Integrating BIM into Facility Management: Typology Matrix of Information Handover Requirements

PURPOSE

Integrating Building Information Modelling (BIM) into Facility Management (FM) has generated fervent debate within extant literature given an increasing realisation amongst practitioners that the majority of BIM benefits reside within whole-lifecycle management. Converting a building's in-use data and information into tangible business knowledge to augment FM performance is crucial for business growth and prosperity. Yet curiously, scant academic attention has been paid to investigating the data and information hand-over process through BIM required by FM. This study addresses this knowledge gap.

DESIGN/METHODOLOGY

The research approach adopted draws upon pertinent BIM in FM literature and a qualitative discourse accrued via focus group meetings of Australian FM experts.

FINDINGS

The study's findings are presented as a data and information typology matrix which captures the associations among different forms of data ownership, FM service delivery categories and data and information typologies for using BIM in FM.

PRACTICAL IMPLICATIONS

Analysis results will prove invaluable for policy-makers, researchers and practitioners by providing a relevant data and information typology and capturing the complex associations in the process of integrating BIM into FM.

ORIGINALITY/VALUE

This study contributes to the field by providing a better understanding of different forms of data and information, required by members of a facility management team. The original insight shared here is the necessity to consider a distinctive array of interests and the potential for using different forms of data and information when integrating BIM into FM.

KEYWORDS

Building Information Modelling (BIM); Facility Management; Information requirements, Typology matrix.

INTRODUCTION

Despite the intrinsic synergy that exists between Building Information Modelling (BIM) and Facility Management (FM), and an escalation of industry activity in this area, outright coalescence between BIM and FM practices has yet to be accomplished (Edirisinghe *et al.*, 2017, Pishdad-Bozorgi, 2017). Indeed, technical infrastructure for BIM and FM integration is missing, due to a scarcity of relevant workable solutions (Becerik-Gerber *et al.*, 2011, Pärn and Edwards, 2017). This is because "*information is the most emerging necessity for FM"* (Yalcinkaya and Singh, 2014, p. 2) and the inherent power of BIM for FM is predominantly associated with facilitating and enhancing data and information handover to members of the facility management team (FMT). Besides, members of the FMT have their own data and information needs and requirements that generate knowledge on how to efficiently and effectively enhance the building's performance (Parsanezhad and Dimyadi, 2014). Current solutions are nevertheless inefficient, particularly in terms of the ability to validate and process different pieces of information based on end users' requirements (Shalabi and Turkan, 2016, Pishdad-Bozorgi, 2017). Consequently, exploring data and information needs (and concomitant knowledge generation) through the lenses of parties involved in FM practice has become of particular interest (Patacas *et al.*, 2015).

A review of extant literature however, reveals that previous studies on BIM for FM (BIM4FM) have predominantly focused upon geometric data requirements (Becerik-Gerber *et al.*, 2011, Yalcinkaya and Singh, 2014) with limited attention being paid to rich semantic data (Pärn and Edwards, 2017). Several existing tools and standards outline the various types of data and information needed by the FMT. For example, Construction Operation Building Information Exchange (COBie) that was developed in the United States of America (East, 2007), was introduced as a BIM4FM solution in 2014 in the United Kingdom (UK). Yet, anecdotal evidence illustrates that FMTs still waste a large portion of their resources searching for data and information required (Shalabi and Turkan, 2016). While COBie provides universal coverage of all FM parameters, it fails to filter the data relevant to a specific building with bespoke requirements and FMT expectations (Yalcinkaya and Singh, 2014, Pärn and Edwards, 2017). Hence, further investigation is warranted to enhance the relevance of data and information in meeting the needs and requirements of FM practitioners, and end users of BIM4FM solutions (Shalabi and Turkan, 2016, Pishdad-Bozorgi, 2017). This study addresses these issues by providing a better understanding of different forms of data and information required by the FMT.

BIM INTEGRATION INTO FM

Facility Management (FM) entails the responsibility for: *"the safe operation and maintenance of a corporation or organization's real estate as well as its systems"* (Levitt, 2013, p. 7). The amorphous range of FM operations and maintenance (O&M) activities contribute significantly to costs during the building's whole lifecycle (Perera *et al.*, 2016). According to figures published by the International Facility Management Association, 57.5 percent of total cost occurs in the O&M phase (Teicholz, 2013). BIM with its proven capabilities in data storage, and information exchange among multiple systems is ideally positioned to streamline FM activities (Liu and Issa, 2013, Ilter and Ergen, 2015, Shalabi and Turkan, 2016, Pärn *et al.*, 2017). The value of integrating BIM for FM resides in the inherent capabilities of BIM in capturing, storing and sharing accurate and comprehensive information about building elements and systems from pre-design project stages to post-construction stages (Becerik-Gerber *et al.*, 2011, Shalabi and Turkan, 2016, Terreno *et al.*, 2016, Pärn and Edwards, 2017, Pärn *et al.*, 2017). By transferring design (as-designed BIM) and construction (as-built BIM) data to the FM phase, BIM provides a central repository that eliminates data redundancy (Shalabi and Turkan, 2016), and links specifications and maintenance instructions to building components (c.f. Pärn and Edwards, 2017). Empowering facility managers with such useful building information is crucial in reducing errors in retrofit planning and deconstruction, and minimizing risks in emergency management within the O&M phase of constructed facilities (Teicholz, 2013, William East *et al.*, 2013, Volk *et al.*, 2014, Shalabi and Turkan, 2016). That is, BIM enhances FM practices through offering easy access to the building's repair histories, details of component(s) manufacturers, assembly of components and sequence of activities (Volk *et al.*, 2014, Kassem *et al.*, 2015). Additionally, cost saving during building occupancy relies upon providing facility managers with a consolidated database of information about the project; more commonly referred to as an asset information model (AIM) (William East *et al.*, 2013, Patacas *et al.*, 2015, Wetzel and Thabet, 2015).

BIM mitigates the occurrence of data loss when handing over constructed facilities from the project team to the FMT (Eastman, 2011, Levitt, 2013). Reduction of energy and space management costs, smoothed integration of systems and higher building performance are ubiquitously quoted as tangible benefits of integrating BIM into FM practices (Teicholz, 2013, Volk *et al.*, 2014, Alwan, 2016, Shalabi and Turkan, 2016). Other benefits concern the maintenance of warranty and service information, quality control, enhanced monitoring, emergency and retrofitting management, and occupancy planning (Volk *et al.*, 2014, Gheisari and Irizarry, 2016). Furthermore, by integrating BIM with Augmented Reality (AR), members of the FMT are able to interact with buildings using tablets, smart glasses and phones to better visualize the scale and intricacy of O&M tasks (Arayici, 2008, Re Cecconi *et al.*, 2017).

Role of data and information

Despite the aforementioned palpable advantages, and the tremendous latent capacity of BIM to support FM, this potential remains largely unexploited (Liu and Issa, 2015, Barbosa *et al.*, 2016, Lin *et al.*, 2016, Edirisinghe *et al.*, 2017). In essence, BIM utilisation is almost entirely restricted to the design and construction phases of a building's development *vis-a-vis* the O&M phase (Volk *et al.*, 2014, Wetzel and Thabet, 2015, Shalabi and Turkan, 2016, Pishdad-Bozorgi, 2017). To address this problem, attempts to expand research within the field of BIM4FM have only recently intensified (Yalcinkaya and Singh, 2014, Ilter and Ergen, 2015, Kassem *et al.*, 2015). Amongst various research themes investigated, the issue of identifying what information and data to be prepared and handed over is a conspicuous variable affecting BIM4FM (Ilter and Ergen, 2015). Particularly, fulfilling the requirements of FMT to acquire accurate and relevant data and information throughout the project's whole-lifecycle is of cardinal importance for the success of BIM4FM (Ghosh *et al.*, 2015, Mayo and Issa, 2016, Re Cecconi *et al.*, 2017). As supporting evidence, Fallon and Palmer (2007) estimated that in 2002, FMT in the US spent US $4.8 billion to verify that handed over data and information accurately represented existing conditions, with an extra US $613 million for transferring the information into useful formats.

Critical review of related works

Despite its importance, studies that attempt to address the recurring problem of information and data requirements for members of the FMT are scant within extant literature. Of these, Fallon and Palmer (2007) defined relevant tools, methodologies and standards for handover of data to the FMT. The authors (*ibid*) however, remained silent on specific requirements of each individual FMT member. Becerik-Gerber *et al.* (2011) provided a structure for data provision and responsibility but focused on operational features of data management for BIM4FM and specifically defined roles and responsibilities of parties involved in the procedure. William East *et al.* (2013), Parsanezhad and Dimyadi (2014) and Shalabi and Turkan (2016) had a bias towards technical problems and issues of interoperability among the data produced at different stages of a construction project. Consequently, they failed to provide an answer to the question 'who needs what' in terms of data and information required by members of FMT. Ghosh *et al.* (2015) concentrated upon identifying the standards available for smoothing information handover and determining the data required to facilitate implementation of BIM4FM on projects for building owners - hence, other members of FMTs were excluded from their study. Concentrating only on owners was also an issue with the study conducted by Mayo and Issa (2016), who employed a Delphi method to identify the information needs of building owners. Their findings suggested that owners mostly demand information on facility, occupant protection and heating, ventilation and air conditioning (HVAC) products.

With the aforementioned in mind, investigating data and information requirements of the various members of the FMT has remained within the 'neglect mode' (c.f. Sandberg and Alvesson, 2011). As a result, because no scholarly work of major significance has hitherto investigated this important topic. Despite stoic ongoing efforts to specify the requirements, data and information type, defining and delineating an optimum level of detail to be handed over to members of the FMT has remained a barrier to fully implementing BIM4FM (Parsanezhad and Dimyadi, 2014, Ilter and Ergen, 2015, Pishdad-Bozorgi, 2017, Re Cecconi *et al.*, 2017). Thereby, this work purports that the benefits of BIM4FM can only be exploited in recognising FM as a multi-disciplinary practice, itemising the various parties involved and their individual data and information requirements (Arayici *et al.,* 2012, Re Cecconi *et al.*, 2017).

RESEARCH APPROACH

An inductive ‘grounded theory’ methodological design using a focus- group technique directed this research. Grounded theory is designed to create empirically-derived theories to deal with real-life problems and guide practitioners through understanding the ‘black box’ of practice (Oktay, 2012). Hence, the outcome(s) of grounded theory is understandable by practitioners and work in real-life settings (Dainty *et al.*, 2000, Oktay, 2012). Grounded theory builds theories from analysis of qualitative data in different forms (Corbin and Strauss (2008). A focus group approach is a popular, primary method for the creation and analysis of qualitative data in grounded theory (Oktay, 2012). Focus group discussions allow respondents to share their needs with a particular emphasis on decision-making based on experience to inform future action (Morgan, 2012). Forming a focus group enables researchers to generate focused and rich data where the topic is complex and needs finer granulated *nuanced* information (Dimitriadis and Kamberelis, 2013).

Focus group

Exploiting pre-existing networks contributes to the success of a focus group, particularly where participants share common goals and are engaged in a common activity (Dimitriadis and Kamberelis, 2013). With this in mind, focus group participants for the present study comprised of members of the Australian Facility Management Association (FMA) BIM-FM Portfolio Group hereafter referred to as FBPG. FMA is the premier national industry body for FM, representing and supporting professionals and organizations responsible for the operational management of Australia’s built environment. FMA aims to inspire, shape and influence the facilities management industry and at every opportunity promotes and represents the interests of facilities managers nationally and internationally. The FBPG was specifically formed in 2015 to provide information leadership in the application of BIM in the context of FM. Ten members of FBPG participated in the focus group study (refer to Table 1) and each member possessed vast experience within the FM industry, along with direct active involvement in major bodies in charge of promoting BIM within the Australian construction industry. This demonstrates a rare demographic profile for the focus group of the present study that is laden with expert ‘cutting edge’ knowledge. Moreover, having a history of collaboration in FBPG and pursuing a common objective represented a unique composition for the focus group. That is, effective focus group composition occurs when members are comfortable with talking to the other participants and share similar interests in the research topic (Dimitriadis and Kamberelis, 2013).

<Insert Table 1 about here>

The FBPG chair was also a member of the research and authoring team. Synergy between the research team’s aim and the FBPG’s objectives created a common goal and afforded many opportunities for creation of rich data and accurate information. That is, an overlap between the research and day-to-day activities of participants provides a rich (auto-) ethnographic account of the phenomenon in which focus group members are involved (Dimitriadis and Kamberelis, 2013). Figure 1 illustrates the iterative procedure for conducting the focus group in the present study to ensure that the outcome was acceptable for all team members. This was also in line with principles of the grounded theory approach in which knowledge is created through application of a multistage procedure with constant checking to the point of theoretical saturation.

<Insert Figure 1 about here>

Data analysis

The focus group sessions started with the moderator (member of the research team and the chair of FBPG), posing two general questions to the group and encouraging all participants to generate responses, views and opinions. The general questions were: 1) who are the main potential users of BIM4FM?; and 2) how we can ensure the relevance of information and data from BIM to the main users of BIM4FM? The sessions were managed with the aim of collecting data, rather than pursuing unity and consensus among focus group members. All interactions and discussions were recorded and in meetings lasting 1-1.5 hours; a report would be relayed by the chair of the FBPG to other research team members afterwards. During research team meetings, observations would be discussed, and new questions were raised. The analyses focused on bringing meaning to the available data, and generating themes, compared against theoretical concepts. First, a thematic framework was produced based on the key themes produced in focus group discussions, and the data were indexed based on this thematic framework, making the data manageable by retaining only the indexed data. Second, the indexed data were exposed to interpretation of the research team. This was to code the data, identify key words, and giving meaning to the context of expressions to assign codes. Codes were termed based on the literature, as recommended for giving titles to codes in analysing qualitative data (Bazeley, 2013). Third, the codes were analysed to record the frequency of codes and give values to the intensity of comments. This approach provided the basis for creating the matrix, where numbers were interpreted based on co-occurrences between the codes, and spotted co-occurrences were interpreted as associations. The number of references to a code in analysing qualitative data reflects its relative importance because participants repeated the more important items more frequently (Bazeley, 2013). This was used to give values for associations between the codes. Finally, the research team discussed and agreed upon the larger trends and key concepts and meanings that emerged. A benefit of separating the focus group discussions from the analysis process was that potential for bias was controlled and minimised. Neither was there a possibility for an emerging theoretically framework forming in the observers' mind in such a way as to filter further observations.

KEY DEFINITIONS DERIVED FROM THE FOCUS GROUP

Data analyses initially sought to define key terminologies to be used throughout the research study. As a result, three key thematic groups that required further enquiry emerged, namely: 1) ownership types of assets; 2) service delivery models offered; and 3) type of data and information. For each thematic group, the key associated terms were identified, defined and delineated to be used in all future discussions and communications. Four ownership categories were identified as distinguishing between the different common types of ownership models applicable to facility and asset management. These four groups are; i) developer; 2) occupier; 3) owner; and 4) owner-occupier (refer to Table 2).

<Insert Table 2 about here>

Service delivery models simplify the description of facilities services delivery structures that are common within Australian. The analyses of data revealed that the following four high-level basic categories are applicable to Australia – namely 1) all contracted out; 2) many contracts; 3) few contracts; and 4) all in-house (refer to Table 3).

<Insert Table 3 about here>

For clarity and consistency, a data and information typology was created out of the data, to standardize the terminology used. Definitions for data and information were considered in line with the simple definitions proposed by Ackoff (1989). Three generic thematic classes were reported upon, namely: 1) operational; 2) tactical; and 3) strategic (refer to Table 4).

<Insert Table 4 about here>

THE PROPOSED TYPOLOGY MATRIX

Using ownership, service, data and information types as a basis for the BIM4FM requirements model, the analyses of data led to the production of a '*matrix'*, as illustrated in Figure 2. This matrix provides a policy framework for facilities information and data management, handover requirements. The matrix was designed to capture the complex relationships between facility and asset ownership, the delivery structure and the data and information needed; where data and information reside within one of the three thematic groups previously reported upon in Table 4. The purpose of the matrix is to provide an understandable graphic to guide organisations operating within the architecture, engineering, construction and owner-operated (AECO) industry and determine how and what data and information is relevant for whom in designing BIM4FM practices. The 4×4 matrix notionally relates the ownership structure (4 categories) and service delivery model (4 categories) to the required level of operational, tactical and strategic data and information types. The size (scale) of boxes indicates the level of strategic application of data and information for each of the 16 categories. There is a 100-point scale with each unit representing 10%. The minimum amount of predominantly operational-oriented data and information was suggested to be demonstrated with 2 units, deemed essential to run the business. When moving vertically on the matrix the amount of required strategic data and information increases, starting from 20 for ‘all contracted out category’ to 50 for ‘all in house.’ Likewise, moving horizontally from ‘developer’ to ‘owner-occupier’ increases the strategic nature of information and data from 20 to 50 for each of the defined ownership categories. The sizes of boxes of the matrix represent the sum of information and data required units. For example, the intersection of ‘developer’ with ‘all contracted out’ is demonstrated with 4 units (40 = 20+20) whereas the intersection of ‘owner-occupier’ with ‘all in house’ shows the largest amount of strategic dominance (100= 50+50). As such, the matrix notionally illustrates different levels of strategic data and information application in FM based on 16 combinations of ownership models and service delivery models.

<Insert Figure 2 about here>

A larger (nominal) box in the matrix (see the right-hand side of Figure 2) would mean that strategic application of data and information to make informed decisions is more likely to be of interest for using and achieving tangible beneficial outcomes. There is a vested interest in holding and managing data and information through the systems owned and operated by the owner and beneficiary of the information and data. This data and information could subsequently be applied to achieve efficient and effective service delivery. Contrary, a smaller box (see the left-hand side of Figure 2) would mean that data and information is not used to make strategic informed decision, neither considered to be relevant or beneficial by the relevant stakeholders (shown in the left column). Data and information is most likely held in different systems owned and operated by entities who do not necessarily hold an operational, tactical and/or strategic interest in the long term efficiency and effectiveness of all FM services for an asset. Thus, the matrix maps various possible relations between ownership and delivery, and facilitates the decision-making on managing data and information for the efficient and effective delivery of FM services. The matrix can be used as a framework for identifying the required data and information to be provided by consultants and suppliers (extracted from BIM applications) driven by building owners and/ or the FMT.

DISCUSSION OF THE FINDINGS

Similar efforts in the UK have focused on the operational needs and requirements of data and information for BIM4FM (Atkin, 2012) - for example, in the family of British Standards (BS) 8536. This study contributes to new knowledge by viewing data and information though an operational, tactical and strategic lens and cross comparing these to ownership and project delivery models. By mapping these complex relations, policy-makers, researchers and practitioners who intend to implement BIM4FM, could benefit from the structured representation of the accountability and requirements for data and information. Consequently, the matrix could be a tool to ensure that all businesses can financially benefit from good data and information that improves building, economic and environmental performance, via knowledge generation of an asset in use. The matrix could show building users how the different types of contractual arrangement may impact upon their primary economic objective.

The matrix does not replace existing FM good practice guides but instead complement them. The premise of the matrix includes a minimum amount of operational information as the baseline while tactical and strategic information belong only to particular cases. This concurs with a widespread industry assumption indicating that operational information is the driving engine for business, whereas tactical and strategic information play the role of equipping and transforming the operational side in order to ensure the long-term business competitiveness (Stowell, 2017). This paper also challenges the popular view that COBie data requirements alone can support BIM4FM. For example, Level 2 BIM refers to a common environment where multi-disciplinary data would be shared using COBie (GCCG, 2011). This rhetoric is based upon a *one-shoe-fits-all* approach towards data and information. Instead, this paper has developed a robust theoretical framework that would allow the building's occupants, users or clients to tailor data and information requirements to prevailing financial constraints and business needs.

The study's findings, particularly the matrix presented here will be of direct appeal to practitioners and can inform real-life cases, where BIM4FM is the target. As a recent case study conducted by Pärn and Edwards (2017) referred to the lack of protocols to inform the integration of data and information between BIM and FM when developing an API plug-in to automate this process. Although very basic in nature, the matrix can be used as a stepping stone to creation of further detailed standards, protocols and guidelines that instruct developing such technical solutions.

CONCLUSIONS

This study provided the basis for a requirements model, which challenges the common approach for promoting hand over of data and information between BIM and FM, with disregard from the fit and categorisation of these deliverables. As the first in its kind, the study provides evidence that the potential for the data and information, and level of appetite and interest might be glaringly different among various parties and for different delivery methods. Analysis of qualitative data from a focus group in Australia suggested the key components of this requirements model: 1) ownership types of assets; 2) type of services delivery models; and 3) type of data and information required from BIM. Practitioners could use these definitions and categorisations to understand the interfaces between BIM and FM practices and the stakeholders who are privy to relevant information. Additionally, this study sheds new light on the relation among these categories by proposing a matrix as a simple illustrative tool to associate the list of required data and information deliverables. The work has laid the basis for policy-makers, researchers and practitioners who intend to design the process of integrating BIM into FM by providing a clear interpretation of the complex relations among involved parties, service delivery models and required data and information. The proposed matrix complements existing FM guides by offering a tool for the pragmatic utilisation of data and information according to bespoke stakeholder and procurement requirements. Subsequently, it can be used by asset owners as a guideline to establish the appropriate type of data and information, depending upon their business case and goals vis-à-vis blindly adopting COBie in its entirety.

Although this study has attempted to form a comprehensive report of the possibilities of data and information from BIM to support FM practices, it has several limitations. First, the study took place in Australia and cannot be fully generalizable, due to local policies and processes; probably the findings might be more relevant to commonwealth countries. Second, the findings must be tested in an empirical setting, to prove validity and applicability in real-life projects. This could form direction for further research, potentially featuring case study research. Potential quantification of the qualitative narrative from a multiple case study could provide a decision support system that allows building occupants to optimize the type and range of data and information and thus knowledge generation. For example, a small business would not need a complete range of data and information for FM, whereas a larger multinational organization would perhaps require the top end (and far more comprehensive) specification of data and information. Future research will focus on further validating these frameworks with similar focus groups in various other countries where BIM adoption is high and mandated, such as the UK and Europe, and its integration to FM practices is vigorously being pursued.

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Table 1 - Profile of the Focus Group Members

ID	Position in the industry	Education	FM Experience	Involvement with BIM
1	Industry Association CEO	MSc	6 years	An industry association representative for BIM
2	Manager Digital Technologies - Technology company	BSc	39 years	Chair of Standards Australia Committee BD-104 BIM; Member of the Australasian BIM Advisory Board; member of SBEnrc Project Steering Groups for Project P2.34; member of the Australian Institute of Architects; member of the AMCA BIM-MEP AUS Steering Committee; member of the reference group for the final report to BEIIC (Built Environment Industry Innovation Council) Productivity in the Buildings Network: Assessing the Impacts of Building Information Models 2010; member of buildingSMART International BIM Guides Project Working Group; member of buildingSMART Australasia National BIM Initiative Working Groups; editor of the NATSPEC National BIM Guide; and author of New Zealand's BIM Handbook.
3	Strategic Digital Engineering Lead at Consulting firm	MSc	12 years	Author of BIM Knowledge and Skills Framework (ACIF, 2017); and author of Australian and New Zealand Revit Standards.
4	Strategic Development Director – Engineering design and installation firm	BSc	27 years	Engineering design and installation firm is a recognized global leader in the development and application of BIM to building services design, manufacture, installation and commissioning; a key contributor to the BIM-MEPAUS industry initiative. Recognized by a number of industry awards for its work in prefabrication as enabled by the leading application of BIM; AIRAH Award for Excellence in Innovation, Property Council of Australia; and Rider Levett Bucknall KONE Award for Innovation.
5	Associate Director – Professional Real Estate Consulting Firm	BSc	17 years	Chair FMA BIM Task Force; Victorian Chair Lean Construction Institute Australasia; Member of the Australasian BIM Advisory Board (ABAB); author FMA Good Practice Guide Facilities Information; FMA committee member of the year; and International experience as Strategic Asset and FM consultant.
6	Independent consultant	Engineer	24 years	Engineering services provision; FMA State Branch chair; and FMA committee member of the year.
7	Group Engineering manager - Engineering design and installation firm	MSc	30 years	Engineering design and installation firm is a recognized global leader in the development and application of BIM to building services design, manufacture, installation and commissioning; a key contributor to the BIM-MEPAUS industry initiative. Recognized by a number of industry awards for its work in prefabrication as enabled by the leading application of BIM; and AIRAH Award for Excellence in Innovation, Property Council of Australia.
8	Enterprise Manager – Specialist systems engineering development firm	MSc	14 years	FM practitioner; FM service provider; and private and public sector property operator.
9	Research Associate / Facilities Manager	MSc	21 years	FM practitioner; and FM research associate.
10	Director BIM technology company	BSc	51 years	BIM software consultant, provider SaaS

Figure 1 - Focus Group (FBPG) Procedure

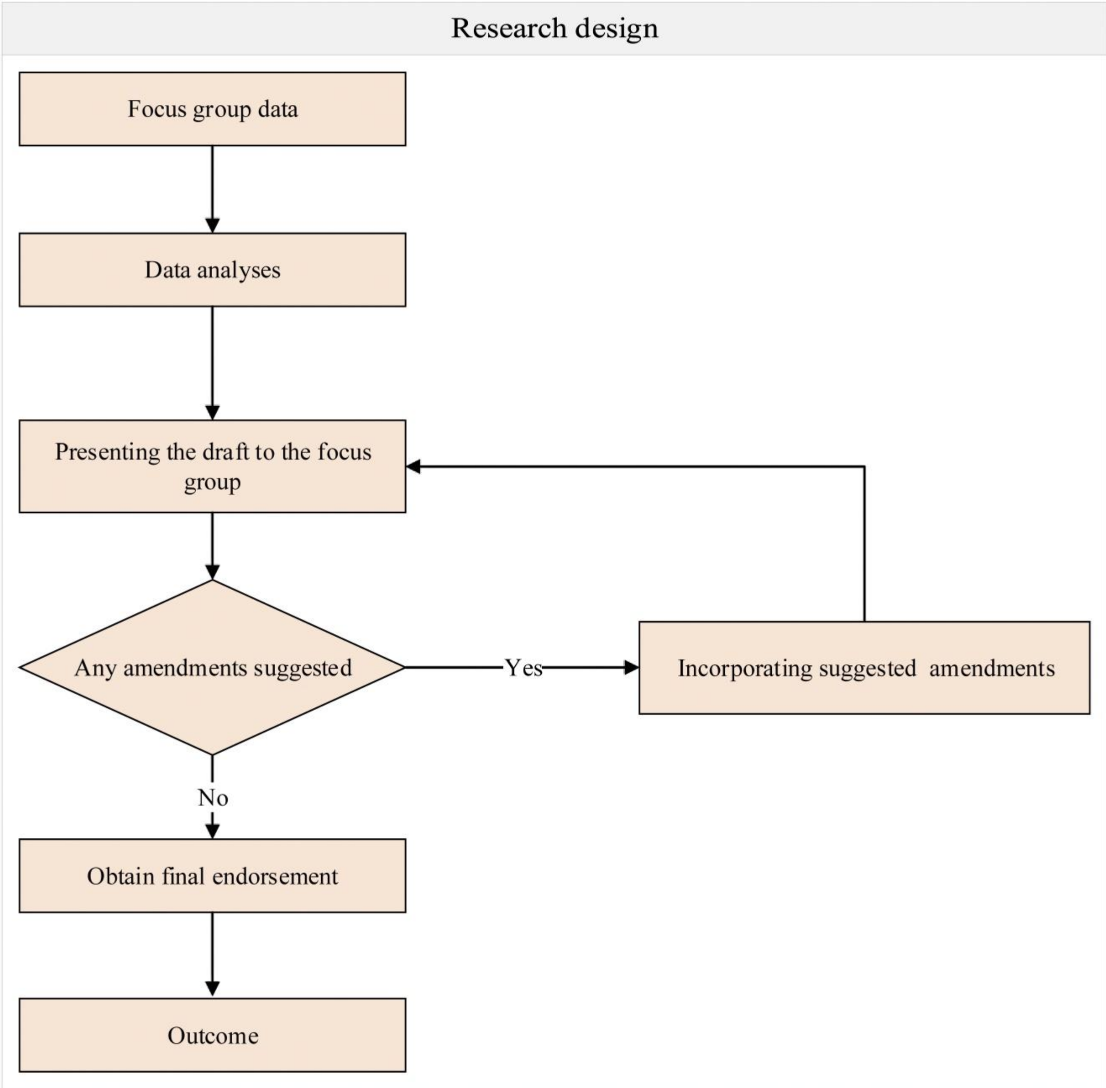

Table 2 - Various Categories of Ownership.

No.	Category	Definition
1	Developer	An entity that constructs or (re-)develops the asset with the intention to sell it to the highest bidder as soon as possible after completion and all development and construction risks have either materialized or been superseded by the passing of time.
2	Occupier	An entity that does not own the facility or asset, merely has an agreement with the owner to use/occupy the asset or facility in return for payment (for a finite agreed time period).
3	Owner	An entity that owns a facility or asset, however does not use/occupy the facility or asset for own use, instead has one or more agreements with occupiers for the use/occupation of the facility or asset.
4	Owner-Occupier	An entity that both owns and uses/occupies the facility or asset.

Note: Organisations can either be one specific category or fit in multiple categories, which may vary per asset/facility.

Table 3 - Various Service Delivery Models for the FM Industry in Australia.

No.	Category	Definition
1	All contracted out*	All aspects associated with facilities management service delivery have been contracted out to suppliers and service providers.
2	Many contracts*	Most but not all aspects associated with facilities management service delivery have been contracted out to suppliers and service providers, the remaining aspects are self-delivered.
3	Few contracts*	A number of aspects associated with facilities management service delivery have been contracted out to suppliers and service providers, however the majority is self-delivered.
4	All in-house	All facilities management services are self-delivered by directly employed staff.

*Note: A common distinction made is whether the management of the services is contracted out or self-delivered, which could apply to each of the structures (1-3). Although a valid distinction (in terms of the high-level broad categorizations defined), this has been ignored for the sake of brevity.

Table 4 - Data and Information Typology

No.	Category	Definition
1	Operational	Data and information is predominantly used to allow for efficient and effective day-to-day (relative short term) operational activities.
2	Tactical	Data and information is generally used to determine how operational efficiency and effectiveness can be achieved over a short to medium term.
3	Strategic	Data and information informs and justifies the actions for long-term efficiency and effectiveness in operational activities.

Figure 2 - The Typology Matrix for Data and Information.