Specific interpersonal and technical skills and competencies were deciphered resulting in a list of key interpersonal and technical skills. The first part of Chapter 7 gained built environment academics' perceptions on the level of importance for the interpersonal and technical skills with the intent on defining the core skills and competencies essential to the construction manager role.

Metaphorically speaking, the stability and longevity of any structure is inextricably dependent upon its foundation; for a weak foundation yields a weak structure no matter how aesthetically pleasing or well-constructed. The same is true for construction management curriculum – it needs a solid foundation. Utilising the final ranked list of the interpersonal and technical skills and competencies of construction managers (refer to Table 7.12), a proof-of-concept model is presented (refer to Figure 7.11A-B). Using a metaphor, the model is characterised as a structural foundation section detail where the four key interpersonal skills ('*communication*,' '*teamwork*,' '*leadership*' and '*listening & understanding*') represent the components of the foundation and its mix design (e. g., aggregate, cement, water, reinforcing steel). Specifically, as the statistics in Figure 7.11B note, these four key interpersonal skills and competencies represent the top four most important skills essential to the construction manager role and thus serve as the role's nucleus. Resting upon the foundation is the entirety of the construction management curriculum, which will be further delineated in Chapters 8 and 9, but broadly includes the Educational Mission, Strategic Educational Plan and the Matrix of Course Modules, all which sit in an environment inundated with external and internal factors (refer to Chapter 4 and Figure 4.9). Whilst many structural foundations lie hidden beneath the surface with the architectural splendour of the structure standing proudly, so too does this proof-of-concept model. The core interpersonal skills and competencies that comprise the foundation are mostly unseen in a curriculum yet provide the critical heavy lifting for the conspicuous and present curriculum.

As for the previously identified technical skills and competencies (refer to Table 7.12), whilst their importance to the construction manager role is lower than most of the interpersonal skills and competencies noted (refer to Table 7.12), they do play a supporting curriculum role; they do have a place. Specifically, the technical skills and competencies find their home within the Matrix of Course Modules – explicit modules where adequate attention is given to a specific remit of technical skills and competencies. However, as the proof-of-concept model indicates, it is important to note that the appropriate educational provision for the technical skills cannot be achieved without four interpersonal skills and competencies. For example, a student will be unable to grasp the holistic intricacies and concepts of '*workflow and sequence*' without complete comprehension of '*communication*,' '*teamwork*,' '*leadership*' and '*listening & understanding*.'

Table 7.12 – Final Ranked Skills and Competencies

Rank	Question	Weighted Average (WA)	Relative Importance Index (RII)
1	7_i – Verbal Communication	449	0.966
2	10_i – Team Management	448	0.963
3	12_i – Team / Group Work	442	0.951
4	6_i – Written / Typed Communication	436	0.938
5	9_i – Authentic Leadership	428	0.920
6	14_i – Listening & Understanding	428	0.920
7	16_t – Budgeting / Cost Control	420	0.903
8	24_t – Work Sequencing	416	0.895
9	11_i – Emotional Intelligence	409	0.880
10	23_t – Critical Path Method Schedule	401	0.862
11	17_t – Estimating	388	0.834
12	13_i – Empathy	385	0.828
13	8_i – Non-Verbal Communication	382	0.822
14	19_t – Interpreting BIM	374	0.804
15	22_t – Civil Engineering	293	0.630
16	18_t – Creating BIM	289	0.622
17	20_t – Digital Technologies	287	0.617
18	21_t – Structural Engineering	276	0.594

$_i$ = interpersonal, $_t$ = technical

Figure 7.11A-B – Proof-of-Concept Curriculum Foundation Model

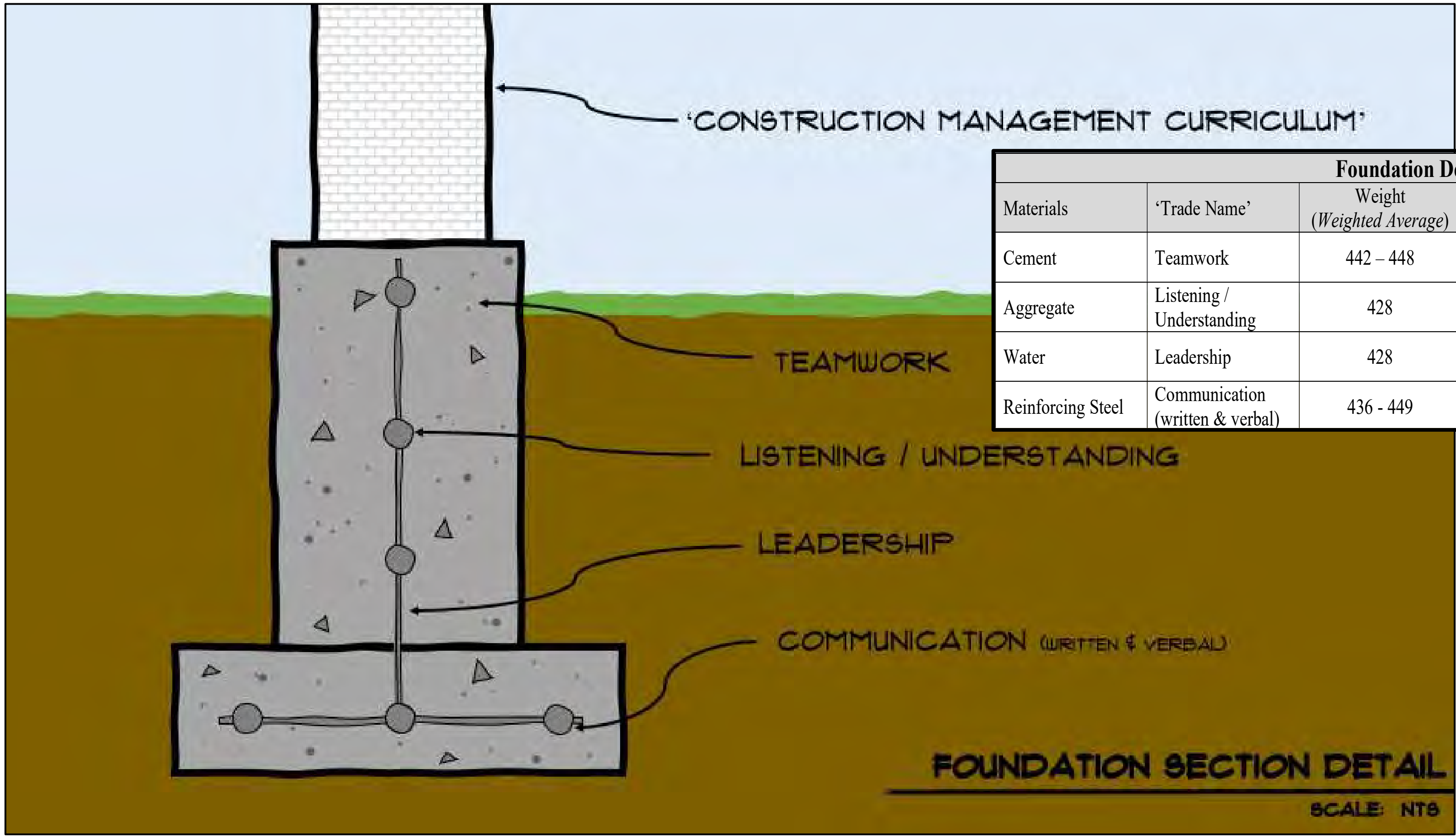


Figure 7.11A

Foundation Design Mix					
Materials	'Trade Name'	Weight (*Weighted Average*)	Ratio (*Relative Importance*)	Strength (*p-value*)	Proportion (*Mean Rating*)
Cement	Teamwork	442 – 448	0.951 – 0.963	< 0.001	4.75 – 4.82
Aggregate	Listening / Understanding	428	0.920	< 0.001	4.60
Water	Leadership	428	0.920	< 0.001	4.60
Reinforcing Steel	Communication (written & verbal)	436 - 449	0.938 – 0.966	< 0.001	4.69 – 4.83

Figure 7.11B

DISCUSSION

A host of practical applications of the research results are present for construction management education. First, there is an overwhelmingly strong preference from academia for interpersonal skills and competencies rather than more technically focused skills and competencies. Specifically, skills and competencies revolving around '*teamwork', 'communication', 'leadership'* and '*listening/understanding'*. Moreover, there was minute support for the importance of digital and BIM skills and competencies. These notes are perplexing given that current construction management curricula, as well as HEIs in general, have doubled down on a digital narrative. Yet, front-line academics, with first-hand industry experience, from across the globe have indicated the exact opposite – an opinion that concurs with practice requirements as elucidated upon in the previous chapter. Perhaps this is the result of a trickle-down effect from, not only the disjointed CMCD landscape, but the individualistic perceptions of senior/programme leadership of what a curriculum 'should' be. More disparaging could be the push to capitalise on a wealth of government grants and income streams that require a stronger digital presence within the HEI landscape? Perhaps HEIs have perhaps gone too far in their estimation of the importance of digital in a management orientated curricular? Further work is perhaps required to explore these speculations in further detail.

Higher education's fascination with digital technologies within the built environment disciplines (Macchiarella and Smith, 2021) is in stark contrast to the humanistic, interpersonal skills and competencies preference noted within the research findings. With a prominent goal of student employability upon graduation (Jackson and Tomlinson, 2021), it is a concern how curricula are designed, implemented and promoted with little regard to not only the voice of the industry in which they are preparing students, but front-line, industry robust academics. With such lucrative short- and long-term employment offerings leading to an increased number of students enrolling in construction management courses (Besné *et al*., 2021; Khan, *et al*., 2021), it is worrisome that the curricula currently in place is not only inadequate in the short-term but potentially fails to adequately meet the long-term '*character-building'* needs of construction management professionals – that is, someone who embodies a high sense of character, where character encompasses an appropriate level of mental and moral qualities (*leadership*, t*eamwork*, *listening/understanding* and *communication*) that distinguish an individual (Oxford Learner's Dictionary, 2021). The proof-of-concept model offered provides a pinpointed slice of an overall construction management curriculum – the foundation for which the entire curriculum is built upon. Validation of this model is now needed to confirm agreement over the top interpersonal skills and competencies from the primary data and more importantly, how practicing academics perceive the specific interpersonal skills as the core foundational element of construction management curricula. This additional research will focus on the validation of the model, its design concept basis, elements, composition and overall practicality in Chapter 8.

CONCLUSIONS

When assessing the level of importance of technical and interpersonal skills and competencies of construction managers, it is evident that interpersonal skills, mainly '*communication*,' '*leadership*,' '*teamwork*' and '*listening/understanding*', play a dominate role. Applying this analysis, a proof-of-concept model for the foundation of a construction management curriculum is developed.

This Chapter has uncovered that global built environment academics, with substantial industry experience, generally rate interpersonal skills and competencies as more important than technical skills and competencies for the role of construction manager. In fact, common interpersonal skills ('*communication', 'leadership'* and '*teamwork'*) were ranked pointedly higher in importance than more trendy and glitzy technical skills such as digital and BIM. Therefore, it can be implicitly noted that, from an educational perspective, interpersonal skills and competencies are an essential or core aspect of a construction management degree programme. Currently, there is a chasm between the skills and competencies industry and experienced academics note as important and what existing educational provision is delivering. The proof-of-concept model is aimed at helping to bridge this void by providing a robust, structurally sound foundation for which to construct a bespoke curriculum. The proof-of-concept model will require validation input from current CDSMEs, specifically focused on the model's premise.

It is clear that interpersonal skills and competencies are essential to the role of construction manager and thus, should be at the heart of construction management curricula. However, with higher education's fascination with technical skills, mainly digitally based skills, a dichotomy in educational provision is born. There is a need to step back and re-think the lowest common denominator of construction management curricula – placing interpersonal skills and competencies at the core of the curriculum. The proof-of-concept model is an attempt to provide a foundation for this dialogue but providing much needed empirical evidence.

Successful graduate employability is an overarching factor for technically based educational programmes; graduates need to have the requisite skill sets to contribute to their respective discipline. Currently, construction management education is misaligned with the essential core skills required of the profession – namely management. Managers need an appreciation of advanced technologies to be able to effectively communicate with other project team members, but applications of these technologies (such as BIM) are not required nor within the management remit. This skewed position not only impacts students but also negatively impacts their outlook of the profession. Through the development of a proof-of-concept model, it is hoped that a shared central foundation of interpersonal skills and competencies for construction management curricula can be shared, not only for the modification of current education provision, but for the benefit of future construction management students.

CHAPTER 8

PROOF-OF-CONCEPT MODEL VALIDATION

INTRODUCTION

The validation of any novel research is an important procedural step that provides credence and reliability to the research's output (Klenke, 2008). Whilst this process can take many forms it is ultimately guided by the themes of the research itself (Kirk and Miller, 1986). Likewise, the validation process does not only lead to a single, pragmatic outcome; many times, it also is the catalyst for identifying future, linked research (Biddle, 2005). This current chapter consequently seeks to conduct qualitative analysis of interview transcripts from CDSMEs to objectively validate the components and overall composition of the proof-of-concept model. Chapter objectives are to: validate the proof-of-concept model's aggregate components; identify areas that need more attention and/or research; and spark new pathways for future investigation and research.

VALIDATION INTERVIEWS

As noted in Stage 4 – Validation (refer to Chapter 2), the validation interviews were conducted individually and video/audio recorded via MS Teams. A transcript of the interview was obtained through the MS Teams transcription application embedded within. The transcripts of the interviews (see Appendix 4 - 7) were reviewed/edited for grammar and, where appropriate, redacted for identifying content. A semi-structured interview process was utilised; a series of predetermined questions with a cache of prompts at the interviewer's disposal should the dialogue warrant (reference Appendix 3). Prior to recording the interview, a review of the research, analysis and proof-of-concept model was discussed in a broad level of detail. This not only allowed the interviewee to gain background knowledge on the specific research topic, as well as an opportunity to check for understanding, but also an opportunity for both parties (interviewer and interviewee) to work through various conversational norms (greetings, familiarisation with speech patterns, pace of speech, annunciation, etc.). Specifically, the semi-structured interview asked six main questions: 1) experience in professional education; 2) experience with curriculum development; 3) initial perceptions of proof-of-concept model; 4) importance of the foundation in a curriculum; 5) interpersonal skills/competencies supporting technical content and 6) open-ended concluding thoughts. As noted above, the interviewer also had a cache of prompts to help expand upon the predetermined questions during dialogue to ensure that specific areas of inquiry were being addressed (reference Appendix 3). That is, prompts ensured that the interviewees gave a full and rich (complete) response to each question posed.

Curriculum Development Subject Matter Expert (CDSME)

The interviewees were identified and selected based on their extensive education and curriculum development experience. Due to the validation method, obtaining unique and/or outside opinions to reflect upon a 'built environment-eque' model was imperative. The interviewees may or may not have had experience within built environment disciplines; however, that was beside the point. The validation was strictly about the proof-of-concept curriculum model, so CDSMEs were the most aligned party to provide validation. Furthermore, the interviewees were not affiliated with any other part of the research. Specifically, they were not associated with any of the universities or construction organisations in which secondary data was collected nor they did not participate in the primary data collection survey; an airgap, of sorts that ensured impartiality of their responses.

Table 8.1 identifies the educational and curriculum development experience of the interviewees. With an aggregate total of 121.5 years of professional educational experience and 101.5 years of curriculum development experience, across a complete spectrum of educational roles, the interviewees can be regarded as subject matter experts (SME).

Table 8.1 – Educational and Curriculum Development Experience of Validation Interviewees (Interview Questions 1 and 2)

Interviewee	Educational Experience (years)	Curriculum Development Experience (years)	Role(s) in Education
CDSME_A	34.5	14.5	Educator Administration (*Multi-Department*)
CDSME_B	45	45	Educator Administration (*Multi-Department*) Regional Curriculum Development National Curriculum Development
CDSME_C	12	12	Educator Regional Curriculum Development
CDSME_D	30	30	Educator Administration (*Department*)
TOTAL	121.5	101.5	

Validation Confirmation

To confirm validation of the proof-of-concept model, a general consensus, obtained from the interview transcripts, was sought. This qualitative approach to validation allowed for interviewees to provide a deeper level of richness to their feedback, as compared to a quantitative approach, due to the intertwined and connected nature inherent with curriculum development (Freebody, 2003). Furthermore, with the various roles of the interviewees the qualitative validation method could be tailored, within an overall guidance, to each individual to obtain a far greater level of detail then a purely quantitative validation method (Kirk and Miller, 1986).

Validation Saturation

Determining the extents of data collection, specifically regarding qualitative data, is a much discussed and argued topic (Jacobs and Decock, 2021; Pequegnat *et al*., 2011; Saunders *et al*., 2018). Data saturation is a concept that suggests, in its simplest terms, no new information can be absorbed or recorded (Boswell and Cannon, 2023; Kosa and Ermolayev, 2022; Vogt *et al*., 2014). According to Grady (1998), from a qualitative data view, data saturation is achieved when:

> *"In interviews, when the researcher begins to hear the same comments again and again, data saturation is being reached…It is then time to stop collecting information and start analysing what has been collected"* (Grady, 1998, p. 26).

Similarly, Fusch and Ness (2015), when referencing Burmeister and Aitken (2012) suggest data saturation occurs, not necessarily from a numerical standpoint, but from a robustness of the data collected.

> *"Once cannot assume data saturation has been research just because on has exhausted the resources. Again, data saturation is not about the numbers per se, but about the* <u>*depth*</u> *of the data (Burmeister & Aitken, 2012)….A large sample size does not guarantee one will reach data saturation, nor does a small sample size – rather, it is what constitute the sample size (Burmeister & Aitken, 2012)" (Fusch and Ness, 2015, p. 1409).*

For the semi-structured validation interviews, utilising Dibley's (2011) vernacular, a richness (*quality*) and thickness (*quantity*) of textual data, in which similar topics, themes and ideas were present, constitutes an appropriate level of data saturation for the research. Furthermore, and along a similar vein to Dibley (2011), the quality and quantity of the interviewees' experience is also a factor impacting data saturation. Data saturation, as evidenced in the interview transcripts, has been obtained.

RESULTS

As noted previously, each interviewee engaged with a semi-structured interview where six guiding questions were asked; where questions 1 and 2 were previously reported upon in Table 8.1. The purpose of the interview was to solicit feedback on the proof-of-concept model from a CDSME. Select interviewee comments have been provided in the below tables (Table 8.3 – Table 8.6) to pinpoint commentary leading to an overall general consensus of opinion of the proof-of-concept model, as noted in Table 8.2.

Table 8.2 – Proof-of-Concept Model General Consensus of Opinion

Interview Question (No.)	Question Summary	Table Reference (No.)	General Consensus of Opinion Obtained?
3	Initial Perceptions of Proof-of-Concept Model	8.3	✓
4	Importance of Getting the Base (Core Concepts) of the Curriculum Correct	8.4	✓
5	Interpersonal Skills and Competencies Supporting Technical Skills and Competencies	8.5	✓
6	Concluding Thoughts / Comments / Suggestions	8.6	✓
		Aggregate Total	Yes

Proof-of-Concept Model Initial Perceptions

When asked for initial perceptions of the proof-of-concept model, specifically placing key interpersonal skills at the core of the entire curriculum, all interviewees provided positive and supportive feedback. As noted in Table 8.3, specific language from the interviewees has been noted providing an additional layer of context. Two sub-takeaways have emerged from the validation interviews. First, the illustration of the proof-of-concept model is an asset. It provides a clear graphical representation of the model so individuals can have an easier time comprehending not only the model's content, but its intent. Excerpts from two of the CDSMEs are noted below:

> CDSME_A noted, *"For number one, I like your graphic. You know, I understood that completely."*

CDSME$_C$ noted, *"Umm, you know, one thing that, you know, I kind of liked when I first saw your model and particularly in concerning that you're looking at construction management is it's very visually appealing. So, I think it's understandable, you know, by people who don't have pedagogical training, you know. A lot of the models you see, or even like curricular frameworks, you know, they're, you know, pages of table and, you know, you have to almost have an educator brain to really understand it. This, you know, I think explains it very simply…explains it very tactfully, because it's narrowed down to kind of four key skills…"*

Second, the guiding content of the model provides affirmation of the significant importance of interpersonal skills to a curriculum. Excerpts from two of the CDSMEs are noted below:

CDSME$_B$ noted, *"When I started teaching in the 70s, it was basically content… but then we got to the point where we said, 'You know, all of these interpersonal skills are so important, it really should be that we're teaching the interpersonal skills and we're using the content to give examples for the students to experience those interpersonal skills.'"*

CDSME$_B$ noted, *"So, I can't disregard the research and say, 'No, no, no, we really need to go back to the technical.' We get there. We still get to the technical [skills] but it's built on a much more evidence-based foundation…the foundation of the sort of these interpersonal communication skills*

Table 8.3 – Select Validation Interviewees' Responses to Interview Question 3

Question 3:	**A proof-of-concept model for the foundation of a construction management curriculum has been created. This lists communication, leadership, teamwork and listening/understanding at the core of the entire curriculum. What are your initial perceptions when seeing/hearing this?**			
Interview (No.)	**Comment(s)**	**CDSME Transcript Comment (No.)**	**General Consensus *(Yes / No)***	**Implication**
1 CDSME$_A$	*"For number one, I like your graphic. You know, I understood that completely. There are basics that all of our students need to have and I think those are reflected in your foundation. The course specifics kind of fit that curriculum piece. But think of, maybe as an example, you have a curriculum topic and the way that you want to deal with that topic is through group activity work…well, if you don't have students able to communicate, we should with each other for forget about, you know the group work and therefore forget about that curriculum concept you're trying to teach them."*	16	Yes	This CDSME focused upon: - Clarity of graphic / ease of communication. - Interpersonal skills provide base for other specific content.
2 CDSME$_B$	*"It's sort of affirms what we in secondary [education] have been trying to do, I would say, since maybe the 90s, maybe 2000s. When I started teaching in the 70s, it was basically content… but then we got to the point where we said, 'You know, all of these interpersonal skills are so important, it really should be that we're teaching the interpersonal skills and we're using the content to give examples for the students to experience those interpersonal skills.'"*	14	Yes	This CDSME focused upon: - Interpersonal skills provide base for other specific content.
3 CDSME$_C$	*"Umm, you know, one thing that, you know, I kind of liked when I first saw your model and particularly in concerning that you're looking at construction management is it's very visually appealing. So, I think it's understandable, you know, by people who don't have pedagogical training, you know. A lot of the models you see, or even like curricular frameworks, you know, they're, you know, pages of table and, you know, you have to almost have an educator brain to really understand it. This, you know, I think explains it very simply…explains it very tactfully, because it's narrowed down to kind of four key skills…"*	10	Yes	This CDSME focused upon: - Clarity of graphic / ease of communication.
4 CDSME$_D$	*"But then you, sort of, demonstrated how the research points to, starting with those, interpersonal skills…listening, teamwork, communication, those kinds of skills and that those are the kinds of skills that are predominately sought in job advertisements make, you know, makes me pause and say, 'Well the research would suggest build a different foundation. You can still get to the technical skills, but this is what is really foundational to the profession and being a successful profession.'* *So, I can't disregard the research and say, 'No, no, no. We really need to go back to the technical.' We get there. We still get to the technical [skills] but it's built on a much more evidence-based foundation…the foundation of the sort of these interpersonal communication skills."*	12	Yes	This CDSME focused upon: - Interpersonal skills provide base for other specific content.

Importance of the Foundation of a Curriculum

When asked about the importance of the foundation of a curriculum, all interviewees provided positive and supportive feedback. As noted in Table 8.4, specific language from the interviewees has been noted providing an additional layer of context. A reoccurring theme within the interviewees' comments was the concept of a knock-on effect. Specifically, if the foundation is weak and/or the skills the foundation point to are not fully developed first, then anything that sits on top of it will either fail or not 'stick' from an educational standpoint. Metaphorically speaking, before a student learns trigonometry, they need to learn basic arithmetic and before this they need to learn what numerals are and their sequence. Furthermore, along the same theme, the concept of 'Pull Planning' where one starts at the end and then works backwards to determine the starting point; the point from which all is built upon and from, is evident. Excerpts from three of the CDSMEs are noted below:

> CDSME_A noted, *"You know, it is strictly common sense. You know, how can again, John… I'm not trying to be simplistic or very casual… but how can educators in this day and age, where we rely on so much interaction between our students, not to develop those skills before they try to teach anything else."*

> CDSME_B noted, *"Yes, it is extremely important. OK, so you look with the end in mind. OK, so you have to say, 'What do we want students to know and be able to do."*

> CDSME_D noted, *"…starting with the end in mind and what is it that students need to know to be able to do? …You know, one of the responses to that question is it is, umm, that you build the foundation in a particular discipline that is evidence-based."*

Table 8.4 – Select Validation Interviewees' Responses to Interview Question 4

Question 4:	**From your experience in developing curricula, how to you view/perceive the importance of getting the base (core concepts) of the curriculum correct? Is this something that you have witnessed as a rushed or misguided process?**			
Interview (No.)	**Comment(s)**	**CDSME Transcript Comment (No.)**	**General Consensus *(Yes / No)***	**Implication**
1 CDSME$_A$	*"Absolutely, absolutely. It does not matter, in my opinion, what the curriculum piece is on top your block wall going up. You know, whether it's a science, uh, humanities, you know, or whatever. With without the base... it's common sense.* *You know, it is strictly common sense. You know, how can again, John… I'm not trying to be simplistic or very casual… but how can educators in this day and age, where we rely on so much interaction between our students, not to develop those skills before they try to teach anything else. Or to continually emphasize those skills as they try to teach, you know more, more structural solid, you know, curriculum concepts."*	18	Yes	This CDSME focused upon: - Foundation is critically important. - Interpersonal skills provide base for other specific content.
2 CDSME$_B$	*"Yes, it is extremely important. OK, so you look with the end in mind. OK, so you have to say, 'What do we want students to know and be able to do' if we're talking about students. I feel the same way about teachers. 'What do we want teachers to be able to do and know?' OK, in order to be excellent teachers, high quality teachers, great teachers… you have to have some sort of a foundation, and if the foundation doesn't include like those employability skills … then they're not going to be taught."*	28	Yes	This CDSME focused upon: - Foundation is critically important. - Starting with the end goal and working backward.
3 CDSME$_C$	*"I would say it's very important to kind of have that foundation correct and really planned out…So, I would say, you know, that in order to accurately develop curriculum and have it strong, those foundational [interpersonal] skills need to be in place…"*	12	Yes	This CDSME focused upon: - Foundation is critically important.
4 CDSME$_D$	*"…starting with the end in mind and what is it that students need to know to be able to do? …You know, one of the responses to that question is it is, umm, that you build the foundation in a particular discipline that is evidence-based. Means that you might start with where you're…starting with construction management, should start based on data…. But I think knowing what the profession or the discipline needs or wants its students to be able to know and do means it's an open question. You have to, sort of let the evidence point to what's in that foundation."* *"Absolutely. I think, for example, if in the construction management profession, the foundation was built around the technical competencies and skills and knowledge and then communication and listening and teamwork…those were sort of secondary. Then the students going into the profession would have a pretty stark awakening…"*	14 16	Yes	This CDSME focused upon: - Foundation is critically important. - Starting with the end goal and working backward. - Interpersonal skills provide base for other specific content.

Interpersonal Skills and Competencies Supporting Technical Content

When asked about the importance of interpersonal skills/competencies supporting technical content for employability, all interviewees provided positive and supportive feedback. As noted in Table 8.5, specific language from the interviewees has been noted providing an additional layer of context. A reoccurring theme noted is that each employer does technical skills/competencies a little different, so regardless of technical skills proficiency, the employer will engage an employee in some sort of training to teach them their way of completing the technical skill/competency. However, interpersonal skills/competencies provide a competitive advantage, not only to the employee looking for a job, but to the employer who can utilise the employee's interpersonal proficiency to, for example, bring in more work, develop internal/external teams, forge relationships with clients, improve company culture, etc. Excerpts from three of the CDSMEs are noted below:

> $CDSME_B$ noted, *"Industry does have a lot of important information to say about the employability [interpersonal] skills, because you talk to any employer and they'll say, 'We'll teach them how to do the [technical] stuff because everybody does it differently, we need students that are dependable. We need students that can communicate. We need students that are dependable, that go beyond expectations. We need students…', you know, and we tell the students there they need the competitive advantage over everybody else and those are those [interpersonal] skills."*

> $CDSME_C$ noted, *"They're [interpersonal skills] critical. You know, the quote I've had given to me on several occasions is, 'You know, you can teach students anything, but the most important thing is the thing that's going to be, you know, transferable to a variety of different employers and settings, you know, are going to be those professional [interpersonal] skills.' So, reliability, time management, leadership skills…But those foundational skills are pretty much the core."*

> $CDSME_D$ noted, "*I think, for example, if in the construction management profession, the foundation was built around the technical competencies and skills and knowledge and then communication and listening and teamwork…those were sort of secondary. Then the students going into the profession would have a pretty stark awakening that, 'My goodness, the skills that I thought were sort of*

communicated as secondary to the job really become our primary. And if I can't do those, I'm going to have a hard time being able to apply my technical knowledge and bring that to the mix.' So, I think it's critical that the foundation be built on what the industry or the profession needs…and the technical skills, it's still there. It's just that it's built on this more solid foundation of what the profession considers foundational to the successful professional."

Open-Ended Concluding Thoughts

When asked any concluding thoughts or comments, all interviewees provided positive and supportive feedback. As noted in Table 8.6, specific language from the interviewees has been noted providing an additional layer of context. Specifically, the interviewees offered encouraging and optimistic concluding thoughts regarding the proof-of-concept model. Excerpts from four of the CDSMEs are noted below:

> CDSME$_A$ noted, *"Oh, I certainly think you're on the right track… I think you're cutting away all the stuff to get to the nitty gritty."*

> CDSME$_B$ noted, "*Well, I think that your proof-of-concept model is excellent… I don't think there has been that much deep research on the importance of these of these employability [interpersonal] skills…. Umm, so I think that what you're doing is so important and I think that you've made it so real because all of us can relate to it…"*

> CDSME$_c$ noted, "*…I think is more condensed and is more understandable, you know, especially in the construction management field, because you have like the building foundation. But I think that's kind of the gist of it, what we've been after for a long time."*

> CDSME$_D$ noted, *"Yeah, it [proof-of-concept model] echoes it [educating the whole student – interpersonal skills]. And I think it reflects the statement…If job ads are asking for these kinds of skills, I think it underscores that it's not just about what's in students' heads, but it's what they bring, the whole person to their professional lives. Yes, short answer yes.*

Table 8.5 – Select Validation Interviewees' Responses to Interview Question 5

Question 5:	**With particular emphasis on career and technical education, interpersonal skills appear to have a significant level of importance for career preparedness/employability. The proof-of-concept model highlights this by placing technical content (and the rest of the curriculum development process) on top of this. Do you agree with this mindset/logic?**			
Interview (No.)	**Comment(s)**	**CDSME Transcript Comment (No.)**	**General Consensus *(Yes / No)***	**Implication**
1 CDSME$_A$	*"Oh, without fail, without fail…* *But all those things [core interpersonal skills] that we assume our students don't know how to do…that we assume our colleagues know how to do…when maybe they don't. You know, we're a team member or colleague we're communicating with each other now. So, these are the skills that I'll bring into that, you know, to help manage situations."*	54	Yes	This CDSME focused upon: - Interpersonal skills provide base for other specific content.
2 CDSME$_B$	*"It's not that those [technical skills] aren't important. It's just that they're [interpersonal and technical skills] two different things, and you can't teach those technical skills in an effective way unless you also have the employability [interpersonal] skills."* *"Industry does have a lot of important information to say about the employability [interpersonal] skills, because you talk to any employer and they'll say, 'We'll teach them how to do the [technical] stuff because everybody does it differently, we need students that are dependable. We need students that can communicate. We need students that are dependable, that go beyond expectations. We need students…', you know, and we tell the students there they need the competitive advantage over everybody else and those are those [interpersonal] skills."*	32 20	Yes	This CDSME focused upon: - Technical skills can be taught / refined by the employer - Interpersonal skills. proficiency provides employability advantage.
3 CDSME$_C$	*"They're [interpersonal skills] critical. You know, the quote I've had given to me on several occasions is, 'You know, you can teach students anything, but the most important thing is the thing that's going to be, you know, transferable to a variety of different employers and settings, you know, are going to be those professional [interpersonal] skills.' So, reliability, time management, leadership skills…But those foundational skills are pretty much the core."*	8	Yes	This CDSME focused upon: - Technical skills can be taught / refined by the employer. - Interpersonal skills proficiency provides employability advantage.
4 CDSME$_D$	*"Yes, I do think if the data point to foundational knowledge and skills that are prioritised, valued, sought in the students, and we have to prepare them with those skills and that knowledge. Everything else follows that… but is also means that maybe there are ways to think about how the technical knowledge that we want students to gain gets integrated into developing these other foundational skills and the, sort of, …an [integrated] approach. You know, skills, knowledge with the, sort of, integration of those two, I think potentially produce results both in terms of the advancement of those foundational skills while also enhancing the technical competencies students will need."*	22	Yes	This CDSME focused upon: - Interpersonal skills provide base for other specific content.

Table 8.6 – Select Validation Interviewees' Responses to Interview Question 6

Question 6:	**I would like to thank you for your time today. Before we conclude the interview, are there any final thoughts, comments or suggestions you would like to share?**			
Interview (No.)	**Comment(s)**	**CDSME Transcript Comment (No.)**	**General Consensus *(Yes / No)***	**Implication**
1 CDSME$_A$	*"Oh, I certainly think you're on the right track.* *And as I said, I mean I know this is part of a, you know, your doctoral thesis. And I know all the research that goes into it. But truly, I think curriculum understanding, curriculum writing, curriculum, understanding the connections between curriculum and instruction is really not a hard concept. I'm not implying that you're making it hard…I don't think you are. I think you're cutting away all the stuff to get to the nitty gritty."*	64	Yes	This CDSME focused upon: - Appreciate the model. - Clarity of graphic / ease of communication.
2 CDSME$_B$	*"Well, I think that your proof-of-concept model is excellent. I think that it will, you know, once you're finished with your research…you got to get that research out because I don't think there has been that much deep research on the importance of these of these employability [interpersonal] skills…. Umm, so I think that what you're doing is so important and I think that you've made it so real because all of us can relate to it…"*	42	Yes	This CDSME focused upon: - Appreciate the model. - Clarity of graphic / ease of communication.
3 CDSME$_C$	*You know, I think the proof-of-concept model is, you know, I think very similar to what I've seen throughout my time in career and technical education. It's not as, you know, yours, I think is more condensed and is more understandable, you know, especially in the construction management field, because you have like the building foundation. But, I think that's kind of the gist of it, what we've been after for a long time."*	28	Yes	This CDSME focused upon: - Appreciate the model. - Clarity of graphic / ease of communication.
4 CDSME$_D$	*"Yeah, it [proof-of-concept model] echoes it [educating the whole student – interpersonal skills]. And I think it reflects the statement…If job ads are asking for these kinds of skills, I think it underscores that it's not just about what's in students' heads, but it's what they bring, the whole person to their professional lives. Yes, short answer yes."*	32	Yes	This CDSME focused upon: - Appreciate the model.

DISCUSSION

Various practical applications of the validation results for the proof-of-concept model are evident. First, and most obvious, is the affirmation of the model as an accurate and robust foundation for CMCD. This can then be segmented into granular parts, specifically regarding the relationship between interpersonal and technical skills and competencies. As with the structure of a building, the foundation is one of, if not the, most important element – the entire structure rests upon this component. The same is true with curricula, if the core foundational skills and competencies are not structurally sound (i.e., the structure of the curriculum needs to bear its weight on this) then the curriculum is weak, frail and subject to failure. Along these same lines, the interpersonal skills and competencies support the technical skills and competencies within a discipline's context. As such, the interpersonal skills and competencies provide the crucial structural support for the technical skills and competencies to rest upon. Finally, the tidy and decluttered nature of the proof-of-concept model provides another practical benefit. Simplifying and uncovering the lowest common denominator helps to reveal the true core or root of a topic, subject, issue, etc. This not only allows educational and industry practitioners to comprehend the model and its components more easily, but also allows for easier communication and dissemination of the model.

Various theoretical implications of the validation results are also present. Having the model validated by CDSMEs provides a third-party endorsement regarding the relationship between the interpersonal and technical skills and competencies. Placing interpersonal skills and competencies at the core of the discipline encourages educational practitioners within built environment disciplines to pause, reflect upon current educational provision and consider adapting similar curricular logic. As demonstrated in Chapters 3 and 4, much of the construction management educational focus is on technical skills and competencies (in particular digital-esque trends). Compounding this is the lack of a community of practice to investigate what the current state of educational provision is and what industry organisations are seeking in employers. As such, the proof-of-concept model provides a bit of pause and grounding for the discipline to think about the vital attributes of the course and industry and ponder potential routes of aligning the two.

There are limitations to the validation research. First, the validation was qualitative in nature, utilising transcripts to determine general consensus. Qualitative research is very much open to interpretation; what one researcher views as important, another may not. Second, the subject matter experts were selected based on their experience with curriculum development. Whilst their experience is profound, there may be aspects of curriculum development in which they have not experienced or experienced in a limited scope. The researcher has identified these limitations and has tried to select a sample and sample size of subject matter experts covering the spectrum of curriculum development. Furthermore, when interviewing individuals, their specific being on the day of the interview could be impacted by a plethora of external factors (i.e., time of day, overall attitude, personal issues, work stressors, etc.) which could impact the feedback provided. Again, the researcher has identified this limitation and has tried to create an interview environment mirroring a casual, relaxed conversation to obtain the interviewee's most accurate feelings and feedback. Finally, the method of an interview can be a limitation as there are other validation methods available that utilise different analyses. The researcher has also identified this limitation but has noted a semi-structured interview would be positive method for obtaining in depth, qualitative, multipurpose feedback to not only validate the model, but provide insight into future research.

CONCLUSIONS

A proof-of-concept model has been presented to a group of CDSMEs for general consensus of opinion validation. Through the process of semi-structured interviews, the comments provided by the CDSMEs, in aggregate, substantiated overall consensus and validation. This validation revealed a few important points. First, the appearance of the model is an asset to educators because it provides for easy interpretation and communication across industry and educational settings. Second, the guiding premise that interpersonal skills and competencies support technical skills and competencies (and thus the key interpersonal skill and competencies representing the foundation of a curriculum) was highly supported. Moreover, the use of interpersonal skills and competencies, not just in the curriculum foundation, but throughout the curriculum to support technical skills and competencies was expressed. Finally, whilst the proof-of-concept model focused on the foundation of the curriculum, an eye to the other end (the output) of the curriculum is symbiotic; for the summit and foundation of a curriculum are inextricability linked.

It is apparent that the proof-of-concept curriculum foundation model is a valid tool for CMCD. From this, a stable platform has been built for which further exploration into various HEI aspects of construction management education, such as course mission/goals, pedagogy and the student experience can occur.

CHAPTER 9

CONCLUSIONS, RECOMMENDATIONS AND DISCUSSION

INTRODUCTION

The thesis' final chapter presents: 1) overall conclusions from the thesis; 2) the major emergent findings emanating from this thesis; 3) recommendations for HEIs and practitioners; 4) clear guidance on the various contributions to knowledge generated within this thesis; and 5) areas for future research investigations. The original research questions are reiterated and aligned with the specific thesis chapter(s) in which provide answers to these questions.

CONCLUSIONS

Curriculum development research within the higher education industry is a discombobulated assortment of intertwined disciplines, drop-in commentaries and is broadly non-cohesive. This setting is replicated and notably exacerbated within the construction management education domain due to the absence of a cohesive community of practice. Similarly, when looking at specific UK CMPs, whilst their curricula are developed largely independently, the foundational building blocks of 'professional skills development,' provide a commonality to the programmes. From an industry standpoint, the construction manager is at its core – responsible for delivering a project within its stated objectives. The overwhelming presence of interpersonal skills, the vagueness of technical skills and the absence of digital themes were the granular refrains regarding 'professional skills development.' When assessing the level of importance of technical and interpersonal skills and competencies of construction managers from a global academic perspective, it is evident that interpersonal skills, mainly communication, leadership, teamwork and listening/understanding, play a dominant role. Applying this analysis, a curriculum foundation model is developed.

This research has revealed numerous findings. First, due to a lack of standard curriculum development through a collaborative community of practice, construction curricula are developing organically and at the impulse of individual programme leaders. At present, construction management education is influenced by internal and external factors which are omnipresent and add character/shape to the construction discipline; however, they are not guiding or foundational factors. Second, different construction organisations, engaged in different categories/sectors of work, share a steadfast commonality in preferred interpersonal skill sets of construction managers. Furthermore, the ambiguity regarding specific technical skills and an absence of digital skills reference further reinforce the construction organisations' weight behind the importance of interpersonal skills for the construction manager. Third, global built environment academics generally rate interpersonal skills and competencies as more important than technical skills and competencies for the role of construction manager. Specifically, common interpersonal skills (‘*communication’, ‘leadership’* and ‘*teamwork’*) were ranked pointedly higher in importance than technical skills such as digital and BIM. Finally, there is currently a chasm between the skills and competencies industry and experienced academics note as important and what existing educational provision is delivering. The curriculum foundation model is aimed at helping to bridge this void by providing a robust, structurally sound foundation for which to construct a bespoke curriculum.

Many items have become apparent throughout the course of the study. First, due to a lack of a defined community of practice, there is a need to develop a unifying curriculum model to help focus educational content relative to the internal and external factors of the construction industry as well as ensure that staff/students remain at the forefront of industry developments. Second, CMPs are offering different routes, with varying degrees of skill focus, for students to obtain a degree. Third, influential construction organisations in the UK are seeking strong interpersonal skills for construction managers. The role is after all to manage people not technology per se, and/or people using technology and so an appreciation of advanced technology is only required. Finally, with higher education’s fascination with technical skills, mainly digitally based skills, a dichotomy in educational provision is born. There is a need to step back and re-think the lowest common denominator of construction management curricula – placing interpersonal skills and competencies at the core of the curriculum. Digital skills are an embellishment.

Successful graduate employability is an overarching factor for technically based educational programmes. Graduates need to have the requisite skill sets to contribute to their respective discipline. The curriculum is the programme’s resolute guide for outlining this skill set. Within CME however, the skills and competencies necessary for employability are solely subject to the writers of the curriculum. Currently, there is a misalignment with the essential core skills required of the profession – namely management. Managers need an appreciation of advanced technologies to be able to effectively communicate with other project team members but applications of these technologies (such as BIM) are not required nor within the management remit. This skewed position not only impacts students but also negatively impacts their outlook of the profession. Through the development of a curriculum foundation model, it is hoped that a shared central underpinning of interpersonal skills and competencies for construction management curricula can be shared, not only for the modification of current education provision, but for the benefit of future construction management students.

SUMMARY OF KEY FINDINGS

Table 9.1 reiterates the research questions that were discussed in Chapter 1 and Table 9.2 depicts the thesis chapters that address each research question.

Table 9.1 – Research Questions at the Beginning of the Study

No.	Research Question
1	What is the existing curriculum development landscape in higher education? Subsequently, what is the existing curriculum development landscape in regarding to construction management education?
2	What are the core skills and competencies current construction management courses are promoting, supporting, developing and utilising?
3	What are the core skills and competencies current construction organisations are looking for in the role of construction manager?
4	How can construction management programmes combine the essential core skills and competencies in their curricula?

Table 9.2 – Research Questions Addressed per Thesis Chapter

Chapter No.	Chapter Title	Research Question			
		1	2	3	4
3	Curriculum Development in the Higher Education Literature: A Synthesis Focusing on Construction Management Programmes	✓			
4	Development of a Conceptual Construction Management Curriculum Model Grounded in Scientometric Analysis	✓			✓
5	Professional Skills Development: Foundational Curriculum Skills and Competencies of UK Construction Management Programmes		✓		
6	Defining the Key 'Professional Development Skills' of Construction Managers from Influential UK Construction Organisations			✓	
7	Developing a Proof-of-Concept Curriculum Foundation Model: A Primary Data Survey of Built Environment Academics				✓
8	Proof-of-Concept Model Validation				✓

Through an abductive approach (which also incorporated element of interpretivism and pragmatism), the final curriculum foundation model was derived through numerous iterations of research conducted. These iterations, much like a potluck dinner, when taken by themselves, may only amount to a small, meagre contribution; however, when viewed in aggregate, they can amount to plentiful meal. Furthermore, as Table 9.2 depicts, a logical, building sequence is evident demonstrating the abductive nature. Interestingly, the last research question is consistently being thought of in the background with interjections of theoretical models and conceptual models throughout the thesis.

The Curriculum Development Landscape

The first research question inquired about the current curriculum development landscape within higher education, specifically regarding CMPs. Curriculum development research within HEIs is a disconnected assortment of intertwined disciplines, drop-in commentaries and broadly non-cohesive. This is evident in the failure to identify leading and key authors, and global communities of practice engaged in this research. This setting is replicated and notably exacerbated within the construction management education domain, perhaps due to the lack of a recognisable body or centre of excellence championing research in the field. Not only does CMCD lack a community of practice, but it is also apparent that curricula are developing organically and at the impulse of individual programme leaders. At present, construction management education is influenced by internal and external factors which are not equal in weight. While these factors are omnipresent and add character to the construction discipline, they are not guiding or foundational factors. Interpersonal and technical skills and competencies are the foundation which supports the framework of a construction management curriculum (as outlined in a theoretical model - refer to Figure 4.9).

Core Skills and Competencies from Construction Management Courses

The second research question inquired about the specific essential skills and competencies that current CMPs were utilising and working with. A spattering of the structure of undergraduate CMP is evident; although fragments of cohesiveness exist, the individualistic nature of the programmes resonates profoundly. The concept of 'professional skills development' from both technical and interpersonal viewpoints, was the underlying foundational motif. Whilst construction management curricula are developed largely independently, the foundational building blocks of 'professional skills development,' provide a commonality to the programmes. However, whilst a general consensus of 'professional skills development' is noted, the structure, intent and focus of the curricula are still largely erratic and scattered. Currently, construction management curricula are being authored at the whim of individual departments and/or programme leaders who may or may not have the requisite educational, industrial, pedagogical and/or administrative experience. In turn, the foundational employability notion remains consistently vague as to reasonably justify the individual agenda(s) of the curriculum's authors.

Core Skills and Competencies from Construction Organisations

The third research question inquired about the specific core skills and competencies that construction organisations are seeking for the role of construction manager. The overwhelming presence of interpersonal skills, the vagueness of technical skills and the absence of digital themes were the main findings. Different construction organisations who are engaged in different categories/sectors of work throughout similar and different parts of the UK share a steadfast commonality in the preferred skill set of construction managers – interpersonal skills. Furthermore, the ambiguity regarding specific technical skills and an absence of digital skills, further reinforce the construction organisations' weight behind the importance of interpersonal skills for the construction manager. It would therefore appear that in a bold move to include 'all things digital' to appease prevailing governmental agendas, HEIs may have inadvertently watered down the construction management curricula. Such a move perhaps suggests that similar alignment to other forthcoming agendas such as circular economy will follow? In both instances, the construction manager needs an appreciation of these agendas only to be able to manage them on site.

Combining Core Skills and Competencies into Curricula

The final research questions inquired about how CMPs can integrate the core skills and competencies into their curricula. When assessing the level of importance of technical and interpersonal skills and competencies of construction managers, it is evident that interpersonal skills, mainly '*communication*,' '*leadership*,' '*teamwork*' and '*listening/understanding*', play a dominant role. Therefore, it can be implicitly noted that, from an educational perspective, interpersonal skills and competencies are an essential or core aspect of a construction management degree programme. Applying this analysis, a curriculum foundation model for construction management is developed. The curriculum foundation model is aimed at helping to bridge this void by providing a robust, structurally sound foundation from which to construct a bespoke curriculum.

The comments provided by the CDSMEs, in aggregate, substantiated the overall consensus and validation of the final model. This validation revealed a few important points. First, the appearance of the model provided for easy interpretation and communication across industry and educational settings. Second, the guiding premise that interpersonal skills and competencies support technical skills and competencies was highly supported. Finally, whilst the model specifically focused on the foundation (or starting point) of the curriculum, an intrinsic link with the output/goal of the curriculum also existed.

RECOMMENDATIONS

Throughout the abductive approach to the research undertaken, numerous potential recommendations have emerged. Three main recommendations emanate from this work. First, more tie-in is needed between industry and academia regarding the educational provision – specifically, the core skills and competencies required. There should be a clear understanding of what skills and competencies industry demands in qualified graduates and how students will be educated accordingly. As this research has shown (refer to Chapters 5 and 6), whilst there is parallel understanding regarding the essential skills and competencies required of construction managers between academia and practice. At present, these two parties are at present 'two ships passing in the night.' Whilst the curriculum is not subservient to specific construction organisations and their ways of doing things, there is, however, a mutual relationship at play and one that needs delicate and careful maintenance (refer to the section on future research). Having pinpointed tie-ins between industry and academia will help to ensure that the curriculum's foundation is aligned with industry essential skills and competencies. And once that is achieved, the curriculum is in an advantageous position to provide relevant, accurate and sound teaching for students.

Second, within the interpersonal-technical skills and competencies hierarchy, new and emerging technologies need to be properly contextualised within the role of the modern construction manager. These technologies are tools for the manager whilst managing others who are managing the tradespeople who are building the project. Afterall, a construction manager is a 'people manager' and the range of new technologies are, at their core, tools. However, just as the pneumatic nail gun did not replace the carpenter (or the hammer for that matter), new technologies will not replace the construction manager; rather, they can assist them to perform better in their role. As such, whilst new technologies radiate funding opportunities for academics, educational provision cannot lose sight of the core role of a construction manager and the core function of new technologies. For example, BIM and VR are technologies that have found steadfast homes within construction management curricula. These modules provide future construction managers the opportunity to gain a comfortable level of proficiency in these specific technologies; not necessarily proficiency in determining when best to use the tool, rather a 'which button to push' proficiency to make the technology work. However, these new technologies are, in some regard, just as important as rather vintage technologies – equipment operation for example. Current construction management curricula do not dedicate the same (or any) content/time ratio for future construction managers to become comfortably proficient in operating a front-end loader or any other item of off-highway plant and machinery – they need only manage its safe and efficient operation (Edwards *et al.,* 2003). This dichotomy illustrates that the interpersonal-technical skills hierarchy (where core interpersonal skills support technical skills) needs to be fully understood so that construction management students are obtaining the relevant skills and competencies (interpersonal and technical) to be proficient when entering the industry.

Finally, a community of practice regarding construction education is profoundly needed. As Chapters 3 and 4 explicitly note this absence has caused ripple effects that have migrated into current educational provision, mainly antiquated curriculum acumen. This notion is echoed in Posillico *et al*. (2022b) whereas a lack of a construction management focused community of practice exists even within the Scholarship of Teaching and Learning (SoTL) sector. Construction management educators do not seem to be placing an emphasis on the 'education' of construction, rather utilising the discipline to forward and advance practice and industry advancements. As such, and as noted in Chapters 3 and 4, this has caused the current educational provision to fail its health check; a focused community of educators is needed for urgent revival. The curriculum foundation model presented in Chapter 7 offers a first step in this regard.

CONTRIBUTIONS TO KNOWLEDGE

Through the various research aspects of the thesis, numerous contributions to knowledge have emerged. Table 9.3 outlines these contributions and their location within the thesis.

Table 9.3 – Overview of the Contributions to Knowledge from Each Chapter

Chapter No.	Chapter Title	Contributions to Knowledge
3	Curriculum Development in the Higher Education Literature: A Synthesis Focusing on Construction Management Programmes.	1. Lack of a defined HECD community of practice.
4	Development of a Conceptual Construction Management Curriculum Model Grounded in Scientometric Analysis.	1. Lack of a defined construction management community of practice. 2. Conceptual model developed outlining internal and external factors of CMCD.
5	Professional Skills Development: Foundational Curriculum Skills and Competencies of UK Construction Management Programmes.	1. Irregularity within programme structure. 2. Interpersonal and technical skills and competencies are noted as essential to construction management.
6	Defining the Key 'Professional Development Skills' of Construction Managers from Influential UK Construction Organisations.	1. High frequency of interpersonal skills. 2. Vagueness regarding technical skills with silence on digital skills. 3. Current educational provision and industry are misaligned regarding core skills and competencies.
7	Developing a Proof-of-Concept Curriculum Foundation Model: A Primary Data Survey of Built Environment Academics.	1. Strong preference for interpersonal skills – *teamwork*, *communication*, *leadership* and *listening and understanding*. 2. Minute support given for digital skills. 3. Development of a proof-of-concept curriculum foundation model.

Chapter 3 – Literature Review – Part I

Research findings illustrate that while curriculum development within HEIs has received increasing scrutiny and attention, a notable lack of connectivity between research conducted also exists. This research highlights the lack of a cohesive agenda for curriculum development within construction disciplines and in so doing, underscores the urgent need for a collaborative community of practice to optimise future educational provisions.

Chapter 4 – Literature Review – Part II

Research findings illustrate that the prevailing body of knowledge lacks a cohesive nucleus of research on CMCD. Rather, bespoke curriculum development research predominates in uncommunicative silos. Premised upon these findings, the conceptual curriculum model developed defines and delineates the universal internal factors (e.g., student marketplace, course leadership and academic precedents) and external factors (e.g., accreditation, construction industry and professional bodies) that impact upon curriculum development.

Chapter 5 – Secondary Data – UK CM Programmes

Research findings demonstrate that the specific content of CMP is bespoke and tailored by the programme teaching team at each individual HEI; albeit all programmes reviewed are in congruence regards the importance of broad technical and interpersonal themes. However, the degree to which these themes are publicly presented differ from the curricular and institutional documentation; specifically, a more 'technical-based skill' image is being portrayed publicly whilst 'interpersonal skills' are doing the heavy curriculum lifting. This research constitutes the first attempt to conduct a cross comparative analysis of descriptive metadata contained with curriculum development documents sourced from various UK HEIs. Findings unearth the key skills and competencies that serve as the curriculum's foundation but also question whether a more consistent approach to construction management education should be sought.

Chapter 6 – Secondary Data – UK Job Adverts

Research findings demonstrate that interpersonal skills and competencies have 70.59% of the importance embodied within construction manager role – as defined by practice. There exists however, a prevalent vernacular imprecision, within the job advertisements about the specific technical skills and competencies for the role exist. Specifically, the lack of digital-esque skills such as VR, AR and BIM is profound – providing a clear indication that such roles are the primary realm of other members of the project management team (e.g., the Architect or Structural Engineer). Thus, a misalignment is present between current educational provision and industry practice regarding the core foundational skills and competencies required of the construction management profession.

Chapter 7 – Survey

Research findings demonstrate that whilst technical skills are relatively important for the role of construction manager, they significantly pale in comparison to interpersonal skills; mainly '*teamwork*,' '*leadership*,' '*communication*' and '*listening / understanding*.' Furthermore, an aggregate ranking of skills/competencies supports the notion that a substantial number of interpersonal skills/competencies outrank numerous technical skills/competencies. Additionally, within the technical skills/competencies, digital-esque themes rank towards the bottom of the table, with 'traditional' skills competencies (workflow, budgeting, costing) ranking higher. Findings noted a hierarchy of interpersonal and technical skills/competencies which provided the nuance within the proof-of-concept model regarding the core foundational skills/competencies. The findings presented in this current chapter also confirm the previous findings emergent from Chapter 6 and as such, further confirm the validity of findings presented.

LIMITATIONS

From a philosophical standpoint, there are important limitations of this work. First, when using an interpretivist and/or pragmatist philosophical approach, research bias is an omnipresent issue of contention by virtue of the philosophy adopted. The research has recognised this limitation and has offered numerous literature sources, data interpretations and results to offer the most unbiased view possible. To combat this, the research has introduced an additional philosophical stances and quantitative metrics (descriptive statistics, inferential statistics, bibliometrics, scientometric, parts of textual analysis). Additionally, grounded theory as a strategy is extremely wide in definition with inherent limitations, depending on the vein employed, for example, utilising literature to inform the development of a concept lacks applied research (i.e., testing in the HEI sector).

With secondary data, the strength and publication of this data can be a variable factor in analysis. Whilst the secondary data in this research has been published by HEIs and which can safely be held in positive regard, the data, nonetheless, may not depict the whole picture. This may be because of internal and/or external factors dictating the content and vernacular of the programme to suit other needs. Regardless, in this specific research, the author purposefully utilised publicly available information from HEIs to align the information present and available to a prospective student comparing, analysing and selecting CMP. Additionally, the secondary data being analysed may be inherently flawed, incomplete and/or imprecise. Specifically, regarding the content of a job advertisement, the research must take the published content at face value given the seriousness and outward publicity of the document.

Regarding primary data collection, whilst careful consideration has been given to the vernacular utilised within the Likert-scale survey instrument, there is undoubtably different interpretations of specific words, phrases and meanings. This could be attributed to differences in language conventions across different parts of globe. Furthermore, as noted previously, there is a discrepancy between the goal sample size and the actual number of survey respondents. Whilst extant literature has provided a solid footing for the use of primary data in which the actual respondent frequency is below that of the goal sample size, there is no question that having a large respondent population would impact the findings – the extent of which would need to be explored in more detail. Finally, whilst the Likert-scale survey instrument did provide a place of open-ended comments, a purely qualitative space for respondents to expand upon their ratings and rankings, such as unstructured interviews, could add an additional layer of richness to the data. Moreover, questionnaires provide a snapshot of a participants view at that moment in time and as Pre-Scholastic philosopher Parmenides points towards, people's opinions constitute the "way of opinion" rather than the "way of truth." They are also subject to change over time.

For the proof-of-concept model validation, similar limitations for primary data collection were experienced. Whilst the one-on-one, semi-structured nature of the interviews does aid in providing a more robust and open dialogue, this can also be seen as a limitation. The expanded nature of the interviews, when both parties are relaxed and fully engaged, can offer tangents and cause the interview to stray and lose focus. As such, a prompt check sheet was constructed to help the interview maintain focus whilst enabling an open dialogue.

FUTURE RESEARCH

The curriculum foundation model supports the entire curriculum. To that end, the foundation represents just a small, but important piece of the larger curriculum framework. To help illustrate an ideal and theoretical construction management curriculum framework, Figure 9.1 is presented. As the heading notes, this figure is theoretical in nature but provides a product of this thesis (viz. a new theory), required further research. However, the framework helps to depict areas of future research and their connectedness. The model comprises three main sections: 1) course curriculum (grey box); 2) higher education institution (purple box) and 3) external marketplace (green box). As expected, the course curriculum sits within the HEI. There are internal factors (double-headed yellow arrows) that impact the HEI and course respectively. These internal factors are the same internal factors of the previous conceptual model presented in Chapter 4. There are also external factors deriving from the external marketplace which impact upon the HEI; these are the same external factors as noted in the conceptual model presented in Chapter 4. The construction industry (represented by the blue box) is situated within the external marketplace and within the HEI. However, the construction industry is not within the course curriculum except for two points of influence (green dashed arrows) – foundation and output.

Construction Leader of Character: Educational Mission and Strategic Educational Plan

As noted within CDSME comments (Table 8.4, $CDSME_B$ and $CDSME_D$), a critically important aspect when developing an entire curriculum framework, besides the foundation, is the end goal or output. A mission statement of any organisation (educational or otherwise), similar to a research aim, describes the purpose and/or goal of that organisation; it is the focus and guiding light for all that the organisation does. The same applies to an educational environment; the educational mission of a course depicts the ideal graduate of that course. The foundation of the curriculum supports this mission. To that end, the core foundational interpersonal skills and competencies noted within the curriculum foundation model are themed and squarely sit within the remit of personal character where character can be described as the mental and moral qualities distinguishing an individual (Oxford Learner's Dictionary, 2021). This is the link that ties the foundation of the curriculum to the output – both curriculum components are aligned.

This logic and stance are akin to three United States Service Academies (Air Force, Military and Naval). The United States Service Academies are four-year, degree granting HEIs with an obligatory service requirement. Competition to obtain an appointment (admission) to attend any one of the academies is extremely high with an overall acceptance rate of 9.00% (U.S. News and World Report, 2022). Upon entry into the academies, students are given a handbook which outlines a wide range of educational, military, conduct and historical content. Each handbook is an essential component of a student's indoctrination into the academies. Whilst the handbooks are different (i.e., content, shape, size, history), they have unmistakable similarities. One of these similarities is the explicit notation of the academies' educational mission. Even more similar is the wording and overall objective of the mission. Table 9.4 notes the educational mission statements from three of the United States Service Academies.

Figure 9.1 – Curriculum Framework Theoretical Model

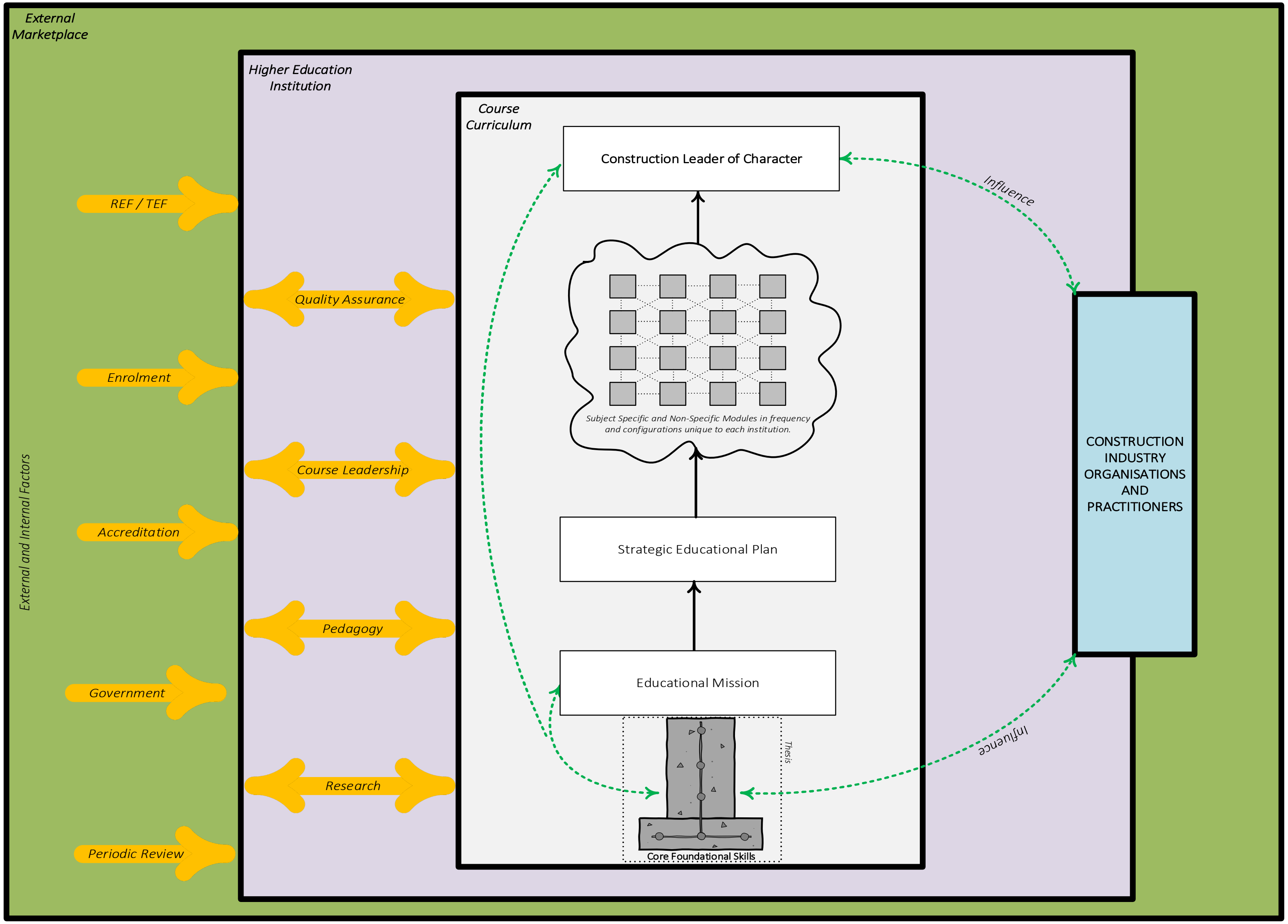


Table 9.4 – Mission Statements from United States Service Academies

US Service Academy	Mission Statement
Air Force Academy	*"To educate, train, and inspire men and women to become officers of character, motivated to lead the United States Air Force in service to our nation."* (United States Air Force Academy, 2010, p. 99)
Military Academy	*"To educate, train, and inspire the Corps of Cadets so that each graduate is a commissioned leader of character committed to the values of Honor, Duty, Country and prepared for a career of professional excellence and service to the Nation as an officer in the United States Army."* (United States Military Academy, 2018, p. 4)
Naval Academy	*"To develop Midshipmen morally, mentally and physically and to imbue them with the highest ideals of duty, honor and loyalty in order to graduate leaders who are dedicated to a career of naval service and have potential for future development in mind and character to assume the highest responsibilities of command, citizenship and government."* (United States Naval Academy, 2006, no pagination)

As noted from Table 9.4, the concept of 'leader of character' is overwhelmingly present. On face value any service academy regardless of country or nationality seems very much aligned with specific technical and vocational skills. For example, as an officer in a Navy one would think seamanship, navigation and engineering would be dominant skills. However, as the mission statements clearly show, whilst there is a great deal of 'technical content' implied, the core, fundamental grounding of the educational provision, is an interpersonally based concept of character leadership. As noted in Chapter 7, perhaps HEIs have perhaps gone too far in their estimation of the importance of digital/technical skills in a management orientated curriculum? The logic and use of the above educational mission and strategic educational plan, as well as an expanded secondary data review of CMPs can help investigate this further.

As depicted in Figure 9.2, applying this reasoning to a construction management course, the thesis research has demonstrated that interpersonal skills and competencies are the core of the educational provision. Thus, having a course mission to emulate this, can help guide the main reason and focus for the course: creating construction leaders of character.

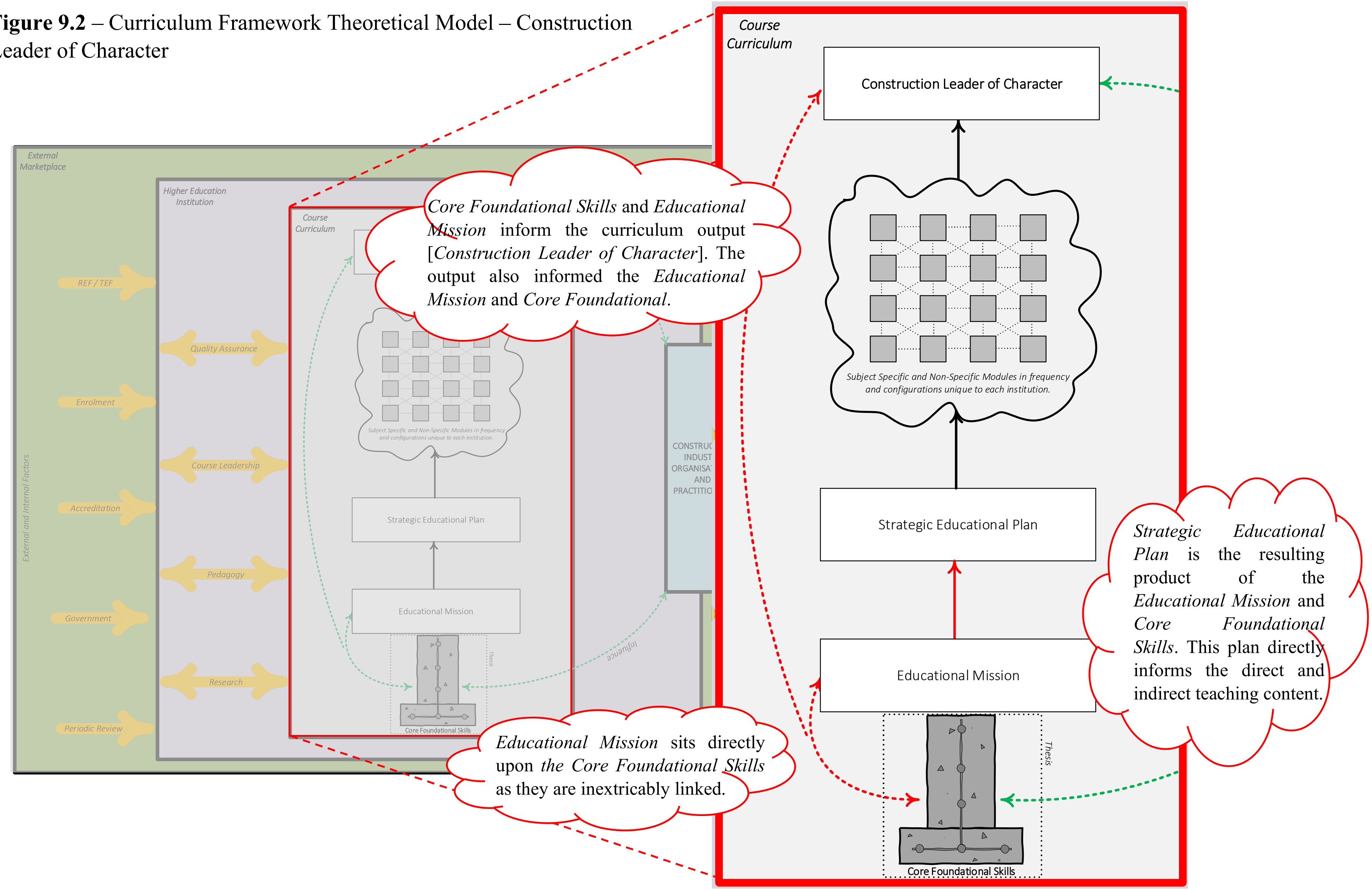


Figure 9.2 – Curriculum Framework Theoretical Model – Construction Leader of Character

Programme Structure

A common interpretation (or misinterpretation) of curriculum development is that the specific modules and their sequence constitute the entirety of the curriculum (Boyle and Charles, 2016; Print, 2020). As the thesis research has demonstrated, there are numerous aspects impacting the curriculum that go beyond specific module and their content. However, the courses' modules do play a very vital role in delivering the educational provision set forth in the educational mission and strategic educational plan (refer to Figure 9.3).

During research related to Chapter 5 where UK CMPs were analysed in detail, the focus was on learning outcomes and educational aims; particularly the vernacular used. However, during this analysis, a complete list of the modules offered throughout the various programmes was composed. Reviewing this list with a lens towards specific modules and content, a few high-level observations are noted.

First, the modules offer a wonderful opportunity to introduce technical content into the curriculum. Whilst interpersonal skills comprise the core foundational skills and competencies of the curriculum, the technical skills and competencies are nonetheless still important in the overall provision. Thus, dedicating specific modules to technical content (grounded in interpersonal skills) can provide students a pinpointed focus on said technical skills. For example, a module dedicated to identifying and estimating plant and machinery on a project, introduces specific technical skills required of the construction manager in conjunction with teamwork / group activities, which support the core foundational interpersonal skills and competencies.

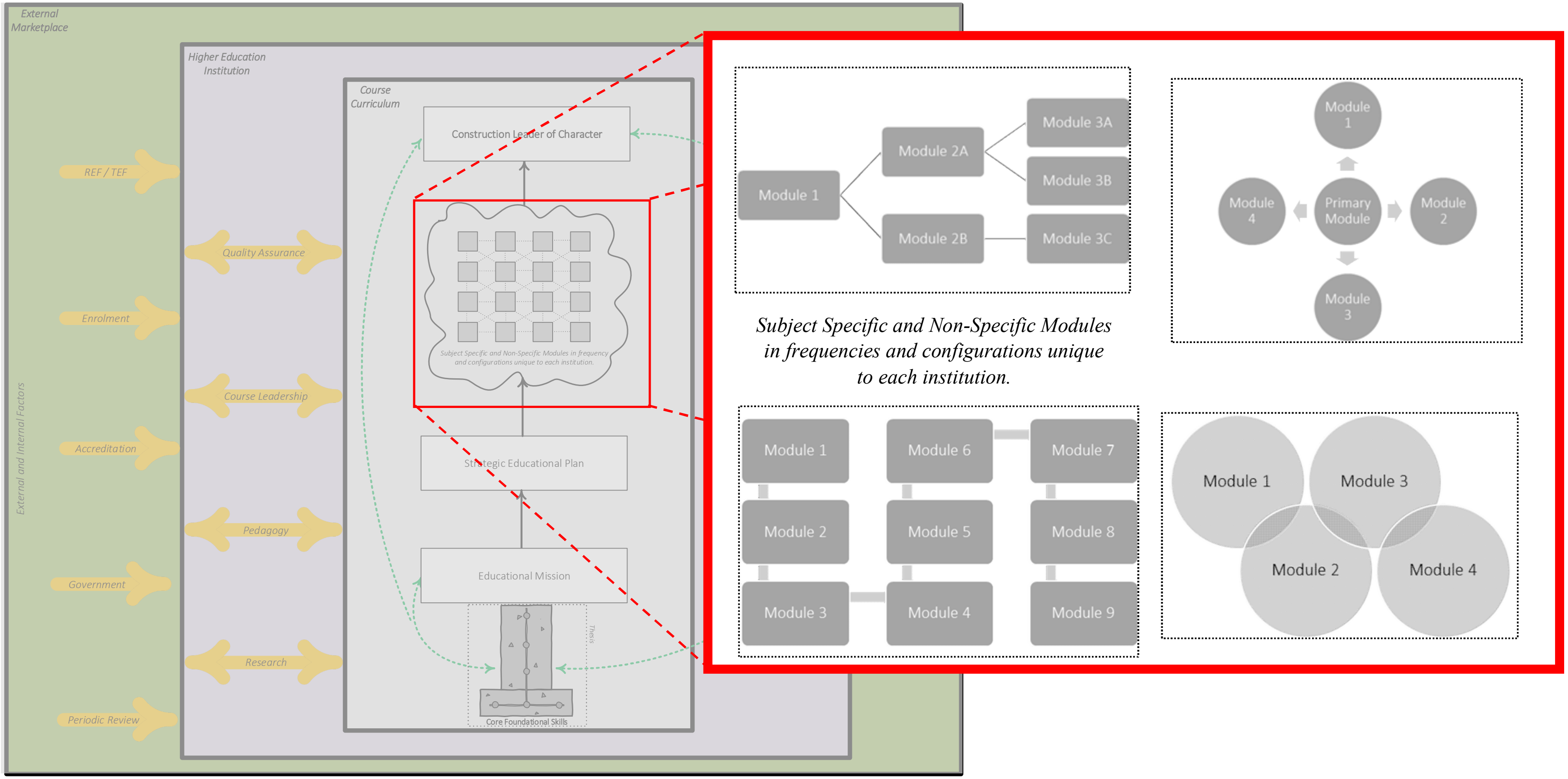
Second, the lack of specific technical modules is surprising. Regardless of the level of construction industry advancement, there are some essential technical skills that are 'bread and butter' of the industry. For example, plans and specifications reading/understanding is an essential skill (regardless of whether they are presented on paper or in a virtual/digital format). This is the language of the industry and a critical means for communicating across built environment disciplines. Surprisingly, not a single construction management programme reviewed within the study had a dedicated plans and specifications reading module. This skill may be taught across a range of modules as a secondary objective; yet a skill of such integrated importance should have its own dedicated module. Similarly, regarding scheduling and workflow sequence, not a single construction management programme reviewed within the study had a devoted scheduling module. A similar style of research to that of Chapter 6 should be conducted on specific technical skills required of construction managers to help inform the offering of technical specific modules.

Third, the lack of elective modules, where students can select, from a range of bespoke or niche topics is severely lacking. With advances in construction industry technology, scope, etc., the use of elective modules can provide students with a specialisation in a topic field, such as healthcare construction or infrastructure construction. Without an opportunity for specialisation, students could be pigeonholed and not be made aware of different sectors in which their construction management skills would be applicable.

Fourth, the sequence of the modules is another area of investigation that requires a focused view. From the review of modules noted within the study, there does not appear to be a dedicated / prescriptive sequence of study. Specifically, the lack of prerequisite modules, where a specific module is required to be completed before progressing to another module, is surprising. There are undoubtedly modules that feed into other advanced modules (for example, quantity take-off estimating feeding into conceptual estimating), thus if a student does not successfully complete the initial module, the requisite content for the advanced level is not obtained for progression.

As noted within Chapters 3 and 4, the landscape of CMCD is disconnected and lacking in cohesion. The use of case studies of specific CMPs can further analyse the programme structure and qualitative comments from staff and administration to better understand the rationale for the current curricula programme structure. Furthermore, the theory of '*autoregressive curriculum development*' (noted in Chapter 3) could also be reviewed through the case studies and qualitative interviews from CMPs.

Figure 9.3 – Curriculum Framework Theoretical Model – Programme Structure and Pedagogical Approach



Pedagogical Approach

As noted within CDSME comments (Appendix 4, $CDSME_A$ Comment 40; Appendix 5, $CDSME_B$ Comment 18), one is not able to fully discuss the impact of curriculum development without a pedagogical conversation. Whilst pedagogy is a wide field of research, a research approach similar to Chapters 3 and 4 would help identify specific construction management (or built environment) pedagogical research. To that end, Posillico *et al*. (2022b) commenced initial research into mapping the current construction management pedagogical landscape. Similar to that of the HECD and CMCD landscapes, there is scant extant literature regarding specific pedagogical or scholarship of teaching and learning (SoTL). A series of initial recommendations have been presented on this topic (Posillico *et al*., 2022b), yet more research is required to investigate this area further. Specifically, additional areas of inquiry are required regarding 'in module teaching' and 'out of module teaching.' This is in regard to CDSME comment (Table 8.6, $CDSME_D$) where higher education has emerged into education of the whole body (interpersonal skills and competencies) rather than just the head (technical skills and competencies). Consequently, a wider view of where pedagogical practice occurs is needed. For example, a more traditional, 'in module teaching' view confines teaching and learning to the walls of the classroom, thus teaching provision is solely focused there. However, a realisation of 'out of module teaching' essential removes the confines of physical boundaries on teaching, thus the HEI environment (academic buildings, social buildings, culture, resources, location, extracurricular activities, etc.) become main motorways for teaching and learning to occur alongside more traditional means.

Further research into the physical spaces (academic, social, communal) and their impact upon module specific teaching and learning should be explored. Similarly, the entire realm of pedagogical applications is displayed. Specifically, students study, socialise, eat, sleep and engage in recreation within a purposely planned environment aimed at supporting the curriculum's mission (United States Military Academy, 2022; United States Naval Academy, 2022).

Furthermore, the periods in which main formal academic engagement is suspended (i.e., summer recess) should not be dismissed from the pedagogical equation. These periods can serve as vital opportunities for students to engage in supportive educational provisions, such as internships/placements within industry or obtaining industry certifications/credentials. With a similar 'in module teaching' and 'out of module teaching' mindset, the formal education suspension periods maybe outside the remit of traditional education provision but can be guided and supported by the curriculum. In reference to the academies, students during educational suspension periods are engaging in more technical based specialities to complement their 'in module' formal education (United States Air Force Academy, 2022; United States Military Academy, 2022; United States Naval Academy, 2022). For example, the United States Naval Academy requires all students during the summer period to engage with areas of the US Navy in which they are preparing to enter (United States Naval Academy, 2022). The purpose of this two-fold: 1) it helps reinforce the student's technical skills in their area of speciality and 2) it provides the student with a different learning environment so as to practice and hone their interpersonal skills in support of their technical skills proficiency (United States Naval Academy, 2022).

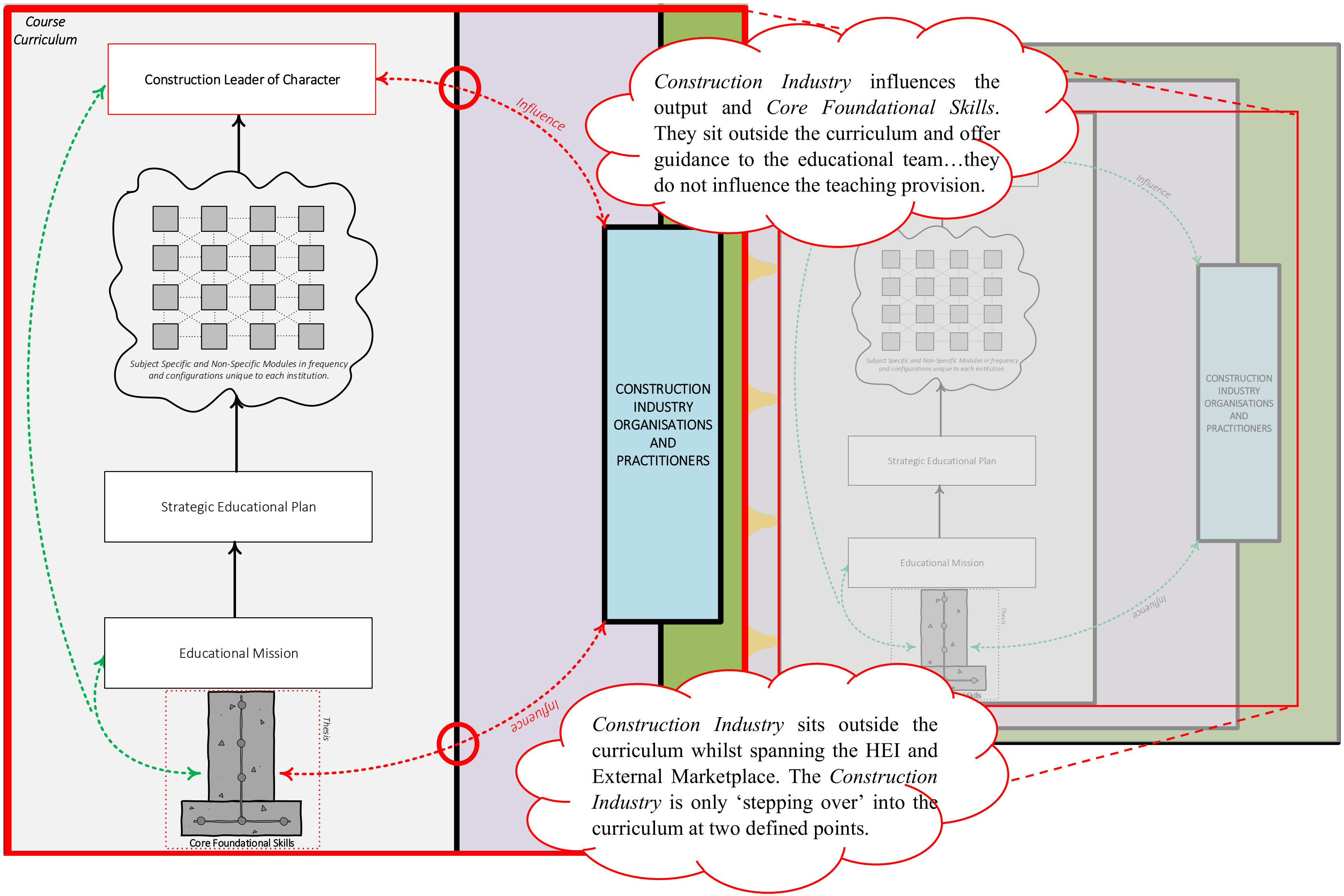
Additionally, the period prior to the start of a new student joining HEI offers an invaluable opportunity to introduce or indoctrinate the student into higher education. Whilst many HEIs use about a week's time immediately prior to the start of the initial semester/term, additional investigate should be sought to determine if a longer, systematic and planned approach is beneficial. An extensive indoctrination programme is completed prior to starting formal academic education at the service academies (United States Military Academy, 2022; United States Naval Academy, 2022). Whilst this does include military facets, the underlying logic and reason is to prepare a student for life in a HEI as well as best utilise and maximise 'out of module' teaching time.

Industry-Academia Link

As noted within CDSME comments (Table 8.5, $CDSME_B$ and $CDSME_C$), the relationship with practicing industry and education provision is important. Specifically, in regard to construction management courses, the dialogue between industry and academia is vital to maintaining relevant and robust educational provision. However, the method of maintaining this link is a widely discussed topic (within technically based disciplines) (Emmer and Ghanem, 2013; McIntyre and Labas, 2019). The correct mix of industry participation in the formal education curriculum is akin to *Goldilocks and the Three Bears* – not too much, not too little, just right. When industry (or a specific construction organisation) is too heavily involved with the curriculum, the educational remit becomes analogous to a bespoke training school for that specific organisation; utilising the specific software that organisation uses, practicing critical path method scheduling in the same manner of that specific organisation and using project examples completed by only that organisation. This overbearing relationship, often fuelled by an industry providing financial incentive to higher education programmes with an aim a obtaining the ‘best graduates,’ (Emmer and Ghanem, 2013) can greatly skew the curriculum for the advantage of the construction organisation rather than advantaging the student.

Conversely, having too little industry involvement is just as detrimental. Without a healthy industry relationship, educational provision is solely at the whim of the teaching staff, whom may or may not be qualified or best suited to advise on current industry particulars. The potential use of outdated materials, equipment and practices is heightened without industry dialogue guiding academia on current trends and their application to the role of construction managers. Figure 9.4 depicts an ideal visual relationship between a construction management course and industry. Note that further research is required to explore this in more detail, but the figure does provide a theoretical model for narration. Specifically, the only influence points industry has with academia is in the curriculum’s foundation and output. This helps support the ‘just right’ approach by maximising the strengths of each party: academics can best speak to the educational intent of the curriculum and industry can provide insight into the foundational skills and competencies (and thus ideal output graduate). Further, industry is engaged with the HEI but not intrinsically with the course. This allows for an airgap of sorts between the two parties allowing for an adequate ‘checks and balances’ approach. This also allows different construction organisations to engage with the HEI and course on a level playing field maximising students’ opportunities to engage with a wide range of industry practitioners. The use of case studies of specific CMPs and their Industry Advisory Boards can help explore the connection or disconnection between academia and industry practice respective to educational provision as well as student employability.

Figure 9.4 – Curriculum Framework Theoretical Model – Industry-Academia Link



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APPENDIX

Appendix 1: Interpersonal and Technical Skills/Competencies Survey (Paper Version)

SKILLS AND COMPETENCIES QUESTIONNAIRE FOR CONSTRUCTION / PROJECT MANAGERS

BACKGROUND AND PRELIMINARIES:

My name is John Posillico and I am a PhD student studying Construction Management at Birmingham City University under the supervision of Dr Mark Shelbourn, Professor David J. Edwards and Dr Chris Roberts. For the thesis, I am conducting research into the skills and competencies of construction and project managers within the United Kingdom. The study aims to gain academics' perceptions of the key skills and competencies of construction / project managers. In order to help with my research, I would invite you to compete the attached questionnaire. All responses will be treated as being strictly confidential and will not be divulged nor disseminated to any third party without the express permission of participants and will be analysed in aggregate form. All data will be securely disposed of post analysis and you are welcome to obtain a copy of the final thesis once complete.

Questionnaire begins on the next page.

To indicate your answer, please place a cross (x) or tick (✓) mark in the ☐ that corresponds with your choice.

SECTION ONE: DEMOGRAPHICS							
No.	**Question**	**Options**					
1	What is your age range?	18 - 24 ☐	25 - 34 ☐	35 - 44 ☐	45 - 54 ☐	55 - 64 ☐	65+ ☐
2	What is your current role?	Assistant Lecturer / Lecturer ☐	Senior Lecturer ☐	Associate Professor / Professor ☐	Senior Leadership / Department Head ☐		
3	How many years have you worked in academia?	0 - 4 ☐	5 - 9 ☐	10 - 14 ☐	15 - 19 ☐	20 - 24 ☐	25+ ☐
4	What Built Environment programme are you most closely affiliated with?	Construction Management ☐	Quantity Surveying ☐	Building Surveying ☐	Civil Engineering ☐	Architectural Technology ☐	Other ☐
5	How many years of Built Environment industry experience do you have?	0 - 2 ☐	3 - 5 ☐	5 - 9 ☐	10+ ☐		

SECTION TWO: INTERPERSONAL SKILLS AND COMPETENCIES

No.	Question	1 (not at all important)	2 (low importance)	3 (neutral)	4 (important)	5 (very important)
6	How important to the role of a construction / project manager is written / typed communication?	☐	☐	☐	☐	☐
7	How important to the role of a construction / project manager is verbal communication?	☐	☐	☐	☐	☐
8	How important to the role of a construction / project manager is non-verbal communication?	☐	☐	☐	☐	☐
9	How important to the role of a construction / project manager is authentic leadership?	☐	☐	☐	☐	☐
10	How important to the role of a construction / project manager is effective team management?	☐	☐	☐	☐	☐
11	How important to the role of a construction / project manager is emotional intelligence (*the ability to monitor one's own emotions*)?	☐	☐	☐	☐	☐
12	How important to the role of a construction / project manager is effective team / group work?	☐	☐	☐	☐	☐
13	How important to the role of a construction / project manager is empathy towards others?	☐	☐	☐	☐	☐
14	How important to the role of a construction / project manager is effective listening and understanding?	☐	☐	☐	☐	☐

15 Please give brief reasons for your answers (optional): --

SECTION THREE: TECHNICAL SKILLS AND COMPETENCIES						
No.	Question	1 (not at all important)	2 (low importance)	3 (neutral)	4 (important)	5 (very important)
16	How important to the role of a construction / project manager is effective budgeting and cost control?	☐	☐	☐	☐	☐
17	How important to the role of a construction / project manager is effective estimating?	☐	☐	☐	☐	☐
18	How important to the role of a construction / project manager is proficiency in creating building information models (BIM)?	☐	☐	☐	☐	☐
19	How important to the role of a construction / project manager is proficiency in reading / interpreting building information models (BIM)?	☐	☐	☐	☐	☐
20	How important to the role of a construction / project manager is proficiency in digital technologies (e.g. laser scanning, 3D printing)?	☐	☐	☐	☐	☐
21	How important to the role of a construction / project manager is proficiency in structural engineering?	☐	☐	☐	☐	☐
22	How important to the role of a construction / project manager is proficiency in civil engineering?	☐	☐	☐	☐	☐
23	How important to the role of a construction / project manager is proficiency in critical path method (CPM) scheduling?	☐	☐	☐	☐	☐
24	How important to the role of a construction / project manager is proficiency in workflow / work sequence?	☐	☐	☐	☐	☐
25	Please give brief reasons for your answers (optional):	------------				

SECTION FOUR: RANKING

No.	Question	Skills and Competencies	Rank
26	Please rank the following skills and competencies in order of importance to the role of construction / project manager, where: 8 is the most important 1 is the least important Please do not duplicate ranking numbers.	Communication *(written, verbal, non-verbal)*	
		Costing / Budgeting / Estimating	
		Digital / Building Information Modelling	
		Engineering	
		Leadership / Management	
		Scheduling	
		Teamwork	
		Understanding / Empathy	
27	Please give brief reasons for your answers (optional):	-- -- --	

SECTION FIVE: FURTHER COMMENTS
Do you have any other comments or feedback on the skills and competencies of construction / project managers that you feel have not been covered in this questionnaire?

End of Questionnaire

A sincere thank you for completing this questionnaire; your assistance is very much appreciated and valued. Your input will help with my thesis but also future construction management educational provision.

<u>Note</u>: You have the right to withdraw from this study at any time up until publication of the work and do not have to give any reasons for this.

Appendix 2: Interpersonal and Technical Skills/Competencies Survey (Online Version)

Skills and Competencies of Construction / Project Managers (copy)

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Page 1: Informed Consent

This research is being undertaken by John Posillico for a Doctoral Thesis on the Construction Management course and is being supervised by Dr Mark Shelbourn and Professor David Edwards during the thesis period [February 2020 to approximately February 2023]. This research aims to gather practicing built environment academics' perceptions of the skills and competencies of construction / project managers. A copy of the final thesis will be made available to all participants when the work is submitted and graded in early 2023.

Please note that you are able to withdraw form this study at any time up until the PhD Thesis is published (early 2023) without giving reason or explanation. All responses will be treated in the strictest of confidentiality and will not be share willingly or otherwise with any third party. Data and information analysed will be anonymised to preserve your identity and all information collected will be securely destroyed upon successful completion of the award.

Title of Study: Skills and Competencies of Construction / Project Managers

Researcher Contact Email: John.Posillico@bcu.ac.uk

By continuing to the next page and completing the survey you:

1) Agree to participate in this proposed dissertation research conducted by Birmingham City University - School of Engineering and the Built Environment.

2) Understand that you are free to withdraw from this study, at any time and without giving reasons. However, if you change your mind after one month since data was submitted / survey response provided, it may be impossible to remove this response from analysis.

3) Give permission for the research team members [John Posillico, Dr Mark Shelbourn and Professor David Edwards] to have access to your anonymised response and/or data/information?

4) Understand that all information and data collated will be anonymised, securely stored during the research period and securely destroyed at the end of this study.

5) If you have questions about the survey - please contact John Posillico (John.Posillico@bcu.ac.uk).

Information Sheet

How often will I need to participate in this research and for how long?	You will be required to partake in one instance that will only take approximately ten minutes.
At what stage in the process will I have the opportunity to discuss my participation?	You will be able to comment upon your participation at the end of the research survey.
Who is responsible for the information and data collected when this study is complete?	Responsibility for information and data collected is the responsibility of the lead researcher and their supervisor – who must abide by Birmingham City University research ethics rules and regulations.
Who will have access to the information and data?	Only the lead researcher and staff at Birmingham City University.
What will happen to the information data supplied when this research is complete?	At the end of the study, all information and data will be securely disposed of (including raw data) and only anonymised data will be used for publishing the findings as part of this dissertation study. At no time will any data be passed to a third party (willingly or otherwise).
How will the information and data be used?	The information and data will be used to create a research paper that will not contain any personal details of participants or organisations supporting this work.
How long is the research project duration?	February 2020 to approximately February 2023 Survey is open until the end of May 2022
Is my data and information secure?	All information is stored electronically on the University's secure 'One Drive' and/or locked away in a secure cupboard.
Can I have access to the research results?	Yes. The study's results will be made freely available to all survey participants. It is at your

	discretion as to whether you wish to receive such publication(s).
What if I do not wish to participate in this research project?	Participation is completely voluntary and you do not have to participate.
What about if I change my mind during the research project?	You can withdraw from the research at any stage of the process. However, if you change your mind after one month since data was submitted / survey response provided, it may be impossible to remove this response from analysis.
Who do I contact if I experience any concerns or if the study generates any adverse effects?	In the first instance, you need to contact my supervisor who should refer the matter to the Faculty Academic Ethics Committee.

Next >

Skills and Competencies of Construction / Project Managers

16% complete

Page 2: Section One: Demographics

1. What is your age range? ✱ *Required*

Please select

2. What is your current role? ✱ *Required*

Please select

3. How many years have you worked in academia? ✱ *Required*

Please select

4. What Built Environment programme are you most closely affiliated with? ✱ *Required*

Please select

5. How many years of Built Environment industry experience do you have? ✱ *Required*

Please select

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Skills and Competencies of Construction / Project Managers

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Page 3: Section Two: Interpersonal Skills and Competencies

This part of the survey uses a table of questions, view as separate questions instead?

6. How important to the role of a construction / project manager is written / typed communication? ✱ *Required*

	1 - not at all important	2 - low importance	3 - neutral	4 - important	5 - very important
Please select	☐	☐	☐	☐	☐

This part of the survey uses a table of questions, view as separate questions instead?

7. How important to the role of a construction / project manager is verbal communication? ✱ *Required*

	1 - not at all important	2 - low importance	3 - neutral	4 - important	5 - very important
Please select	☐	☐	☐	☐	☐

This part of the survey uses a table of questions, view as separate questions instead?

8. How important to the role of a construction / project manager is non-verbal communication? ✱ *Required*

	1 - not at all important	2 - low importance	3 - neutral	4 - important	5 - very important
Please select	☐	☐	☐	☐	☐

This part of the survey uses a table of questions, view as separate questions instead?

9. How important to the role of a construction / project manager is authentic leadership?
✱ *Required*

	1 - not at all important	2 - low importance	3 - neutral	4 - important	5 - very important
Please select	☐	☐	☐	☐	☐

This part of the survey uses a table of questions, view as separate questions instead?

10. How important to the role of a construction / project manager is effective team management? ✱ *Required*

	1 - not at all important	2 - low importance	3 - neutral	4 - important	5 - very important
Please select	☐	☐	☐	☐	☐

This part of the survey uses a table of questions, view as separate questions instead?

11. How important to the role of a construction / project manager is emotional intelligence (*the ability to monitor one's own emotions*)? ✱ *Required*

	1 - not at all important	2 - low importance	3 - neutral	4 - important	5 - very important
Please select	☐	☐	☐	☐	☐

This part of the survey uses a table of questions, view as separate questions instead?

12. How important to the role of a construction / project manager is effective team / group work? ✱ *Required*

	1 - not at all important	2 - low importance	3 - neutral	4 - important	5 - very important
Please select	☐	☐	☐	☐	☐

This part of the survey uses a table of questions, view as separate questions instead?

13. How important to the role of a construction / project manager is empathy towards others? ✱ *Required*

	1 - not at all important	2 - low importance	3 - neutral	4 - important	5 - very important
Please select	☐	☐	☐	☐	☐

This part of the survey uses a table of questions, view as separate questions instead?

14. How important to the role of a construction / project manager is effective listening and understanding? ✱ *Required*

	1 - not at all important	2 - low importance	3 - neutral	4 - important	5 - very important
Please select	☐	☐	☐	☐	☐

15. Please give brief reasons for your answers. *Optional*

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Skills and Competencies of Construction / Project Managers

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Page 4: Section Three: Technical Skills and Competencies

This part of the survey uses a table of questions, view as separate questions instead?

16. How important to the role of a construction / project manager is effective budgeting and cost control? ✱ *Required*

	1 - not at all important	2 - low importance	3 - neutral	4 - important	5 - very important
Please select	☐	☐	☐	☐	☐

This part of the survey uses a table of questions, view as separate questions instead?

17. How important to the role of a construction / project manager is effective estimating? ✱ *Required*

	1 - not at all important	2 - low importance	3 - neutral	4 - important	5 - very important
Please select	☐	☐	☐	☐	☐

This part of the survey uses a table of questions, view as separate questions instead?

18. How important to the role of a construction / project manager is proficiency in creating building information models (BIM)? ✱ *Required*

	1 - not at all important	2 - low importance	3 - neutral	4 - important	5 - very important
Please select	☐	☐	☐	☐	☐

This part of the survey uses a table of questions, view as separate questions instead?

19. How important to the role of a construction / project manager is proficiency in reading / interpreting building information models (BIM)? * *Required*

	1 - not at all important	2 - low importance	3 - neutral	4 - important	5 - very important
Please select	☐	☐	☐	☐	☐

This part of the survey uses a table of questions, view as separate questions instead?

20. How important to the role of a construction / project manager is proficiency in digital technologies (e.g. laser scanning, 3D printing)? * *Required*

	1 - not at all important	2 - low importance	3 - neutral	4 - important	5 - very important
Please select	☐	☐	☐	☐	☐

This part of the survey uses a table of questions, view as separate questions instead?

21. How important to the role of a construction / project manager is proficiency in structural engineering? * *Required*

	1 - not at all important	2 - low importance	3 - neutral	4 - important	5 - very important
Please select	☐	☐	☐	☐	☐

This part of the survey uses a table of questions, view as separate questions instead?

22. How important to the role of a construction / project manager is proficiency in civil engineering? * *Required*

	1 - not at all important	2 - low importance	3 - neutral	4 - important	5 - very important
Please select	☐	☐	☐	☐	☐

This part of the survey uses a table of questions, view as separate questions instead?

23. How important to the role of a construction / project manager is proficiency in critical path method (CPM) scheduling? ✱ *Required*

	1 - not at all important	2 - low importance	3 - neutral	4 - important	5 - very important
Please select	☐	☐	☐	☐	☐

This part of the survey uses a table of questions, view as separate questions instead?

24. How important to the role of a construction / project manager is proficiency in workflow / work sequence? ✱ *Required*

	1 - not at all important	2 - low importance	3 - neutral	4 - important	5 - very important
Please select	☐	☐	☐	☐	☐

25. Please give brief reasons for your answers *Optional*

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Skills and Competencies of Construction / Project Managers

66% complete

Page 5: Section Four: Ranking

This part of the survey uses a table of questions, view as separate questions instead?

26. Please rank the following skills and competencies in order of importance to the role of construction / project manager. ✱ *Required*

	1 - least important	2	3	4	5	6	7	8 - most important
Communication (written, verbal, non-verbal)	☐	☐	☐	☐	☐	☐	☐	☐
Costing / Budgeting / Estimating	☐	☐	☐	☐	☐	☐	☐	☐
Digital / Building Information Modelling	☐	☐	☐	☐	☐	☐	☐	☐
Engineering	☐	☐	☐	☐	☐	☐	☐	☐
Leadership / Management	☐	☐	☐	☐	☐	☐	☐	☐
Scheduling	☐	☐	☐	☐	☐	☐	☐	☐
Teamwork	☐	☐	☐	☐	☐	☐	☐	☐
Understanding / Empathy	☐	☐	☐	☐	☐	☐	☐	☐

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Skills and Competencies of Construction / Project Managers

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Page 6: Section Five: Further Comments

27. Do you have any other comments or feedback on the skills and competencies of construction / project managers that you feel have not been covered in this questionnaire? *Optional*

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Skills and Competencies of Construction / Project Managers

100% complete

Thank you!

A sincere thank you for completing this questionnaire; your assistance is very much appreciated and valued. Your input will help with my thesis but also future construction management educational provision.

Note: You have the right to withdraw from this study at any time up until publication of the work and do not have to give any reasons for this.

Appendix 3: Validation Interview Questions/Prompts

Introduction	Thank you for agreeing to meet with me for an interview. For this interview, I will begin with presenting the research findings and analysis that led to the development of a proof-of-concept curriculum model. I will then ask a series of pre-prepared questions with the aim at collecting your feedback.		
JP to present research findings, analysis and proof-of-concept curriculum model			
QUESTIONS		**POSSIBLE PROMPTS**	CHECK TO CONFIRM FULL ANSWER
Question 1	How long have you been professionally involved in career and technical education?	At what level(s)?	☐
		What is your educational background – Degree, Masters, PhD, etc.?	☐
		Any industry experience and tell me more about this (years in the sector, doing what job, professional qualifications, etc.)	☐
Question 2	How long have you been involved in curriculum development / review / implementation?	In what capacity - Module Leader, Programmer Leader, Head of School or other management position?	☐
		What do you feel are your specific areas of expertise – management, economics, environment, legal etc.	☐
		Talk me through the process of your experience of curriculum design / development / implementation.	☐
		Can you talk me through your experiences of ensuring employability in curriculum design?	☐
Question 3	A proof-of-concept model for the foundation of a construction management curriculum has been created. This lists communication, leadership, teamwork and listening/understanding at the core of the	Does the model make logical sense – i.e., do the constitute parts make sense and flow logically from one to the next?	☐
		Are there any parts that are missing?	☐
		If you could make constructive suggestions for change what would these be and why?	☐
		What are the good features of the model and why?	☐

	entire curriculum. What are your initial perceptions when seeing/hearing this?	Is this a model you would use in practice and if so, how would you implement this?	☐
Question 4	From your experience in developing curricula, how to you view/perceive the importance of getting the base (core concepts) of the curriculum correct? Is this something that you have witnessed as a rushed or misguided process?	In other words, does this impact upon the students' knowledge and understanding, their attitudes when studying modules and ultimately their career prospects?	☐
		Do you find that there is a temptation for staff to want to teach what they know rather than what the curriculum dictates is in the best interests of students?	☐
		If yes to the above – what are the ramifications of this and how can we avoid this happening?	☐
		Who informs curricular design and development – can you state the major stakeholders involved (both external and internal?)	☐
		What are the good points or practices you have seen in your experience of curriculum design?	☐
		What are the practices you would advise to avoid when designing a curriculum?	☐
		How important is industry engagement in the process?	☐

Appendix 4: Validation Interview 001 Transcript

Interviewer: John Posillico (JP)	
Interviewee: Curriculum Development Subject Matter Expert A ($CDSME_A$)	

Comment	Speaker	Transcript
1	JP	Thank you for agreeing to meet with me for an interview for this interview. I will begin with presenting the research findings and analysis that led to the development of a proof-of-concept model. I'll then ask a series of prepared questions with the aim of collecting your feedback and just to reiterate some ethical items you've been provided with an information sheet which outlines some general information about the research and that consent form your participation in this interview is completely voluntary and you can withdraw and/or stop the interview at any time for any reason. You, your information and your responses will be treated anonymously and will not be divulged or disseminated to any third party without your permission. Recording and transcript of this interview will be kept in a secure location and destroyed no later than two years after the completion of the research or the end of the year 2025 thirty first of December, whichever comes first. Any identifiable content from the transcript will be redacted upon publication. With that being said, are you happy to continue with this interview?
2	$CDSME_A$	Yes, I am.
3	JP	How long have you been professionally involved in the education field
4	$CDSME_A$	34 ½ years.
5	JP	And what if you can kind of just go into a little more detail about your educational level that would be fantastic.
6	$CDSME_A$	My personal educational level or what I what it was involved in teaching?
7	JP	Your qualifications. We'll start with that first.
8	$CDSME_A$	OK, I have a Bachelor Science degree in Early Elementary education certified by the 'Region A' to teach nursery school kindergarten through 'Level X' and then 'Level Y' through 'Level Z' general science. I also have a Master's Degree, Master of Science in Health Education and again certified by 'Region A' to teach health education 'Levels A through B.' I also have a Certificate of Advanced Study in Educational Administration, again certified by 'Region A' to be a building principal 'Levels A through B' and or any department supervisor that requires administrative certification.
9	JP	Great. Thank you for that comprehensive response. A notation, and specifically regarding curriculum development. As an administrator, I would assume and please correct me if I'm wrong. You've been involved with curriculum development or review, or the implementation of that. Is that correct?
10	$CDSME_A$	That's correct.
11	JP	And in what capacity, for example, was this done at a kind of a departmental head level or as an administrator of an institution?

12	$CDSME_A$	From the administrative perspective and that will be different from my actual teaching perspective. So, I'll come back to that later. It was my responsibility to make sure that in the schools that I was an administrator in that we had well developed written curriculum. I might not have been actively involved in writing that curriculum as an administrator, but certainly provided opportunities for teachers in those schools to have staff development time to work on the curriculum, to provide resources if necessary, including, you know, staff development professionals to come in and help lead them in curriculum writing. And then to, you know, disseminate that to other administrators throughout the district and share that with parents who might be interested in what we're teaching in the next grade level for their child or parents coming in new to our school district, you know, interested in what our curriculum consisted of. So, we actually had, you know, something in paper to hand them something in writing. As a teacher, my teaching experience was 20 years, all 'specific' level. That would be a 'Level A through C' both in science and in health education. Direct involvement in writing curriculum, either individually on my own or with, you know, department colleagues… level colleagues, team colleagues, if we were working on, you know, some special project. We needed a road map of you know what we were where we were going, what we were trying to accomplish and how we were going to do that. So, I hope that answers your question, but yes, I've had had my hands involved quite a bit.
13	JP	Yeah, it it's. It sounds so very much both at both at the kind of boots on the ground…classroom level and the management of it providing those opportunities in the culture for others to continue with that. Just specifically off of that and you can kind of interpret this question as you wish, kind of ensuring employability or stated differently, essential skills for the next level, whether that be a next grade level or life after education, was that of, you know, the insurance of that in the curriculum. Was that something that was prevalent when you're working through the development or review of curriculum?
14	$CDSME_A$	That's kind of a yes or no answer with explanation to follow up. It it's very easy when you're working by yourself or working with say grade level colleagues. Just think of what you're doing in isolation. It's only through maybe someone else's eyes or someone else that knows a little bit better, let's say in quotes, you know that you're just a piece of the bigger puzzle. OK, so in 'Level A' science, we're working on XY&Z. Now, does that lead to 'Level B' science or 'Level C' science completely different? Well, there are certain concepts that will, you know, transfer certain things that you want your students to be knowledgeable on, be exposed to, maybe a very simplistic level that will be developed later on in in the following [levels]. That might apply more if you think of social studies type curriculum where history you know they're following history… chronologically. Science is a little, you know, you can separate sciences, but you know you have some concepts that are same. So again, it really… you can get very focused and narrow visioned, but sometimes you have to step back and say, wait a minute. So how does this? How does my piece fit into the whole picture of our department, per se or of our school per say, if we're working on, you know, certain skills and qualities? That's where I think the administrative aspect came in.

		Uh, someone that you know is saying, "OK, yeah, I want you to focus on what you're doing for your students right now. But let's start thinking about what you do and how that impacts your students next year when they're not with you, but with someone else." Yeah, so they start to think more broadly. That leads to other benefits. I mean it engages colleagues and dialogue, which is essential. You know who's going to teach what? How do you teach this? What works? What doesn't work? You know, all those little side things that might not be formal curriculum writing, but certainly play into it.
15	JP	Great. Wonderful. OK. Moving on to kind of more specific questions about the proof-of-concept model. So, as you just saw, this kind of proof-of-concept model for construction management curriculum has been created. It lists communication and leadership, teamwork and listening. Understanding at the core of the entire curriculum, the foundation upon which it rests. What are your initial perceptions when seeing and hearing this?
16	$CDSME_A$	For number one, I like your graphic. You know, I understood that completely. There are there are basics that all of our students need to have and I and I think those are reflected in your foundation. The course specifics kind of fit that curriculum piece. But think of, maybe as an example, you have a curriculum topic and the way that you want to deal with that topic is through group activity work…well, if you don't have students able to communicate, we should with each other for forget about, you know the group work and therefore forget about that curriculum concept you're trying to teach them. You know, those spend more time. You know, I'm thinking of middle school kids. They'll spend more time arguing, who's going to be the boss and who's going to, you know, take notes and, you know. And that was my idea, not your idea. You know, those types of things. And that might be a very simplistic answer to your question, but you know, sometimes we as educators, try to make things more complex than they need to be. You know, if you if you can't get along with your colleagues, if you can't express yourself, if you can't talk. You know, if you're not organized or whatnot, nothing else is going to happen. Plain and simple.
17	JP	So, in other words, and I'm looking for if I mistake what you've mentioned, please correct me that if the foundational part was put into practice, it would be useful in in providing a good basis for exploring connections and curriculum further on.
18	$CDSME_A$	Absolutely, absolutely. It does not matter in my opinion what the curriculum piece is on top your Block wall going up. You know whether it's a science, uh, humanities, you know, or whatever. With without the base, it's common sense. You know it is strictly common sense. You know, how can again, John... I'm not trying to be simplistic or very casual…but how can educators in this day and age, where we rely on so much interaction between our students, not to develop those skills before they try to teach anything else. Or to continually emphasize those skills as they try to teach, you know more, more structural solid, you know, curriculum concepts. We've moved away from what I consider quality education is, is moving away from students sits teacher talks. You know that that just doesn't cut it. Again, my background is middle school students. They can't sit long enough for that. You know, there are attention spans not focused. They can't focus for that, so there has to be activities to get them engaged in their learning. And those activities really build on your foundation skills.

19	JP	I agree. I agree wholeheartedly.
20	$CDSME_A$	And again, you know there are times when I sit with others who are better with language than I am expressing, you know concepts and whatnot. I'm kind of a meat and potatoes kind of guy, you know, I mean it's to me, it's plain and simple, you know, why are we trying to make this complicated?
21	JP	Thank you. Thank you for that insight. We've kind of jumped into the kind of the next question through our dialogue, which is fantastic, which is kind of the nature of a semi structured interview. Maybe thinking back to when you were kind of boots on the ground teaching as well as, not at the same time, but the teaching hat as well as the administrative hat, did you find that there was a temptation for staff to want to teach what they knew rather than what the curriculum dictated or suggested that was in the best interest of the students?
22	$CDSME_A$	Oh, absolutely. And again, my answer again is you know, you fall back on what you know or what you're comfortable with. Experiences as an administrator observing elementary teachers trying to teach math concepts that I don't think they understood themselves. Sometimes even some science concepts. And again, I'll bring that back to the way that they were trained as teachers and the emphasis, or lack thereof, of you know, teaching content. You know, to people that you know it's not their forte… yeah, they were great with writing. They were great with literature. They were great, you know all that stuff, but you know the math, yeah, challenging some for some of them they don't understand it. So, if you know and I would often say, "If you know if can't explain then you don't know it." I would say that to my students when I asked them, I say that to teachers, if you can explain it to your students, then obviously you don't know it well enough. So how do we correct that? I alluded earlier to bringing in staff development trainers to work with teachers. Well, maybe they needed some, you know, somebody to teach them math, you know? So, they know they could go back and teach math and so it kind of goes along with that. So, you kind of fall back on what you know, you fall back on what you're comfortable with. I mentioned earlier that sometimes you get in this little zone of you're only thinking about yourself. Your class rather than yourself with your grade level colleagues in the department or the department as a whole covering of the you know, the span of, you know grade levels. You know you're out there in an area that you're not comfortable with and you know, as an educator, you know, we've often said you got to know what you don't know. Yeah, when you have to be able to say, "Hey, I don't get this." If we expect our students to ask questions about, "Hey, please, I don't understand this." You know, we have to ask that of ourselves as well. And when you were afraid to do that, whether it's a student or a teacher, then you limit yourself as to what you what you're willing to do and delve into because you want to stay with what you know and what you do well.
23	JP	So those are those are very good points.
24	$CDSME_A$	But yeah, it can be a trap that you fall into. And any supervisor, any good supervisor needs to be aware of that when they, you know, observe their teachers, when they supervise them in curriculum writing or give them curriculum writing opportunities.

		You know, maybe they need to start with, “OK, tell me what you don't know, and let's work from there.” You know, before we can get this done, you know what? What don't we know or what are we comfortable with or what? Aren't we sure about? You know that that willingness to say, yeah, I don't have all the answers, but if we work on this together, we can figure it out. You know, working together, communication, you know that knowing who we are, knowing what our competencies are, what our, what our weaknesses are and there's nothing wrong with that. Yeah, we can't know it all. We can't do it all.
25	JP	Those are those are excellent points and we're touching on a bunch of the prompts that I have here which is fantastic in the sense that while the prompts are there to help guide the fact that they're coming up in the discussion means that they're kind of intrinsically linked together, so they're free flowing, which is nice.
26	$CDSME_A$	I'd be very interested to touch base with you later on just to find out if others share my kind of view. Like I said, sometimes I tend to be very simplistic but now it's not rocket science. You know let’s not make this harder than it needs to be, you know?
27	JP	So off of kind of and in a similar vein, but focusing in on the curriculum, writing development review implementations at that kind of sector, that hat. In your opinion, the internal and external stakeholders in the curriculum design process. You can list those. We can have a discussion on those, but who do you think are some of the major stakeholders, any party, individual group, et cetera that? Has some type of tangible benefit, whether it be implied or explicit in in that what? What's your opinion on that?
28	$CDSME_A$	Excuse my laughing, but who the hell [do] we write in the curriculum for? You know, we’re not doing it for us. You know, start with the end in mind. What do we want the students to learn? Alright, how are we going to get there? And you just keep backing it up and backing it up and backing it up. You know, I mean, they are the only stakeholder. Well, now maybe I should. I shouldn't say only I generalize. I know, but it it's about what's best for kids. What's best for our students. That’s what drives everything.
29	JP	So, prodding a little bit… what, who determines, or what group or what decided what is best for the students. Is that policy related? Is that educator related? I don’t want to get too far off track. I just want to kind of tease this out a little bit more. What, where do you stand on that?
30	$CDSME_A$	You know, thank you for that, because it's kind of narrowed. My focus though a little bit on this in in ‘Region A’ we have State competency exams, so to speak. Whether they're proficiency exams at… the [primary] school level, whether they're [regional] exams at the [secondary school] level. You know there are, there are [regional] curriculum guides that the [Regional Education Board of Directors] has worked on through this, there's subsidiary, the [Region] Education Department. Bringing teachers in from across the state as representatives and talking about what should be the basis of our curriculum. So, you have to have those guidelines to go by. You know which are important. So with those kind of thinking of those as kind of like the umbrella, you know that they kind of help you steer which way you know you go with your curriculum or at least what you have to you know cover. And I and I don't mean, you know, a lot of people will interpret that as, “Oh, you know, like I mentioned these proficiency exams and that the Regents exams. So, we're teaching for the test.” I never felt that way. I might say we’re teaching toward the test, or the test tells us what we should be teaching. You know, yeah, maybe we don't agree with all of it, you

		know, and that was little personal biases come in. But so be it. It's a little bit more structure, so it's not just teachers coming up with whatever they want to do themselves. I'm not sure I answered your question satisfactorily. Maybe we want to revisit the question?
31	JP	No. I believe you have and let me rephrase it in the way I interpreted it and maybe you can correct me if I'm wrong or add a little bit to it. You know what who determines what's best for the student and your response kind of alluded to as well. The student is the focus. However, there's multiple factors that impact that, one of which being kind of a federal or national or kind of jurisdiction level. But that's only an umbrella that provides a guide of specific content areas that a student should be proficient in. However, the way in which the student gets there is up to the education professional. Also, that road map doesn't dictate the limits of a student's knowledge; it just provides an outline ow what is going to be assessed. So, in other words, this is the lowest or this is the smallest amount of content that a student needs to be proficient in. If an educator is able to instil more, expose students to more, there is no limit on that either.
32	$CDSME_A$	I would agree with that and thank you for rephrasing.
33	JP	No worries. I understand it's a multifaceted topic where we're dealing with… It's a very humanistic environment, so there's a lot of, it's not… the scientific method does not necessarily apply here. So, it's we're dealing with humans, we're dealing with emotions, we're dealing with bias, we're dealing with all of that. So, it's not as black and white as one may think so. When you are developing a curriculum, whether it be individually for maybe specific class or at the at an institution level where other aspects were kind of tying into one another… Did you come across any or that you have read about or witnessed others doing? Have you come across any what you would consider best practices? When designing a curricula or curriculum and you can interpret that as methods, process, procedure, culture, environment can interpret that however you want. Was there anything that really stood out to go? Hey, that's really cool. That's really neat. I need to do that or I wish I did that.
34	$CDSME_A$	That's a very interesting question and I'm not really sure I have an answer. You know, so sometimes it might have been, you know, some occasions might have been a little bit more black and white. Some might have been just let your mind wander and things come out so you know. There is one thing that comes to mind is almost like a…. where you were almost writing down, you know, like little concepts. You're just kind of like doodling and then you start drawing arrows to connect things and, you know, kind of a little quasi freehand flow chart type of thing. I think that type of modelling fits the person who might not be as structured. Oh, this idea came up. Oh, this other idea came up. Or, can they be linked. How do they link and what should come first? What would come second? You know the day then you get into if you're working in a group and you've got the structured person and they're free, you know, I mean, it comes back to some of your foundation stuff. Well, let's make sure we have good foundation things going in our staff first. Time might be a factor. How much time do we have to work on this? Am I rushed to get something done now I'm not willing to accept criticism, you

		know, feedback, you know, that's a good idea or that's not going to work or, you know, that gets off base here or that's right on target. And then you know, the thing that you have to factor into that we haven't talked about yet is assessment. You know how we going to assess our curriculum? And you know what's going to come first, you know? And the state says, well, here's an assessment. You know, do whatever you need to do to make sure kids have the skills to answer the assessment questions. You know that that type of thing. But I always kind of liked a little bit of structure, but that’s just the way my mind works. I like that randomness, so let my mind wander and come up with things. I’m always trying to bring un unique things with the idea of trying to grasp student’s attention. You know, not as a, you know, a sideshow or, you know, smoking mirrors or gimmicks or whatnot. But you know something, again, for the adolescent mind, you know, to what's the hook and let's get them engaged. You know that type of thing.
35	JP	So, maybe one word to kind of sum that up would be it’s situational?
36	$CDSME_A$	Yeah, I would agree.
37	JP	And then building off of that…whilst designing a curriculum or curricula, there is some aspect of pedagogy that is at play. While they are two separate tasks, they’re kind of done in parallel. Would you agree with that statement?
38	$CDSME_A$	Could you give that to me one more time so I can really focus in on what you’re asking?
39	JP	So, when someone is writing a curriculum or reviewing a curriculum or whatnot, there is the active writing the curriculum, but at the same token, that’s not it. It’s not a siloed task. Their brain, or the group’s brain, needs to also be considering the pedagogy of how then that curriculum would be implemented whilst writing the curriculum.
40	$CDSME_A$	I definitely agree with what you said. And what’s going through my mind is… you could have four people working on writing a curriculum and when you get into their classrooms, you could see it taught four different ways. Yeah. Yeah, absolutely. You know that that's where it comes down to. OK, here's what I have to teach here. It is in black and white on a piece of paper, you know. Now what? What paints am I going to use to make that picture? What activities? What skills? What props. Whatever, you know, to bring that to life for the student. To me, that's the true pedagogy piece you're writing. Yeah. OK, I get it. That's part of it, you know, but putting that into play. That's the bread and butter, meat and potatoes, the sauce call it whatever. That's the stuff… Ask your interviewees, “Do they remember the subject matter, that particular class, or do they remember the educator?” Any they’ll remember the educator. You know why? Because that person could make connections. Could bring something to life. Could get them engaged. You know, to whatever. And that’s the pedagogy part that I just, really, really enjoy. That’s what it’s all about.
41	JP	Getting a little of track with this next question, but I think you’re touching on a really interesting vein. Let’s say there’s a curriculum that you inherit and there is very little you can do to change it in the short term. How does that impact the quality of educational provision given by the educator?
42	$CDSME_A$	Well, you might not like the curriculum that you've inherited… You changed… levels, you get assigned a new course. You know what? Whatever. Stuff like that happens. The quality of the written curriculum that you that you were

		handed could be lacking. Uh, you might look at that as an opportunity to revise that to update it. You know, maybe it's 10 years old, who knows? Umm, you know your outlook, your attitude going into that is key. Yeah, you might not be able to change it, but certainly you can update it. You can make it more relevant. It might require you to teach in a certain manner that you're not comfortable with. But a good educator, you know, we'll try to make the best out of it. And maybe the first year through, it's not the greatest they've ever done. But they have plans…you know, "Let me work with this for a while. I've gone through this first. Yeah, now I see what it is this I like that I didn't like this. I can change that. I can't change that." So, I modified it. I say, "Hey, students, you know, I'm sorry that this this next week is going to be kind of cut and dry kind of boring. Hang in there with me. We'll get through this. I'll teach you what you need to know. I'll tell you why you need to know it. You know, and then we'll move on and we'll do something else." And that's honesty. I mean that's OK. And if going back to that communication piece, you know those personal skills, you know, if the teacher and the student have a good professional relationship. They'll appreciate the fact that. Yeah, you understand it yourself that this is kind of dry, but, you know, they know you're not like this all the time. Kind of an off the wall analogy you buy, you buy your house. You know, and you go in and boy, you don't really like the colours of the living room or the way the kitchens laid out. But you live with it for a while and you use it for a while until you can make the changes that you need to make. It's kind of a sketchy analogy, but it kind of gives you that that, that same mindset. You know, I accept it. For now, I'd like to change it. I'm going to work towards changing it within whatever parameters are set for me.
43	JP	So, flipping the script a little bit. You have the best curriculum known to education, but you don't have a quality educator. What does that do to the education provision?
44	$CDSME_A$	Good luck. Good luck. And again, I don't mean to be so flippant. Another analogy, think of a curriculum as a road map. You know you've got good drivers and you got lousy drivers. Say I'll have driver's license. You know, some are really good and some are really bad. And who would you whose car do you want to be in? You know, yeah, having the best curriculum in the world doesn't make up for having an inadequate teacher.
45	JP	So, there is a delicate relationship between the curriculum and an educator. It's not a lopsided… it's a delicate yet harmonious relationship to provide a quality level of education.
46	$CDSME_A$	Dr Barry Bennett, I think it's University of Ontario. The school district brough him in to work with teachers on curriculum development and whatnot, and his analogy, you know, was as the classroom teacher, you have a palette of paint and what colours are you going to use to help paint this picture and what is your picture going to look like. And is your picture for this student the same as the picture for that student? And so on and so on. Yeah, it's where the rubber it's the road. That's where it's at. I mean, if you got, you know, an excellent written curriculum, chances are you know your better students can more or less teach themselves. You know your middle of the road students could survive. Your struggling students are dead in the water. That's where the teacher comes in. That's where the teacher helps those struggling students. It really challenges and boosts your accelerated students and you know, it brings everyone that your middle of the road average students and encourages them to be excel as well.

		You know it but just different levels and knowing what brush strokes to use, what paints to use, how to say things. You know how you encourage your students to feel part of, you know, the class. So, yeah, I mean in an ideal world, you certainly want both. You want the best curriculum, and you want your best teachers.
47	JP	I think just one more kind of set of questions and then we then we can close this. This dialogue has been fantastic just by the way. So I've thoroughly been thoroughly enjoyed it so far.
48	$CDSME_A$	Well, you're going to find more people that are more verbose and articulate better than I, but those are my honest feelings.
49	JP	And I appreciate that. With particular emphasis on career and technical education, construction management in particular… Interpersonal skills appear to have a significant level of importance for career employability and preparedness. The proof-of-concept model highlights this by placing the technical content and the rest of the curriculum development process on top of that. In previous conversations you mentioned that you agree with that and provided some excellent detail. In regard to that, are there any thing that you think the model has missed or any concepts in which…now this is just the foundation part ot it… the specific classes, the pedagogy, etc. have purposely not been discussed for the sake of scope… but in terms of that foundational element, are there any aspects that need a little further refinement work or concepts that have maybe been missed?
50	$CDSME_A$	Would you be kind enough to help me just go back and you can just… you don't have to show me a graphic but, you know, let's maybe one at a time. Those your foundation skills. Let's go with those in any order that you wish.
51	JP	Communication…written and verbal communication would be the first.
52	$CDSME_A$	We've talked about that throughout our interview today. the communication piece…How to express your ideas. How to be an active listener? I think, because you can break that communication topic down into what are the components of a good communicator? Knowing how to listen, knowing how to communicate, knowing how to read other people. Being able to validate someone else when opinions may be different such as, "So, here's what I think I heard you say. Is that correct?" And then, "You know, here is what I meant to say, maybe it didn't come out right, but you know my background that always been this, this and this and that makes me think that, that and that." You know, being able to use those phrases in communication. Might be something if you were going to teach a little course on construction/programme management communication skills…having a little checklist of phrases to use… "Help me understand that you meant by…" or "Help me understand what you were thinking when you did this." Those little pieces can smooth out miscommunication very easily. So, it's not only how to communication, but how to make sure we don't miscommunicate. But it's essential.
53	JP	During your during your response, you actually touched on the remaining three, which I find it interesting in the sense that they are so related and kind of point those out. When we talked about communication, we'll know the aspects of communication is listening, which is one of the skills listening and understanding. Understanding listening, taking in. Do you understand something? And then asking for that feedback back on which goes into some aspect of teamwork,

		working with others, checking for understanding, making sure that we're not assuming things in the like so. Through your explanation that you are in agreement with at least three of the four, the 4th one being leadership and leadership qualities.
54	$CDSME_A$	Oh, without fail without fail. You know it's interesting because I would think that if you have a quality leader, I mean a really top shelf leader, you know what you're going to find is that leader already has good communication skills. You know that leader is going to have, you know, some of your other subsets there as well and that's what helped makes them a good leader. Knowing what they don't know, knowing how to ask for help. Knowing how to set directives or be direct or, you know, hold the line, but also willing and having your subordinates know that you're willing to listen to, you know, their needs and come up with something, you know, mutually agreeable. You know, going back to that communication piece, you know there is a…and I think this might be related to Saint Francis of Assisi, you know, “Seek first to understand then be understood.” You know that's how we listen. being able to verbalize that, you know and then say, “Oh yeah, OK. I see your point” or you know whatever. But all those things that we assume our students don’t know how to do…that we assume our colleagues know how to do…when maybe they don’t. You know, we're a team member of colleague. We're communicating with each other now. So, these are the skills that I'll bring into that, you know, to help manage situations. Again, I rambled, I apologize.
55	JP	No, this is this is one of the reasons why an interview was selected for this tool is because we're able to have a dialogue and explore the issue rather than checking boxes for the like. So no, I appreciate it. It's not rambling. This is all valuable information from someone well experienced in the field. So, thank you. One last and this may seem a little off topic in the sense of what we've been discussing. But due to your long tenure in education and in curriculum development, you have probably experienced a significant turnover in technologies coming in and out of educational practice. So, what skills…specifically looking at a student… do you see as, fads and then conversely, what skills do you see as transcending time?
56	$CDSME_A$	When I first started teaching, it was pretty much, five students in a row with five rows. When I started teaching Health, I had my students arranged in a circle so we could see each other. I think I was the only one in the middle school that was doing anything like that. Sometimes we'd group our desks together. So, over the years we went from student as individual to now student as part of a group. The way students presented their or demonstrated their knowledge changed. Because of technology through the use of, you know, computers. Whiteboard smartboards. Call them whatever they could present different ways. We started to see a lot more student presentations rather than just test taking. Yeah, I've. I've, I'm. I'm thinking of having a little hard time answering this one for you. Let's go back over to question again. What best technology advanced would? What did I see change?

57	JP	Well, it’s in relation to the skills of the student. So, you have been teaching when, correct me if I’ wrong, prior to the computer being in a school…or the abundance of computers being in a school… to now, when we have smartboards in every room that are connected to the internet. Throughout that, there’s been curriculum of the school, curriculum of the course. The skills in which are being taught to the student, regardless of the specific subject, can be broken into technically aligned to the subject and interpersonal. Do you see, through your tenure with technology flowing in and out of the classroom, that technical skills should be more important or interpersonal skills should be more important. Should it be a balance…kind of that whole mess of a question.
58	$CDSME_A$	Yeah, OK. PowerPoint got to be a big thing. Alright, well, you got to you. You have to instruct students on how to use PowerPoint. You know, and then what's a good PowerPoint presentation and what's not? You know, the example that no example. You know, we had some students every bang and whistle they could put into a PowerPoint. They did, you know, vanishing script and floating in flying in objects. And, you know, it was overkill. You know, so that there was that I guess you can consider that maybe the technical piece how to use the program. How to you know, wisely use the program. And then it becomes OK well, how are you going to present, you know, your information? How do you want to organize that? How do you want to group? But do you want to be is it a text presentation? Is it a graphic presentation? But the students still have still had to gain that knowledge, and then it's just a matter of how we're going to present it. Which, if they're working individually, are working as a team, goes back to the communication piece, you know. So, you still have that communication piece, but now it's cantered around some modern technology. Having educators become very familiar with modern technology, no matter what the time period is. And again, how do I incorporate this to make my instruction more meaningful for the student? You know, and maybe you change the way that we have to you know, to write the curriculum piece a little bit. Yeah. Because, you know, there may be the way we do research now is different. Or the way we you know, gather information is different or how now it's easier to compare pieces of information or is the information you're collecting you know really accurate or not. You know, just because it's on the Internet, you know, you know those types of things. But yeah, I think, uh, you know, think back to you know, the old-time movies that you saw on TV where students were in school and they were writing on slate boards with chalk. Yeah, things change. So, how do we adapt to that? You know? Yeah, you can still do. You can still do math on slate boards. You can still do math on individual whiteboards and have students hold them up. You know, there's a quick check for understanding. You know, it's got its place, but it's not the only way to do things now. And it doesn't have to be technology. Summer school. Again, think of summer school. Now. These are students who didn't pass during the year. You know, they're learning about positive and negative numbers by standing in the stairway. Well, we had, you know, stairs that had a landing and then changed direction. Going upstairs, positive numbers going downstairs, negative numbers, you're at a positive three, and now we're going to add a negative 5. Where do you wind up?
59	JP	Great example.
60	$CDSME_A$	Technology, absolutely. Technology certainly not modern.

61	JP	That is a really interesting point.
62	$CDSME_A$	And where did that come from? Where did that come from? The teacher's head.
63	JP	I think that is a wonderful example to wrap up our wrap up our interview and I'll pose just one last thing, and this is just an opportunity. I want to say to say thank you again for your time, for your thoughts, for your honesty, for your openness, for your candour with all of this on this is. It greatly helped in in my research so thank you. And then just give you an opportunity to provide any final thoughts, comments, questions, suggestions and you don't have to, this is just an opportunity if we you want to say something that we haven't mentioned or whatnot before, just want to provide you that, that opportunity here.
64	$CDSME_A$	Oh, I certainly think you're on the right track. And as I said, I mean I know this is part of a, you know, your doctoral thesis. And I know all the research that goes into it. But truly, I think curriculum understanding, curriculum, writing, curriculum, understanding the connections between curriculum and instruction is really not a hard concept. I'm not implying that you're making it hard…I don't think you are. I think you're cutting away all the stuff to get to the nitty gritty. But. I think, and it's been a while since I've done any, you know, real journal reading… but I think sometimes the tendency is for people to try to make things harder than they really are or seem harder or…Yeah, I ramble, but it's the road map. It's you know, where are we? Where do we need to go? Why do we need to be there? What's the best way to get there? Might be the direct way to get there. You know, might be the scenic way to get there, but if we get there and we understand and we, you know, constantly check for knowledge and that's checking are we on the right route. You know, I'm big into this. In your classroom, that's not part of any curriculum, but creating a classroom environment where students are comfortable asking questions where students are comfortable saying hey, wait a minute, I don't get this. Can we back up or can I come see you after class or you know, whatever. To me, that's probably the ultimate level of creating an environment and communicating to your students that I'm here for you. You know, and it's that, that piece they can't learn, you know unless you know they feel that they're going to be criticized for expressing an inadequacy. You know, and have you ever been in one of your construction meetings where a contractor didn't say something or whatnot because they didn't want to admit they didn't know? And my God on a construction project that can cost thousands or millions, it can cause the ways it can cause. Safety issues, I mean you name it. You know, but for whatever reason, they weren't comfortable in front of their peers, their colleagues, their others saying, hey, wait a minute, I don't get this. So, that's it. I'm going to stop because I ramble too much.
65	JP	So again, thank you for your time and thoughts.

Appendix 5: Validation Interview 002 Transcript

Interviewer: John Posillico (JP)	
Interviewee: Curriculum Development Subject Matter Expert B ($CDSME_B$)	

Comment	**Speaker**	**Transcript**
1	JP	So, thank you for agreeing to meet with me for an interview. For this interview, I will begin with presenting the research findings and analysis that led to the development of a proof-of-concept curriculum model. I will then ask a series of prepared questions with the aim of collecting your feedback. Just to reiterate some ethical items you've been provided with an information sheet outlining general information about the research and it consent form. Your participation in this interview is completely voluntary and you can withdraw and or stop the interview at any time. You, your information and your responses will be treated anonymously and will not be divulged or disseminated to any third party without your permission. The recording of this recording and transcript of this interview will be kept in a secured location and destroyed no later than two years after the completion of the research or the 31st of December 2025, whichever comes first. Any identifiable content from the transcript will be redacted upon publication. With that being said, are you happy to continue with the interview?
2	$CDSME_B$	Absolutely.
3	JP	Wonderful. Thank you very much. So, first question. How long have you been professionally involved in education?
4	$CDSME_B$	OK, approximately 45 years.
5	JP	And from an educational level, can you expand on some of the qualifications that you have?
6	$CDSME_B$	Sure, I have a Bachelor of Science degree in home economics, which is now called Family and consumer sciences. I have a Master's degree in curriculum development and I also have a Master's degree in educational administration and supervision.
7	JP	So, building off of that from a curriculum development 'review implementation' kind of synonymous here… How long have you been involved…of the 45 years…how long have you been involved with curriculum?
8	$CDSME_B$	45 years. OK. I also was a consultant for the 'Regional' Education Department. Once I began teaching and that was my primary job. When I did any consulting with the 'Regional' Education Department was in curriculum development.
9	JP	Great. So, to reiterate consulting at kind of a regional level with curriculum development and then with an educational capacity. Umm, correct me if I'm wrong, but you started kind of as boots on the ground educator and then worked your way to more of an administrative role department administration level.

10	$CDSME_B$	Right. So, it would be local [and] regional… level. And eventually national later on in my career.
11	JP	National…can you expand on that a little bit?
12	$CDSME_B$	Sure. Around 1997 or so I was asked with two of my colleagues to represent 'Region A' as a as sort of a top consultants as the nation was creating national standards for home economics or family consumer sciences. So we went to 'Location A' and basically we were part of focus groups analysing the draft standards that were already been written, so we did that, and then we went to a couple of national conferences basically talking about how 'Region A' could align their [region] standards because a lot of [regions] didn't have [region] standards at that point with the national standards, a lot of the [regions] were taking the national standards and creating their [region] standards from that. But 'Region A' already had those state standards, so we did that and we worked with a researcher from 'Location B' probably did that for about four years. And then of course brought it back to our region... You know, our what we had learned and what we had been involved in.
13	JP	Wonderful. That's really impressive. Definitely a subject matter expert when it comes to when it comes to curriculum. We may circle back to some of this as it kind of weaves through. So, I'm kind of playing a little bit of a hopscotch here. So, moving specifically to the proof-of-concept model. It was presented and it lists communication, leadership, teamwork, listening, understanding at the core of the entire curriculum. What are your initial perceptions? Thoughts. Comments. When you saw and heard that?
14	$CDSME_B$	It's sort of affirms what we in secondary [education] have been trying to do. I would say, since maybe the 90s, maybe 2000s. When I started teaching in the 70s, it was basically content. For Home Economics, it was, you know, food lab procedures, the process that you got to the product. Same with clothing construction, even with child development. It was mostly content, but then we got to the point where we said, "You know, all of these interpersonal skills are so important, it really should be that we're teaching the interpersonal skills and we're using the content to give examples for the students to experience those interpersonal skills." So let me just take, for example, a foods lab. So, instead of the foods lab, let's just say I'm feeling very traditional…I'm going to say muffins… OK, so instead of, "Did you use the right ingredients? Did you use the right measurements? Did you use the right mixing procedures and baking procedures." Well, I remember when I first did this, I used half of the grading rubric as the product and half of the grading rubric as the process. So, basically the process would have been, "How did you do with your time management? You had 45 minutes in class, how did you do with your teamwork? Were all three team members involved? Did you work out any types of conflict? Could you communicate effectively? Did you write down…" You sort of like your reflection about what you thought you did right…what you thought you did wrong. Set goals for the next time you had a lab. So that's where I really saw… there was a conversion. And we truly believe that at the same time we had a…school curriculum [region-wide], called Home and Career Skills, and there were those process skills and I think was communication leadership… um, I can't remember what the other ones were, but management, mange resources and something else, so even at the time we were talking about how important those skills were. Now let me use an example of health education because I was also responsible for health education at 'Institution A,' which was my first time doing that. We

		worked with 'Region A' because they were changing their [region] health curriculum. They were making it totally skills based. So instead of having drugs, tobacco and alcohol and those types of topics, what they were doing were the topics were communication skills, leadership skills, management skills and then they decided what content would be used as examples. For the students, they would still get the content OK, the content still would be taught, but within the context of and they would be assessed on the skill in addition to the content.
15	JP	Those are wonderful examples and kind of… please correct me if I am wrong, but what I am hearing is that the proof-of-concept model that was presented is a model that, in a different format, was put into practice…or was kind of themed…the interpersonal skills. We're trying to place into the foundation of the curriculum models throughout various content disciplines.
16	CDSME_{B}	Absolutely. And just one more thing, while it's on my mind… But basically, even with academics, we found that when we would be talking about the employability skills, 21st century skills, soft skills, professional skills, whatever. Whatever the referred to, everybody says, "Oh, we're doing that. We teach teamwork. Oh yeah. We teach communication skills. We do that. The students work in groups." It's like that, but they didn't purposefully teach the skills. No one did that, and that's where we and CTE (career and technical education0. Some of us tried to do that. OK, so what is good teamwork? How are you a good team member? How are you a good team leader? You know, some experiences, some games, some things like that. But a lot of people think that they're doing it. Educators think that they're doing it, but they're not intentional. It's not intentional and intentional instruction. And talking about curriculum maps, it's probably not in their curriculum maps either.
17	JP	And you kind of read my mind a little bit in terms of kind of a follow-up question was. Again, correct me if I'm wrong. I don't want to put words in your mouth. When writing a curriculum, one also needs to think about how it's to be taught. And while a curriculum can be taught many different ways, if they're not talking with one another, the curriculum and the pedagogy, or different types of pedagogies, then there's a discord. There's a disconnect. So, off of your example, if part of it is to teach teamwork, then that should be reflected in the curriculum, black and white. Leaving it up to the teacher to decide what the best method is to teach teamwork.
18	CDSME_{B}	Exactly. Exactly. Can I give more example of that of how important it is in 'Region A' now, but not for not for not curriculum wise…let me say, this is my sixth year doing the program approval process with the 'Region' Education Department and working with schools. Basically, it's like a certification of a program of CTE program, none of a department…bit of a specifical career pathway, and there's lots of different components that basically one of the components is an employability profile that have to be created and there has to be technical skills which I typically suggest the school use, the competencies that are on the technical assessment, the nationally recognized industry based technical assessment, which gives you the, the you know, the technical skills that the industry wants and also has to have an employability part. All of those skills that employers say students are not coming to work with, so that shows you right there that you know, in order for a program to be considered highly

		qualified or high quality by the 'Regional Education Examination for Region A,' it includes employability skills and technical skills.
19	JP	Going off of those employability skills and you mentioned kind of a little bit of an involvement from industry, whatever industry that that may be in your opinion and kind of in a perfect world in your eyes… what level of involvement do those external stakeholders have in, informing, persuading, writing even, the curriculum for students?
20	$CDSME_B$	I think they should have more. Basically, with this programme approval process, which is very formalised, some schools (I'm going to call them Local Education Agencies). You're supposed to have sort of like an industry committee that meets periodically to review your CTE curriculum. Some of them do it more regularly than not, and it depends on how you use them. You may have. I've seen some schools or bosses bring in this committee to review their curriculum, and basically, they have a curriculum and then they say, "How does it look?" And the business partners go, "Oh yeah, it looks great, looks great." And then you have others where they really have periodic conversations. And they say, "What types of skills do you really feel students need, blah, blah, blah, blah." Sometimes it ends there. Those are recommendations. OK, fine. And sometimes it doesn't go any further. All our teachers have so much technical information that they have to cover. They don't have time to do this type of information. We leave that to like the English teachers or, you know, those types of things which we know they're not teaching those types of skills. So, it depends. I think they should have more, but in a very prescriptive way. We don't want business running our curriculum. Some people think that CTE is just to fill the pipeline, find out regionally what the, what the industry needs and just get kids into those programs. I don't think it should be that narrow, narrowly focused. I think students should be prepared to go. And we should prepare students to go into jobs where there are jobs, [locally] and 'region-wide.' But I don't think that is the only reason why we teach CTE so. Industry does have a lot of important information to say about the employability skills, because you talked to any employer and they'll say we'll teach them how to do the stuff because everybody does it differently, we need students that are dependable. We need students that can communicate. We need students that are dependable, that go beyond expectations. We need students, you know, and we tell the students there they need the competitive advantage over everybody else and those are those skills.
21	JP	So, to kind of paraphrase and reiterate what you're saying is… industry engagement within the development of a curriculum is important. However, there's… I don't want to say limits, but fences, guideposts for them to provide effective and efficient information for the education professionals to digest and push into the curriculum. So, it's a harmonious relationship between the tow, utilising the expertise of both.
22	$CDSME_B$	Absolutely. And I yeah, I just wouldn't want to see the industry was starting to sort of control the curriculum.
23	JP	And at the same token, we don't want to see educators thinking they know what industry wants without their input either.
24	$CDSME_B$	Especially those educators who have never been in any business.
25	JP	Interesting point. Wonderful. Thank you for sharing.

26	$CDSME_B$	It's just like administrators who taught for two years or three years. And then you have administrators who taught for 20 years. Who do you think can relate better to teachers?
27	JP	Interesting point. Interesting point. All right, moving on and this conversation in dialogue has been fantastic. So, thank you. So, from your experience in developing curricula. How do you view or perceive the importance of getting kind of the foundation of that curriculum correct? And you can interpret the term correct however you want. Is this something that you have witnessed? As they rushed, or possibly misguided process on in the past.
28	$CDSME_B$	Yes, it is extremely important. And, yes, I have seen it. And I'll give you a couple of examples. OK, so you look with the end in mind. OK, so you have to say, “What do we want students to know and be able to do” if we're talking about students. I feel the same way about teachers. “What do we want teachers to be able to do and know?” OK, in order to be excellent teachers, high quality teachers, great teachers… you have to have some sort of a foundation, and if the foundation doesn't include like those employability skills and those technical skills, OK, if indeed you feel that they are as important, then they're not going to be taught. OK, we are fortunate in ‘Region A’ that we have very strong [regional] curriculum, OK. And a lot of guidance with that, especially with the academics. In Family and Consumer Sciences, Business Education, Technology Education, and all of the trades in CTE, there are national standards that everything is based on and there are ‘Region A’ standards. So, when you're talking about what types of curricula a school has in order to be go through the certified process, they have to do a well. I help them do a crosswalk, aligning the national standards, umm and the industry standards and the ‘Region A’ standards. OK, with the courses that they the curriculum of the courses that they're teaching and it's basically just a sort of like a chart. And if I find after they check, I put down all of the competencies because they're not that versed in standards, they're worried about what goes on every day in their classroom. What I do is I look through and if I find…and this will also include some of the reading, writing, listening and speaking. OK, that everybody should be teaching within the context of their curriculum…so, if I find that there aren't many checks, I go back to the teacher and I just say, “OK, let's sit down and look at this. You know why? You know, why are there social checks here in this, you know, career pathway in Human Services that are part of the national standards, these national standards are written, you know, in conjunction with people that are in the human service field. Why aren't there that many?” Well, basically comes down to well that teacher didn't feel the teacher teaches what they feel is important. They teach what they like, so when you have standards, it takes the person out of it. When you have something that's already, you know, the foundation, it's not ‘Teacher X’ saying that you should teach this. This is what you know, employers in the field say that someone in a human service field, early childhood teacher would ever know and be able to do so. You know. Then they start thinking, “Hmm. So, I said, OK, we got to look at your curriculum” … and OK, so… I was very fortunate. I student taught and I did most of my career at ‘Institution Y’ and they were very focused on curriculum, very focused. I had to write daily lesson plans, you know, and cite the objector from the ‘Region A’ curriculum that we were working from. So, I had a very strong background. I went to ‘Institution Z’ as administrator and there were some teachers that were very well versed because they had been

		very involved in curriculum. And there were some that weren't. I went to 'Institution W' and it was even more obvious that they weren't focused on curriculum. They taught what they wanted to teach. Some were, I'm not saying all, but some of them didn't even have a course outline Because they never had a course outline and nobody made them have a course outline, so there was absolutely no accountability. So, you wonder students that went through certain classes where they going to be prepared, if indeed they did decide to continue in post-secondary education rather than just having that course as a hobby. In CTE and I think that that it's important and I got a lot of backlash from the teachers when I insisted we have we sit down and have some correct, some standard curriculum. I mean there is standard curriculum in 'Region A' and then you locally implement it the way that you want to. And then as a teacher you use your talent, your skill, your interest as the way you implement it. But basically, doesn't matter if at student has 'Educator X' or 'Educator Y' or 'Educator Z' as a teacher in the end. All the students should have the same information and that's what 'Region A' wants you to do now is look at, you know, let's just say an… exam or some other type like technical assessment. Look at each of the questions. What content did a cover in the curriculum? How did your students do? "'Educator Z,' really look at your students on this, the, you know, employability skills, the professional skills, look how great they did on that part. My students, that was their lowest content area. Tell us how you did that so all of our students can benefit."
29	JP	So, the getting the foundation of the of a of a curriculum, correct. It's not only important to the curriculum, but what that curriculum can then support from a boots-on-the-ground classroom, from the full educational provision and then for future endeavours of students.
30	CDSME$_B$	It's, you know, not to be funny, but it's is the whole foundation. If you and, you know what, if you don't have a teacher that believes in a foundation of a curriculum and there's just no hope that it's going to go any further because that's what that's your guidepost, your guidepost. OK. That's your structure. And that's what's most important, you know. And you know what I tried? I tried doing lots of things with my teachers that would help promote that sense of foundation. So, our department would have a foundation of collaboration and interpersonal skills. You know, I did themes for every year I did, you know, bulletin boards with everybody's picture as a team. I did, you know, different types of games during our department meetings. You know, I did the best that I could. And of course, you know, just like anything else, you have your speedboats, you have your, you know, your tugboats, and you have your barges, you know what I mean? But I was even trying to do those skills, all those employability skills with the teachers, so they would indeed see the importance to use those in their classes.
31	JP	That's a really good example. Thank you for sharing. So, we with the foundation, we focused on those four skills for the proof-of-concept model. You previously mentioned those were important. You would agree with those. Reflecting critically on that, are they any skills that you were surprised to see were not on there? Were there aspects that you were kind of anticipating seeing…Was there anything that I need to go back and look at or review a little more?
32	CDSME$_B$	Me, now after the years of experience that I've had with soft skills, employability skills, etc., you know that sometimes they're called college and career ready skills because those are the skills that make students successful and post-secondary, not just in their careers. So, it's college and career ready

		because eventually everybody has a career. So that's what we're using in CTE in the United States now, not just career ready. Years ago, before I started learning about this and professionals in the field that have never been exposed to it, and you may find the same thing. I always assumed if there was a survey like that that it would be the technical skills that would have been first… Construction management -> construction. You know, “How to make a budget? How did you, you know, do a timeline.” It’s the same thing, just like the foods lab, you know, how to measure correctly, blah blah blah. It's not that those aren't important. It's just that they're two different things, and you can't teach those technical skills in an effective way unless you also have the employability skills. See, I don't even see them as separate. I see them as you need them in conjunction with each other. Umm. So no, not now, but I remember when something very similar…probably was at a conference or something and it was like what's important and it was like, “Yeah, let me see knowledge of recipes, knowledge of tape measuring patterns.” You know, those are the things that were most important in my content.
33	JP	Going back to the comment of, “You don't see the skills as separate. You kind of see them as more hierarchical.” …Would you make a similar comparison or treating interpersonal skills and technical skills within a specific content… Would that be akin to kind of the leadership and management conversation in the sense that leadership is not management, management is not leadership. However, you know that kind of conversation, they're different, they're different in context, but yet they're together and in an interesting way, would you agree with that statement?
34	$CDSME_B$	Absolutely, because you can't be an effective administrator unless you can manage and lead. Like, you know, if you're a leader…I don't think you can say, “No, we don't want you to be a leader. We want you to be a manager.” And I don't think if you have a manager, you can make them a leader. I think that, if you’re a leader, you can teach them management skills and that will make them an effective administrator. But, yeah, absolutely.
35	JP	And the same in the same token…correct me if I'm wrong…you can't be an effective administrator without being an effective teacher.
36	$CDSME_B$	That's my opinion, and I know there's a lot of discussion about that, a lot of controversy. I feel that part of it is innate and the innate part of being an effective teacher. Call me crazy, but it's the interpersonal skills. I think that is one of the most essential elements for to be an effective teacher are the effective interpersonal skills that you have with students. And I think that we're finding that was one of the problems with the virtual instruction of students, you know, for a year and a half, they didn't have interpersonal connections with their teachers and being at ‘Institution Z’ last year in a school, you could hear the teachers talk about that. You know, the students didn't have that interaction and they're trying to get back on that train back on that track. But yes, absolutely.
37	JP	So, with the proof-of-concept model specifically looking at construction, it shows those interpersonal skills being the foundation we've talked about. As we just mentioned, to be an effective educator and then administrator (implementing, writing, developing the curriculum), you need a very similar set of interpersonal skills such as the foundation. So, one could argue, and correct me if I’m wrong, that the proof-of-concept model for a student with the construction management curriculum is harmonious, if not the same as, kind of, an internal curriculum with the construction management educator.

38	$CDSME_B$	Correct. Exactly. And that's where I feel an administrator has to model, as an administrator, how you want your teachers to act with their students. You know, because that doesn't always hold true. I was fortunate. I still taught when I was administrator. So, the teacher's going to say, “You don't know what it's like to be in the classroom.” But then again, I never treated teachers badly. I always look to see what their fears were, what they didn't feel comfortable with and try to have an open environment so they could come to me. I mean I we did a lot of new state initiatives and I was at ‘Institution Z’ and it was we had to do a lot of these. There's a student learning objectives we had to do stuff on the computer and the department backlash was incredible. And it was like, “OK, guess what? We're going to the computer lab for our department meeting.” I had a step-by-step. Step 1, open the computer. Step 2. I had done all the pre work and we did it together and it was like…wasn’t so bad because they sat next to somebody, would you do for that? Would you do for and we sort of got through it together. Umm, because you know what…as an administrator I liked district office people to do that with me when I had to learn how to do something new. That in turn I had to teach to my teachers and in turn the teachers had to teach their students. So, it goes the whole way, just like the, you know, administration of the district, you know, that's important too, because you fall through. But it is one and the same one and the same.
39	JP	Not necessarily a follow up question to that. Switching gears, a little bit… with your 40 plus years in education… I think you will agree with me that you have seen a wide range of technology come into the classroom and out of the classroom at various paces throughout your career. So much so that perhaps when you first started teaching, there may have been one or two computers in the in the building, and when you finished your career or when you at the current point. Now there's computers on every single desk in the building. What are your thoughts regarding technology infiltrating the curriculum, either on an interpersonal or a technical standpoint?
40	$CDSME_B$	Well, I already told you that I don't think that it can take the place of interpersonal. I think that it's another teaching tool. I don't think it can take the place of anything. Umm, but I think it does have a role because the students are going to have to deal with some sort of technology in their job or in college, and they have to know ethically what how they should manage that. They need to know that you cannot text when you're writing a professional e-mail. And that's the stuff that we never needed to teach before. But it cannot take the place because it's going to change so quickly. Interpersonal skills don’t change. If you got it…you got it. You don't know how to use the technology. You know how to ask. But I do think that it does have a role. And there are things that teachers can do in order to utilize technology. And on my God, I look now at what the teachers are doing. Their students have a Chromebook, they take home and then they have. They don't even have to bring your students to the computer lab. So, I see that there's like, there's fashion computer programs now where you can and interior design computer program. I mean there's all sorts of things that I never had before, but it cannot take the place, it cannot be. And I know a lot of technologies like bells and whistles, a lot of vendors trying to sell stuff. It cannot take the place. It's a teaching tool. It's another teaching tool.
41	JP	Excellent point and thank you for sharing. So, I just want to, again, thank you for your time today.

		It's an open-ended question. Basically, is there anything through our conversation here that you wish you mentioned or a thought you want to leave with or anything like that? You know, you don't have to take me up on this at all, but just kind of wanted to give you an opportunity to kind of provide any kind of final thoughts or comments that you'd like to share regarding either the interpersonal skills, the technical skills, the proof-of-concept model.
42	$CDSME_B$	Well, I think that your proof-of-concept model is excellent. I think that it will you know once you're finished with your research…you got to get that research out because I don't think there has been that much deep research on the importance of these of these employability skills. And I think that will be a big player not only in the UK but in 'Country A'. When you know, they're finding that this these employability skills, like I said, college and career ready. Umm, so I think that what you're doing is so important and I think that you've made it so real because all of us can relate to it and you know, doesn't matter whether you're talking to a preschool psychologist who talks about the parents that aren't effectively communicating with their children, right, or you're talking about somebody in, in post-secondary that you know… the majority of students fail before they, in 'Country A' you know, 55% of the students or so, you know, don't finish two year colleges or four year colleges and two or four years. Not because they didn't get in because they can't communicate, manage the resources. They can't, you know, work as a team. They can't collaborate. They don't know how to access information. Then we'll go to their professor because they don't feel comfortable doing that.
43	JP	Thank you for those comments and I think that's a really good example and kind of concluding thoughts to end the interview with.

Appendix 6: Validation Interview 003 Transcript

Interviewer: John Posillico (JP)

Interviewee: Curriculum Development Subject Matter Expert C (CDSME$_c$)

Comment	Speaker	Transcript
1	JP	So just to reiterate some ethical items you've been provided with an information sheet which outlines the general information about the research, your participation in this interview is completely voluntary and you can withdraw or stop the interview at any time you, your information and your responses will be treated anonymously and will not be divulged or disseminated to any third party without your permission. A recording and transcript of this interview would be kept in a secure location and destroyed no later than two years after the completion of the research or the 31st of December 2025, whichever comes first. Any identifiable information in the transcript will be redacted upon publication. With that being said, are you happy to continue with the interview?
2	CDSME$_c$	Yes.
3	JP	Wonderful. OK. As I mentioned before, this is a semi-structured interview, so I have a couple of questions and some prompts, but we will kind of carry on with the conversation. So, first question is, "How long have you been professionally involved in education?"
4	CDSME$_c$	12 years. So, I hope this answers your question. So, I've taught as a business education teacher at the [secondary] level. I have also had teaching experience at the [primary/secondary] as well as the [college] level.
5	JP	Ok, wonderful. Great. And kind of in the same regard, your involvement with curriculum. How long and what kind of…if you can give a little bit of a description of your experience and your relationship with curriculum?
6	CDSME$_c$	Uh, sure. So, umm throughout the entire time I've been in education, I've had some type of hand in curriculum, whether it's developing courses and projects that I've taught myself or supporting schools in kind of interpreting their own curriculum. I will say in my current position, [Region A] does not, umm, have specific curriculum, so my role is sort of more helping schools to bring resources together, understand standards and sort of. Help them to build out local level curriculums
7	JP	From that experience, with curriculum specific, kind of, in the in the career and technical education side of things…a big concept, or a large concept is [or] could be your readiness employability from the secondary to [university] and then into the career fields when you're working with schools, institutions and developing curriculum. How important are those employability skills resonating throughout a curriculum?
8	CDSME$_c$	They're critical. You know, the quote I've had given to me on several occasions is, "You know, you can teach students anything, but the most important thing is the thing that's going to be, you know, transferable to a variety of different employers and settings, you know, are going to be those professional [interpersonal] skills. So, reliability, time management, leadership skills. I'm sort of the framework, you know, we use in [Region A] and career and technical education is those common professional [interpersonal] skills are sort of standard regardless of whether you're studying construction, business,

		cosmetology. And then from that you kind of have, you know, what are the specific things you need to know in order to be successful in your particular content area. But those foundational skills are pretty much the core.
9	JP	It's really reassuring and pleasing to hear you say that because it leads into my next question which I think you have just answered. The proof-of-concept model, you know, provides that foundation of interpersonal skills for which technical skills…the entire curriculum sits upon. Correct me if I'm wrong but is seems like you are in agreement with that. Can you expand on it a little bit? Your initial thoughts or perceptions when seeing that?
10	$CDSME_c$	Yeah, I am. And, you know, definitely I think that's sort of, you know, from my experience and career and technical education, that sort of the basis we use. Umm, you know, one thing that, you know, I kind of liked when I first saw your model and particularly in concerning that you're looking at construction management is it's very visually appealing. So, I think it's understandable, you know, by people who don't have pedagogical training, you know. A lot of the models you see, or even like curricular frameworks, you know, they're, you know, pages of table and, you know, you have to almost have an educator brain to really understand it. This, you know, I think explains it very simply…explains it very tactfully, because it's narrowed down to kind of four key skills whereas, you know, you could really, you know, depending on how many people you talk to, you could get into hundreds of skills and, umm, you know, its easy to explain and interpret.
11	JP	Great, thanks. That's a really interesting observation and one of the kind of intents of this was to make it easily understood, but also powerful in a sense, you know, simplifying the complicated in some regard. So, continuing with the curriculum theme, how important do you think it is to ensure that the base, the root, the support of a curriculum is correct. I guess maybe coming from a stance of ensuring that what the curriculum is resting upon is robust, as strong for then the more nuanced aspects of the curriculum to take place. How important do you think that is? Have you had experiences with it being rushed or not done well or not to your standards?
12	$CDSME_c$	I would say it's very important to kind of have that foundation correct and really planned out and, you know, one of the things, you know, particularly in career and technical education it requires is constant conservations with people who are out in the field. Sometimes when individuals go into education, they're leaving the field that they're in and there may be evolutions in that field depending on, you know, how long they've been out…changes in technology. So, I would say, you know, that in order to accurately develop curriculum and have it strong, those foundational [interpersonal] skills need to be in place and there needs to sort of be a mechanism, whether it's through an advisory committee or some other means, to sort of consistently validate and revalidate those skills.
13	JP	Yeah, that an ongoing discussion in CTE…The role of industry and how much or how little industry gets involved with the development of a curriculum and forming the curriculum. Where do you stand on that? How much or how little should industry get involved? I don't want to use the word 'dictating' the curriculum but having a hand in the design of a curriculum.
14	$CDSME_c$	I think they should have a hand in it. I don't think most industry, unless they have people who are trained, as you know, education developers, would necessarily have the time or skills to really develop curriculum themselves, but there should probably be, you know, I would say a…60/40 relationship of the educational professionals to industry input. The educational professionals are going to know more about instructional design and making things appropriate

		to whatever level they're teaching. Industry is probably more likely to take more of a consultative review type role and sort of, you know, look at things, tell them if they're on track and if they're not, provide, like, support and resources to kid of help to get it to where it needs to be and prepare students with the right skills.
15	JP	Thank you for that. You hit on a lot of important points there, at least from what I have seen that has worked well and has not worked well. I like that 60/40 relationship. It seems that's a nice one. So, thank you for sharing that. With kind of a reoccurring theme here with the proof-of-concept model, is placing those interpersonal skills as the support for technical skills and the content above it. In other words, we need to be teaching and supporting those leadership skills before we can then try to introduce a technical concept as scheduling. When you kind of reflect on that model, do you see any skills that may be missing or anything that, you know, kind of on first impression you were like, "Oh well, wait a minute, why isn't X there? Or I was expecting to see Y and it's not there." Was there anything that kind of came to mind?
16	CDSME_c	Is there a change I can see it [the proof-of-concept model] one more time?
17	JP	Sure, yeah.
18	CDSME_c	One thing, I think is important, and again, you know, I would, you know, defer to your expertise in construction management. But one thing, you know, I think is sort of a recurring theme I, you know, any career and technical education area is sort of…trying to think of the best way to phrase this…appropriate use of technology and understanding of, sort of, the technology to make things happen. That can be computer software, or it can be, you know, basic, you know, software packages, skills training, you know, just sort of like the knowing how to use the technology that, sort of forms, you know, what you're going to do with it. And I would say a basis, you know, at the really ground level would be computer technology because there's computer applications in every field. That's my only thoughts and it may have been incorporated someplace else, but…
19	JP	So…what could you and, you know, kind of appropriate use of technology in the sense of knowing and correct me if I am wrong or misstating what you've said… is kind of knowing that potentially sending a text message to my boss isn't appropriate when, kind of, an e-mail would be the more appropriate means of communication.
20	CDSME_c	Right, right.
21	JP	Or picking up the phone and calling when it's an urgent issue rather than sending an email, etc.
22	CDSME_c	Right.
23	JP	OK, wonderful, great. So, kind of going off those concepts of technology and technology conversation, as you rightfully noted, as we're seeing an influx of technology coming into the industry and to the classroom at an alarming pace…it's hard to keep up sometimes. Do you see that the level of technology impacting how curricula is formed, in the sense of…is there a constant throughout, you know, career and technical education that we can kind of rest our back on and know that it's not going to change in a world where technology is constantly changing and the like?
24	CDSME_c	Umm, I think digital resources for curriculum, that not going to go away. You know, various content areas have their own online modules, online training and before things might have been, you know, in textbooks or handouts. Umm,

		definitely. I think the computer and computer technology is going to be a constant in instruction. It’s not going to replace the teacher because there’s so many human aspects of education that a computer cannot replace, but computers help. Umm, to kind od put content into manageable packages and also, sort of, help the instructor in, sort of, determining a proper sequencing order and how to best interpret their content they need to teach so that others can understand.
25	JP	With those kind of software applications and, kind of, digital resources, the previous comment, kind of, up above those interpersonal skills, kind of, bringing the human side to those digital technologies in understanding the outputs, understanding what tool is useful in a specific situation. Do you see those skills as changing, for example, an educator or construction manager gets or has access to a full suite of digital tools that help with their job? Umm, the individual with a higher degree of interpersonal skills, communication, teamwork and awareness of that, do you feel that they would be better suited in their role rather than someone who is, say, an expert in those digital skills, but without, kind of, a human awareness to those?
26	$CDSME_c$	Umm, I think the interpersonal skills, you know, I would say would be more paramount because, you know, like you said, that kind of infuses its way into every aspect of a profession. Use of, you know, digital learning...umm, you know, again it can help with, you know, certain aspects of the curriculum or the technical skills side of it, but really the professional [interpersonal] skills are, kind of, going to be, you know, first and foremost important.
27	JP	It’s interesting…throughout my research, I’ve noticed this, kind of, technical versus interpersonal… and it’s they’re always together and there’s been a lot of discussion around it. So, then you place it into an educational context, and it get so much more muddied because there’s the human side of it. So, I appreciate your commentary with this. This is fantastic, so thank you. The last thing I want to do is, first off, just thank you again for your time today and our conversation and give you, kind of…you don’t have to take me up on this at all, but just kind of an open question, any concluding thoughts, suggestions, comments that you’d like to share either in regard to the kind of research and presentation that we discussed before the interview or the proof-of-concept model…or if there’s anything that you’ve wanted to say throughout the interview that we haven’t been able to discuss. Just wanted to provide you with this opportunity.
28	$CDSME_c$	Umm, no. I think we’ve covered most of it. You know, I think the proof-of-concept model is, you know, I think very similar to what I’ve seen throughout my time in career and technical education. It’s not as, you know, yours, I think is more condensed and is more understandable, you know, especially in the construction management field, because you have like the building foundation. But I think that’s kind of the gist of it, what we’ve been after for a long time.
29	JP	So, in other words, there kind of been a conscious effort to recognise interpersonal and technical skills…get that sequence correct within a curriculum… and this model is a variation of what you’re seeing elsewhere in the world.
30	$CDSME_c$	Yes.
31	JP	Ok, great. Wonderful, that’ all I have.

Appendix 7: Validation Interview 004 Transcript

Interviewer: John Posillico (JP)

Interviewee: Curriculum Development Subject Matter Expert D ($CDSME_D$)

Comment	**Speaker**	**Transcript**
1	JP	Just to reiterate some ethical items you've been provided with an information sheet outlining general information about the research. Your participation in this interview is completely voluntary and you can withdraw and/or stop the interview at anytime you, your information and your responses will be treated anonymously and will not be divulged or disseminated to any third party without your permission. A recording and transcript of this interview will be kept in a secure location and destroyed no later than two years after the completion of the research or the 31st of December 2025, whichever comes first. Any identifiable content from the transcript will be redacted upon publication. With that being said, are you happy to continue with the interview?
2	$CDSME_D$	I am. Thanks.
3	JP	Great. So, how long have you been professionally involved in education?
4	$CDSME_D$	Starting my 30th year in higher education.
5	JP	Of those30 years, how long have you been involved with curriculum development or curriculum review/implementation?
6	$CDSME_D$	The entire 30 years.
7	JP	The entire 30 years. Wow. Wonderful.
8	$CDSME_D$	Initially as a faculty member, now as kind of a mid-level administrator.
9	JP	OK. Great. Within your role in the Faculty Centre for Teaching and Learning, related to curriculum development, what do you feel your areas of expertise in the current role you have?
10	$CDSME_D$	To give it in, maybe two ways – kind of a macro and a micro level. At the macro level, I have experience helping programmes develop or refine the entre curriculum for students in a degree-seeking programme. So, thinking about programme outcomes, what they want their students to be able to know or do as a result of being in the entire academic programme. And being able to design courses and curriculum learning experiences, teaching strategies that would be used throughout the curriculum to help students achieve those outcomes. That's kind of a macro level expertise. Kind of a micro level would be an individual course curriculum planning…same kind of approach…What do you want students to know or do as a result of being in this course? And then designing curriculum accordingly for the entire course. You could even scale it a little lower than that and to think about just an individual class session and the experience tat you want student to have in that class session.
11	JP	Wonderful. Thank you for expanding on that. Defiantly a wealth of experience and knowledge when it comes to education and curriculum. Moving into kind of a more specific question, still open-ended, in regard to the proof-of-concept mode. As we just discussed, it lists communication, leadership, teamwork and listening/understanding at the core of the entire

		curriculum; the foundation for which the rest sits upon. What are your initial perceptions or thoughts when you saw that model?
12	$CDSME_D$	I think two things come to mind. One, if I weren't looking at data and I, you know, were to ask for…to think about, sort of 'what's the foundation for their curriculum,' my initial thought might be one of the technical skills. And, sort of, technical knowledge that students need to know to be able to be successful in construction management. So, I might have started there. I think at some point that it would have come into play, the sort of communication or sort of interpersonal skill set that students need to be able to, sort of, apply the, you know, be able to work on the job with others. So, at some point that might have come in, but might have started with thinking about the technical perspective, kind of what they need to know technically. But then you, sort of, demonstrated how the research points to, starting with those, interpersonal skills…listening, teamwork, communication, those kinds of skills and that those are the kinds of skills that are predominately sought in job advertisements make, you know, makes me pause and say, 'Well the research would suggest build a different foundation. You can still get to the technical skills, but this is what is really foundational to the profession and being a successful profession.' So, I can't disregard the research and say, 'No, no, no. We really need to go back to the technical.' We get there. We still get to the technical but it's built on a much more evidence-based foundation…the foundation of the sort of these interpersonal communication skills.
13	JP	And off of that, with your experience in developing curriculum, how do you view or perceive the importance of getting that base or that foundation of a specific curriculum correct?
14	$CDSME_D$	And mentioned, like in response to an earlier question, sort of starting with the end in mind and what is it that students need to know to be able to do? …You know, one of the responses to that question is it is, umm, that you build the foundation in a particular discipline that is evidence-based. Means that you might start with where you're…starting with construction management, should start based on data. For another discipline, it might mean that the technical skills, the knowledge is where one might start. But I think knowing what the profession or the discipline needs or wants its students to be able to know and do means its an open question. You have to, sort of let the evidence point to what's in that foundation. Not sure if that answered the question.
15	JP	Just to tease out a little more…regardless of the content of the foundation of a curriculum…ensuring that the foundation is strong, robust, regardless of the discipline. Do you see that as kind of a key part of building or developing curriculum?
16	$CDSME_D$	Absolutely. I think, for example, if in the construction management profession, the foundation were built around the technical competencies and sills and knowledge and then communication and listening and teamwork…those were sort of secondary. Then the students going into the profession would have a pretty stark awakening that, my goodness, the skills that I thought were sort of communicated as secondary to the job really become our primary. And if I can't do those, I'm going to have a hard time being able to apply my technical knowledge and bring that to the mix. So, I think it's critical that the foundation be built on what the industry or the profession needs…and the technical skills, it's still there. It's just that it's built on this more solid foundation of what the profession considers foundational to the successful professional.

17	JP	Thank you for expanding on that. Really insightful, so thank you.
18	$CDSME_D$	You're welcome.
19	JP	Off of your curriculum development experience, what have you seen, or in your current role, what do you do and what would you recommend for, kind of, good practice when designing a curriculum? Or maybe looking at it differently…of all the things that you've witnessed that were downright awful or bad or 'let's not do that again,' when designing the curriculum.
20	$CDSME_D$	This is top of my thought right now speak to maybe both sides of that coin. That's sort of what to avoid and sort of poor choices and what then to do instead. So, one of the things that I think I often experience in working with faculty around curriculum development is, sort of, there's a predisposition on their part, I think, and I can relate…I has taken me year to get to a different place on this… but the predisposition to thinking about what do I need to transfer, what knowledge do I need to transfer to students? And so, that shapes both, you know, a choice of prioritising content and prioritising the method by which that gets experienced by the students, so 'content heavy… they have to know this and the best way for them to know this is by me telling you.' So, that often leads to, I think truncating in shortcomings in terms of thinking about two things. What are the, sort of, dispositions, ways of thinking…approached to understanding skill development that comes from students engaging in what is more messy work of learning. The transmission seems pretty clean., 'I just tell them and they learn.' But learning is, I think, way more complex than that in that hearing something is often where a lot of faculty stop with curriculum development. Instead of thinking about, 'OK, they may have heard it…they may have read it…but now, what do they do with it? How do they practice it? How do they assimilate it into other prior knowledge? How do they retrieve it in new contexts?' And that work, for the retrieval and practicing and processing and connecting it to prior knowledge is messy and it's hard and it takes time, but leads to much deeper learning. The result is tat it often means that you have to make some choices about, 'What do I have to know? What content do I have to make…'? This choice between content transmission and deep learning. And that's a hard thing, I think, for people to get a handle on. I come from a content rich discipline and so, I know the challenge of making that choice, but I think in the end, choosing for that messier work processing, connecting to prior knowledge, assimilating, recalling, using in new contexts, that's going to have much longer-term impact on their success and they're learning. So, the bad practice is a focus on lots of content transmission through telling while the best, better practices would be to think about the deeper learning application of knowledge…the practicing, the recalling that often take more time as deeper learning, but it may result in having to make some choices about content that just doesn't get told. The other ways that students might have to gain that.
21	JP	So, off of that, would you agree that if we have, you know, a set foundation within a curriculum that has specific skills that could serve as a guide for educators when deciding on the messy learning process will let, for example, let them focus on these skills or utilise these skills more because they're so foundational, because they're so ingrained in the curriculum or profession…using that as a guide rather than pulling them out of think air or doing a best guess.
22	$CDSME_D$	Yes, I do think if the data point to foundational knowledge and skills that are prioritised, valued, sought in the students, and we have to prepare them with those skills and that knowledge. Everything else follows that and it's, you know and it may mean some choices and what er can do with everything else, but is also means that maybe there are ways to think about how the technical

		knowledge that we want students to gain gets integrated into developing these other foundational skills and the, sort of, not an unintegrated/non-integrated approach. You know, skills, knowledge with the, sort of, integration of those two, I think potentially produce results both in terms of the advancement of those foundational skills while also enhancing the technical competencies students will need.
23	JP	Great. Great.
24	$CDSME_D$	It just required more careful thought about curriculum design. When the data point to something that's truly foundational, it can't be an afterthought.
25	JP	Well said. Thank you for your time today and for providing your thoughts from your wealth of experience. I wanted to just give you this opportunity, if there was something, kind of, burning that you wanted to share, or that we haven't come across or, kind of, a last thought or observation, etc., kind of just open-ended.
26	$CDSME_D$	OK, two thoughts. If you wouldn't mind, John, the question you had…just wanted to hear it again in case I had any other thoughts because I felt like maybe I didn't speak to everything in the question. It was the question, maybe the second one. Do you remember which on what was?
27	JP	Yes, I believe it was getting the foundation of a curriculum correct.
28	$CDSME_D$	Ok. Ok. I think maybe…
29	JP	Or the previous one…initial thoughts when you saw the proof-of-concept model, kind of initial perceptions, thought when you viewed the graphic.
30	$CDSME_D$	Ok. Thanks for repeating this. I think…I maybe have spoken enough to those. If you start to have follow up questions on those at some point, I'm happy to come back to them, but the other thought I had was…one of the experiences that I've had over and over again in the years working both as a faculty member looking at curriculum and now as a Director for our Centre for Teaching and Learning, working with faculty looking at curriculum, this that I often cam to that topic and I think I see faculty come to the topic of curriculum development with a dominant thought in mind, and that is, 'I know how I was taught. I know what I went through as a student to become a professional that I am now. I just need to replicate that.' And for some, in some disciplines have a real openness to, sort of, developing the whole student what works well today because, I think today's educational system is shifting, has shifted towards thinking about the whole student, not just the technical competencies and knowledge base that I have and want students to have. But to think about the whole student development…social, emotional, cognitive or the skills and communication and dealing with other and leadership skills that…leadership itself has, sort of, developed, matured into much more of a, kind of, servant leadership approach…listening skills. So, these broad range of life skills along with the technical skills are the kinds of demands that higher education has been asked to meet and it's different, I think, then the kind of educational experience I have and so a lot of faulty like me think about just the technical competencies, the knowledge base. So, it's often hard to think differently. Given my own experience, any effort and every effort the faculty have to learn how to think about the whole student is, in the end, going to serve the students and society and our professions. That's true whether we're talking about biologists or social workers, pharmacists, construction managers, historians. That the whole student approach to their educational experiences is what we've been asked to do in higher education and a lot of faculty…that's just foreign we it's always been about the head and now it's much more than just the head, it's part in the values and the dispositions and the, you know, managing self, managing

		stressful conditions, situations, all of those thing are now part of the, kind of, approach that we've been asked to bring to the student experience.
31	JP	And do you feel that the proof-of-concept model echoes that?
32	$CDSME_D$	Yeah, it echoes it. And I think it reflects the statement…If job ads are asking for these kinds of skills, I think it underscores that it's not just about what's in students' heads, but it's what they bring, the whole person to their professional lives. Yes, short answer yes.
33	JP	Well, with that, thank you again for your time today.
34	$CDSME_D$	You're welcome.