A Systematic Approach for Enterprise Systems Upgrade Decision-Making: Outlining the Decision Processes

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SYSTEMATIC APPROACH FOR ENTERPRISE SYSTEMS UPGRADE DECISION-MAKING: OUTLINING THE DECISION PROCESSES

ABSTRACT

Purpose – Enterprise Systems (ES) upgrade is fundamental to maintaining a system's continuous improvement and stability. However, whilst the extant literature is replete with research on ES upgrade decision-making, there is scant knowledge about how different decision processes facilitate this decision to upgrade. This paper aims to investigate and better understand these processes from an organisation perspective.

Research approach – A qualitative survey design adopted, utilised a web-based questionnaire and semi-structured interviews to collect data from 23 large organisations. Data accrued was qualitatively analysed and manually coded to identify the various decision processes undertaken during ES upgrade decisions.

Findings – Analysis results reveal complex interrelations between the upgrade drivers, the need to evaluate the new version's functionality and the upgrade impact. Understanding the interaction between these elements influences the upgrade decision process.

Research limitations – The study proposes ES upgrade processes that support a decision to upgrade major releases. Further research is required to offer either similar or conflicting arguments on the upgrade decision-making and provide a probabilistic generalisation of the decision-making processes.

Originality – The research offers a comprehensive and empirically supported methodical approach that embraces an evaluation of a new version's functionality, technical requirements and concomitant upgrade implications as intrinsic decision processes. This approach assists in the decisions to establish the upgrade need and determine the level of change, effort required, impacts and associated benefits.

KEYWORDS

Enterprise Systems; Post-Implementation Phase; ES Upgrade; Upgrade Decision-Making; Decision Processes; Systematic ES Upgrade.

1. INTRODUCTION

Enterprise Systems (ES) are a comprehensive, configurable, integrated suite of systems, information resources and technologies that support organisation-wide operational and management processes (Xu, 2011). ES offers a range of capabilities to support end-to-end processes that enable collaboration, interaction and an organisation's information processing needs (Ward et al., 2005). Hence, ES incorporates Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), Supply Chain Management (SCM) and other systems. Organisations typically adopt ES to gain competitive advantage, improve productivity and facilitate real-time decision-making (Dittrich et al., 2009; Grabski et al., 2011). However, Panorama's market survey reported by Ng and Wang (2014) suggests that few organisations exploit the full potential of their ES after implementation; possibly because the inherent value of ES is often realised after the systems 'go-live' (Voulgaris et al., 2014). Motiwalla and Thompson (2009) suggest that two main activities occur after systems 'go-live' to enable organisations to exploit the inherent value of ES, namely: i) maintenance to ensure that the existing system is sufficiently supported and that operations are stabilised; and ii) upgrade to improve and extend the existing system to fulfil business needs. While daily maintenance and minor version improvements are essential to sustain systems, upgrading major release improves the technological features and functionalities of current systems (Ng and Gable, 2009; Vaucouleur, 2009), and ensures that existing systems operate efficiently to support organisational needs (Leyh and Muschick, 2013). Major release upgrade is a continuous process recurring at least once every three years (dependent upon the vendor's version release cycle) and takes up to eight months on average to complete (Olson and Zhao, 2007). According to Teoh et al. (2015), realising the scale and scope of upgrade requirements will help to alleviate failures.

Upgrading replaces a current version entirely or partly with a newer version or system (Ng, 2011), thus highlighting two upgrade dimensions. First, system-to-system upgrade occurs when the new version of the installed ES does not support the organisation's requirements and warrants replacement with another system from either the same or an alternative vendor. Second, version-to-version upgrade occurs when the same systems are upgraded to a newer version released by the vendor. Given frequent releases of new versions and familiarity with system capabilities (Seibel et al., 2006), organisations may undertake version-to-version more often than system-to-system upgrade. The same level of preparation and planning is required with both upgrade dimensions (Beatty and Williams, 2006). Upgrading offers palpable benefits such as lower operational costs, improved performance, new functionalities and technology features (Vaucouleur, 2009). However, high associated costs preclude many organisations from upgrading their systems (Vaidyanathan and Sabbaghi, 2007; Dempsey et al., 2013) which can range between 20% to 30% of the initial implementation cost (Otieno (2010). Morgan and Ngwenyama (2015) revealed that upgrading costs consume a large proportion of the US$1.03 trillion spent in 2014 for Information Technology (IT) in the United States. Other academics have focused upon intangible costs, for example, Khoo and Robey (2007) proffer that a new version's functionality could impact upon the existing version and increase the possibility of disruptions.

Not upgrading means utilising outdated systems that increase costs, and the possibility of encountering bottlenecks in system performance and functionality (Ng, 2001; Vaucouleur, 2009). The complex upgrade decision-making process requires careful consideration to circumvent disruptions to operations and budget overruns. Khoo (2006) and Otieno (2010) explored ES upgrade decision-making and suggest that upgrade decision-making encapsulates an interaction of both motivating and constraining forces. However, knowledge of ES upgrade decision processes remains scant, possibly because the literature on ES upgrades (Ng, 2011; Teoh et al., 2015) and decision(s) models offer limited information on upgrade decision processes (Khoo, 2006; Otieno, 2010; Morgan and Ngwenyama, 2015). The increasing importance of upgrade decisions needs a better understanding to enable a systematic approach to ES upgrade decision-making

This study provides insights on ES upgrade decision processes from an organisation perspective to understand how the different processes facilitate upgrade decision-making. In pursuing this aim, the research objectives are to: i) provide a detailed understanding of upgrade decision-making; and (ii) identify essential elements in order to develop a better understanding of the mechanisms involved for example technical change and system's functionality during the decision-making processes.

2. ES UPGRADE DECISION-MAKING

The decision to upgrade embraces stakeholders with diverse expertise and interests (Beatty and Williams, 2006); this amalgamation of tacit knowledge is a strength but also problematic when individuals perceive ES upgrade differently. Technical experts may interpret the upgrade to mean changing the underlying system whilst functional experts may construe such to incorporate new functionality and improve existing processes (Khoo, 2006). Maximising the upgrade benefits requires an inclusive approach to decision-making that embraces all expert perceptions to augment the organisation's overarching strategic goal (Wenrich and Ahmad, 2009). Table 1 presents prominent studies that offer significant insight into ES upgrade decision-making - a literature synthesis and evaluation suggests that the decision to upgrade derives from balancing a triangulation of the interaction between various upgrade factors, the trade-offs and risks (refer to Figure 1). While the studies in Table 1 outline several interesting arguments on upgrade decision-making timings and factors, there is very little mention on the upgrade decision-making processes.

<Insert Table 1 about here>

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2.1 UPGRADE DRIVERS

Previous studies define upgrade drivers as influential reasons underpinning an organisation's decision to upgrade their systems (Kremers and van Dissel, 2000; Khoo, 2006; Claybaugh, 2010; Otieno, 2010; Dempsey et al., 2013; Feldman et al., 2016)[1]. Kremers and van Dissel (2000) classified upgrade drivers as: i) *functional* – encapsulating reasons that encourage organisations to upgrade their systems such as new functionality to support business needs (Khoo and Robey, 2007; Vaidyanathan and Sabbaghi, 2007; Claybaugh, 2010; Otieno, 2010; Dempsey et al., 2013; Claybaugh et al., 2017); ii) *technical* **–** covering operational requirements such as vendor maintenance and support, compliance with new standards and performance improvement (Kremers and van Dissel, 2000; Claybaugh, 2010; Claybaugh et al., 2017); iii) *organisational* – encompassing internal factors such as expansion, and integrating different data and information sources (Khoo and Robey, 2007; Dempsey et al., 2013; Claybaugh et al., 2017); and iv) *environmental* - comprising of all drivers that are external to the organisation such as improving value chain collaboration or remaining competitive (Otieno, 2010; Dempsey et al., 2013; Claybaugh et al., 2017). Khoo (2006), Otieno (2010) and Dempsey et al. (2013) all explored factors influencing the decision to upgrade and categorised these drivers into two dichotomous groups, namely: i) *motivational* **-** including drivers such as new functionality; and ii) *constraints* **-** including drivers such as costs and perceived risks. Feldman et al. (2016) conducted a thematic review of these drivers within the extant literature - the context, description and drivers are summarised in Table 2 for brevity.

<Insert Table 2 about here>

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[1] ~~Author et al., 2016 – authors and paper details removed to preserve anonymity during reviews.~~

2.2 ASSESSMENT OF THE TECHNICAL CHANGES

Upgrading changes the underlying infrastructure that supports the system, and invariably increases the costs, duration and effort needed to complete the upgrade (Whang et al., 2003). Implementing new functionalities and technical features may create compatibility issues and thus negatively impact upon the existing version (Khoo and Robey, 2007). Circumventing these compatibility issues during upgrade consumes an inordinate proportion of time and effort allocated for the upgrade (Beatty and Williams, 2006). Upgrading can change the infrastructure, operating systems, databases, hence accounting for these changes during the upgrade decision-making could reduce risks of the upgrade incurring budget, and programme overruns. Additionally, an assessment of workload and costs associated with implementing changes will enable the organisation to better determine the cost-benefit of pursuing the upgrade.

2.2.1 Assessment of system's functionality

Assessing an implemented new version's functionality provides opportunities to explore internal business needs and external environments to facilitate decision-making (Olson and Zhao, 2007). A comparative analysis between existing and new version functionality will determine the extent of any improvements available to reduce customisations and modifications (Beatty and Williams, 2006). Zarotsky et al. (2006) recommend consultation with vendor documentation to understand new version's functional improvements whilst Ng and Gable (2009) propose an upgrade assessment and recommendation report to evaluate new functionalities against organisational requirements. This gap-fit analysis ameliorates an otherwise subjective decision-making process and can facilitate efficient resource planning and allocation to support upgrading (Beatty and Williams, 2006).

2.2.2 Assessment of the upgrade impact

Upgrading requires an extensive knowledge of the underlying system and existing business processes, as changes applied in one part of the system may affect the whole system (Rothenberger and Srite, 2009). When opting to upgrade, the performance and input/ output capacity of the existing hardware and supporting systems must be measured (Whang et al., 2003). Estimating the degree of modifications and corresponding implications, enables decision makers to better understand the benefits and trade-offs required (Parthasarathy and Daneva, 2016). Dor et al. (2008) automated this process using an algorithm that evaluates the impact of the new version features on the implemented version and estimates the effort required to upgrade. While undertaking an impact assessment before upgrading incurs additional cost, understanding the implications of change will mitigate costly rework changes once upgrading commences, thus justify this expenditure.

2.3 UPGRADES STRATEGIES

Technical and functional main upgrade strategies predominate (Dempsey et al., 2013; Morgan and Ngwenyama, 2015). Technical strategies move the existing system to the latest technology platform, hence concentrating on technology changes such as system architecture to leverage latest features and align systems within the product lifecycle (Dempsey et al., 2013). Undertaking a technical upgrade involves analysing the structure of data dictionary objects and evaluating individual coding areas to confirm that changes do not disturb the existing system (Beatty and Williams, 2006). Functional strategies concentrate on functionality extension and optimising business processes based on the organisation's needs. Consolidation of different systems is required to optimise processes by adopting generic functionality offered in the new version (Feldman et al., 2016). However, business process re-engineering may be required to align functionality to the organisation's requirements (Otieno, 2010). Mukherji et al. (2006) explain a suitable upgrade is the one that includes a combination of functionalities, supporting software and hardware capabilities to support both the internal and external needs. Thus, many organisations would combine both technical and functional upgrades at the same time due to the gap between the versions (installed vs released) being huge, potentially making the upgrade lengthy, costly and riskier.

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2.4 ES UPGRADE DECISION PROCESSES

Figure 2 provides a graphical representation of ES upgrade decision-making derived from extant literature. While major ES vendors offer strategies and methodologies to manage and support upgrades, most organisations incorporate multiple systems from various vendors. Hence, vendor-specific approaches are inadequate to support a myriad of organisational needs, resulting in informal strategies and philosophies being adopted when contemplating upgrading ES to the latest version (Seibel et al., 2006). These strategies include considering the technical fit, functionality mapping and assessing the impact as essential activities that can influence upgrade decisions (Ng, 2001; Dor et al., 2008). Furthermore, ES upgrading must be timed to guarantee minimal disruption and downtime (Claybaugh et al., 2017); many organisations delay upgrading until the stability and reliability of the new version are established (Vaidyanathan and Sabbaghi, 2007; Urem et al., 2011). Critically assessing the upgrade need could facilitate taking full advantage of the upgrade, gaining business benefits and reducing upgrade risks (Beatty and Williams, 2006). Ng and Gable (2009) suggest that such processes are undertaken after the decision to upgrade is reached. Undertaking these activities before upgrading could help organisations take full advantage of the upgrade and evade difficulties that could place the upgrade at risk (Vaidyanathan and Sabbaghi, 2007; Riis and Schubert, 2012).

<Insert Figure 2 about here>

Riis and Schubert (2012) focused upon vendors and resellers and proposed a transition decision process for ES upgrades that suggests the presence of 'pull' and 'push' mechanisms between different stakeholders - such can cause disinterest in the implementation of new versions. From the vendors' side, three decision processes identified are: i) strategising to acquire an understanding of the new version, its benefits and shortcomings, when compared to the existing version; ii) upgrading as part of the decision to either upgrade the add-on to fit the new version or leaving it to be matched to the old version; and iii) selling concerns with the sale of upgraded add-ons. From the resellers' perspective, three decision processes are proposed: i) strategising in an identical manner to vendors; ii) implementing the upgraded add-ons; and iii) increasing experience and knowledge gained during the implementation. Additionally, research suggests that organisations push for a new version depending on their needs (Beatty and Williams, 2006; Riis and Schubert, 2012), however, the literature has scant detail on how these decision processes evolve within an organisation. Assessing decision processes from an organisational perspective could enable greater understanding of the: role of upgrade drivers; the importance of technical and functional assessment; and upgrade impact. Assessment influences the selection of the upgrade strategy, which could result in undertaking either a technical upgrade, functional upgrade or both.

3. RESEARCH APPROACH

Given inherent complexities of the upgrade decision-making process and interaction between the various procedures involved, further research must disentangle this perplexing area of ES and extend schematic guidance for industry. This work adopts a qualitative survey design (refer to Figure 3) because it offers diversity and depth on upgrade decision processes and their interrelationships (Jansen, 2010; Lindgren and Münch, 2015). Two data collection techniques were employed. First, a questionnaire was undertaken to: identify organisations that have upgraded their ES and capture the decision-making experiences/ process employed; and establish a sample pool of respondents for interview. Second, follow-up semi-structured interviews conducted allowed the in-depth investigation to elicit detailed insights about upgrade decision-making processes to formulate pertinent conclusions. Data accumulated was qualitatively analysed and manually coded to formulate a coherent interpretation and synthesis of crucial concepts to identify various decision processes undertaken during ES upgrade decisions. An evaluation subsequently compared and contrasted the schematic model derived against existing upgrade decision-making models prior to presenting it to participants for validation.

<Insert Figure 3 about here>

3.1 DATA COLLECTION

3.1.1 Questionnaire design

The questionnaire contained two distinct sections, namely: i) *upgrade decision-making* to identify decision processes and their relationship. Additionally, this section aimed to gather information about factors influencing the upgrade decisions, along with understanding factors that influence the selection of a particular upgrade strategy; and ii) *evaluation of new version functionality* to identify process and techniques used to assess new version's features and the impact of an upgrade on the existing version. It also allowed exploring the importance of conducting an evaluation of functionality and assessing the impact. The questionnaire included both open-ended and close-ended questions. Closed-ended questions used a five-point Likert item or boolean coding of the upgrade drivers to establish the soundness of previous upgrade decision factors. Multiple options answers were used for other questions like the type of upgrade strategy selection. Open-ended questions sought to elicit the accounts, experiences and decision-making process of respondents when implementing an ES upgrade project(s). The questionnaire was hosted on an open-source third-party service repository (www.limeservice.com) that provided user-friendly, low-cost structuring tools and logic validation techniques when compared to postal surveys. This administrative approach reduced transcription errors and expedited the delivery and receipt of responses (Denscombe, 2010).

To validate the questionnaire, a draft was first presented to six colleagues to assess its logic, clarity and completion time. An amended version was then tested on a pilot sample of five respondents who had recent experience of ES upgrade projects. Feedback received prompted the removal of thirteen unnecessary/ redundant questions whilst ten other questions were amended to offer greater clarity and reduce completion time.

3.1.2 Semi-structured interviews

Semi-structured interviews explored emergent ideas to gain rich, detailed insights which supplemented and extended constructs obtained from the questionnaire and extant literature. This approach offered innate flexibility to intensively pursue specific lines of inquiry to gain valuable insights from respondents' knowledge (Denscombe, 2010). The interview guide was influenced by three main constructs identified from the analysis of questionnaire data, namely:

- decision-making processes - this included questions about the role of the interviewee during the upgrade, how the decision to upgrade was reached, and if there were any activities followed and in what order~~-~~;
- evaluation of functionality - these questions ~~concerned~~sought to understand why it was important to evaluate the new version, and identify the techniques and tools used for evaluating functionality; and
- measuring the impact of the new version upon existing systems ~~-~~, these questions explored the need for impact assessment and its occurrence within the upgrade decision-making process. Additionally, it aimed to capture the techniques for impact assessment.

These thematic groupings have previously been identified as being important (Khoo, 2006; Ng and Gable, 2009; Otieno, 2010) but need further explanation to offer more depth to initial data analysis conducted. Depending upon the interviewee location and availability, either face-to-face, video conference or telephone interviews were conducted. Each interview lasted circa 45 minutes during which handwritten notes were taken, and discussions recorded to afford retrospective referral to key points discussed.

3.1.3 Respondent selection

Respondent participation was secured using snowballing and purposeful sampling techniques. SAP and Oracle user groups were contacted to request access to their members within the United Kingdom (UK) and Ireland. Implementation of snowballing involved searching LinkedIn® professional networking site for respondents with ES upgrade experience - where key search criterion was: involvement in at least one upgrade project; and for the semi-structured interview, at least six years' experience of managing ES. This approach secured participants that have been involved in at least two upgrade projects since upgrade projects occur on three years cyclical basis (Olson and Zhao, 2007). When evaluating the findings, non-involvement in previous data collection stages was enforced as an additional selection criterion.

The web-based questionnaire survey was conducted from May – September 2013 and the semi-structured interview was conducted from December 2013 to March 2014. Forty-one respondents representing large organisations participated in this study, out of which twenty-nine respondents from eighteen organisations were involved in the web-based questionnaires. Twelve respondents participated in the semi-structured interviews from which six had also participated in the web-based questionnaire. The remaining six represented five new organisations, thus the total number of participating organisations was twenty-three. All these organisations have international footprints and operated in diverse industrial sectors such manufacturing, service delivery, education and transport. Respondents' employment profiles were manifold (Table 3) ranging from Chief Financial Controller in senior management to database administrators. Table 4 displays the respondents' years of experience and revealed almost 76% had accumulated more than six years' experience, thus providing an extensive source of knowledge on ES upgrade projects. Securing an appropriate number of respondents is a fundamental requirement of felicitous qualitative research that acquires depth and richness (Mason, 2010). Jansen (2010) suggests that when research incorporates an appropriate level of diversity and when new responses do not offer new research insights, an empirical confidence is reached. Therefore, it was construed that the respondents' years of experience (Table 3), roles (Table 2), and the different organisations represented offer prerequisite depth, richness and an appropriate level of diversity required to develop cognisance of the upgrade decision-making process. Table 5 highlights the list of systems upgraded by the organisations that took part in this study. To evaluate the findings, ten additional respondents (representing seven organisations) with more than eight years' experience and involvement in at least two upgrade projects decision-making were recruited.

<Insert Table 3 about here>

<Insert Table 4 about here>

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3.2 QUALITATIVE DATA ANALYSIS

The web-based questionnaire survey was conducted from May – September 2013, and the semi-structured interview was conducted from December 2013 to March 2014. Data analysis for both data collection techniques was guided by the principles of qualitative inductive content analysis (Patton, 2002). The organisation represented the defined unit of analysis and this facilitated exploration of decision processes from an organisational perspective. Data analysis followed three steps. First, *transcribing the interview notes and open-ended questions into a written form* – this facilitated data cross-examination. Additionally, interviewees received the transcription to verify its contents for accuracy, and where necessary, interview summaries were updated. Data collated from both techniques was collaborated to draw commonality and studied to acquire a comprehensive picture to produce summaries of the main concepts.

Second, *descriptive and interpretative codes assigned* - to summarise emergent concepts, descriptive and interpretative codes were assigned to group the codes into segments (refer to Table 6) to give meaning and systematically eliminate repetition. Pattern codes were applied to identify any significant relationships emerging from the segment groups, resulting in high-level analytical content. To augment reliability of the findings, two independent coders performed the systematic coding for data collection instruments. Third, *inductive inference generation* - the final stage involved inductively drawing inferences from the analytical content, to formulate theoretical attributes based on similarity of the meaning and their properties. Table 6 presents the final coding framework.

<Insert Table 6 about here>

3.3 EVALUATION OF THE DERIVED MODEL

The derived model (Figure 4) was evaluated against existing upgrade decision-making models to identify any similarities and uniqueness. One-to-one and face-to-face discussions held with respondents sought to evaluate the research interpretations and assess the proposed model's processes to ascertain relevance and applicability to support ES upgrade decision-making. The session commenced by contextualising the model and various stages within to provide respondents with insights on the parameters used. Feedback and suggestions accrued were analysed to appraise the model's acceptability, significance and applicability.

4. Findings

Twenty-nine out of forty-one respondents argued that the eclectic decision-making process combines personal experiences, previous knowledge and the attainment of relevant information. For example, respondent 14 suggests their decision-making process: "*mostly is based on a combination of empirical evidence and what you call gut feeling and personal experience.*" This prompted organisations to apply changes in a measured way to ensure a successful outcome when upgrading projects. However, for an upgrade to occur, a common consensus between the different stakeholders' interests is required. According to Respondent 21, "*Business continuity was the main driver; however, this was more of a blanket reason to get all stakeholders on board with the upgrade.*" Therefore, reason suggests that many different drivers influence the need to upgrade, a stage known as the exploration stage - where the organisation gathers relevant information about the new version and examines organisational requirements which in-turn triggers the decision-making process.

4.1 UPGRADE DRIVERS

A frequent driver to upgrade was the need to reduce maintenance costs and use standardised functionality or simply keep abreast of vendors' version release cycles to secure continuous support. For example, respondent 20 explains, "once we upgrade it will cost less to maintain and support due to greater use of standardised functionality and less customisation." Over reliance on vendor support and maintenance makes organisations believe that by not upgrading, their systems are at risk of not attaining necessary support in a timely manner. In other situations, government agencies drive the need to upgrade through new legislation(s). As described by Respondent 6: "my team is regularly involved with upgrade projects, for example, we upgrade our HCM system every year, as we have to comply with government legislative changes." These views suggest that upgrading is influenced by different external and internal elements and stakeholders. For example, it is common for organisations to change the way they are operating to meet market demands which can result in the upgrading of systems to support daily operations, along with taking advantage of new features available in the newer versions.

Top management also plays a critical role in supporting or preventing ES upgrades, largely through setting directives that seek to improve company performance or engender competitive advantage. Respondent 26 explained that their organisation is upgrading because of: "the directive from the head office management, which was to integrate all its subsidiaries systems to simplify information sharing and reporting." While top management involvement in upgrade projects are not similar when compared with the initial implementation, any level of commitment ensures that upgrade projects is appropriately supported to reduce the risks of failures. While these drivers are similar to those identified in previous studies, this research suggests that upgrade drivers play an influential role in the upgrade decision-making process. In contrast to (Khoo, 2006; Otieno, 2010; Dempsey et al., 2013), this study propositions that the interaction of drivers defines the need for upgrading, which then triggers other decision processes, suggesting that upgrade decision is an outcome of the drivers and several decision processes.

The study offers three broad categories that encapsulates all factors based on the thematic suggestions by Feldman et al. (2016) and Claybaugh (2010); these are: (i) *technological* represents the existing and new system relevant to the organisation, this includes the technical and functional aspects such as the compatibility, ~~and~~ complexity improvements and ~~the~~ the system's benefits ~~of the systems~~; (ii) *organisational* describes the internal measures such as scope, size, managerial support~~,~~ and availability of resources; and (iii) *environmental* refers to the field in which the organisation operates comprising government legislation and vendors' support.

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4.2 DECISION PROCESSES

The findings indicate it is important to analyse the existing system landscape and the new version ~~is a~~ before reaching ~~upgrade~~a decision to upgrade. Three types of analysis are carried out during upgrade decision-making.

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~~4.1.1~~4.2.1 Technical analysis

Nine out of the twenty-three organisations deliberated upon the stability, reliability and overall benefits of a new version before upgrading to it. As explained by Respondent 22: "*Prior to upgrading, we network with colleagues from other organisations that have recently upgraded their systems, in order to establish the reliability, stability and functionality of the new version.*" A new version may not support modifications implemented in the previous version and can disrupt existing functionality. Technical analysis involves gaining insights of how the new functionalities would affect the current technical landscape that requires understanding the current version licencing and support cycles and identifying any modifications within the system landscape. Respondent 24 states: "*major modifications result in high costs, which include the cost of re-implementing the changes and testing the components and ensuring none of the existing functionality is disturbed.*" This introduces a need to analyse the structure of data dictionary objects and evaluate individual coding areas to confirm that changes preserve existing functionality. Undertaking technical analysis ensures appropriate information amassed supports informed decisions about upgrade costs and effort required. Technical leads supported by database and systems' administrators are responsible for performing the analysis which focuses on obtaining a detailed understanding of the current and new version to establish the degree of change required in the hardware, software and processes. This involves assessing the level of modifications and evaluating the new version's compatibility against the existing systems functionality and modifications to gain a better understanding of effort, cost and duration, which can influence the decision on the upgrade strategy.

~~4.1.2~~4.2.2 Functional analysis

All twenty-three organisations assess the new version, either by exploring the vendors' website or by meeting with vendor's representatives to acquire a high-level understanding of proposed functionality changes. Respondent 17 states: "*we communicate with the vendors, to get details of the introduced changes. This helps us know what to expect and if the vendor will support some of our functionality.*" User requirements for new functionalities influences organisations to assess their operations that help redefine, or add new processes into the existing landscape and eliminate waste in the processes. Despite the new version's documentation being subjective and not effectively highlighting significant changes offered, most organisations consult this documentation to obtain a detailed understanding of how the new version's functionality supports their requirements. Respondent 22 expresses concerns by saying: "*documents from the software vendor are not very valuable because they do not provide objective evaluations of the changes and upgrade value proposition."* At least eighteen out of the twenty-three organisations used consultants to provide detailed assessments and explanations of additional features offered by the new version to supplement vendor information and documentation. The use of consultants and vendor documentation facilitated mapping the new release functionality to the organisation's requirements, which encouraged identifying current and future upgrade value propositions that can influence the decision-making. Functional analysis is an important step that allows the organisation decision makers to make informed decisions by gaining a better understanding of the new version's functionality; thus, allowing prioritising core features for implementation to support the business continuity strategy. A decision matrix can be used to prioritise functionalities against requirements, which in turn supports the upgrade business case, through highlighting the benefits for undertaking an upgrade.

~~4.1.3~~4.2.3 Impact analysis

Understanding how the new version affects existing modifications and functionality is important since it provides the overall depth of the upgrade before project commencement. Respondent 24 explains that: "*Sometimes is not a clear-cut decision, I mean you cannot just go from version A to B. Typically, we will identify what the requirements are, then we will assess the different versions based on the requirements.*" Respondent 21 explains: "*I would not like to upgrade something if I have not considered the impact of an upgrade from multiple perspectives. As there is no point in imposing functionality without looking on how it influences the existing business process."* Volume and sizing tests were techniques mentioned for determining the impact on hardware and supporting technologies (such as database and operating system). However, the impact could also be measured using risk-based testing which allows assessing the upgrade impact on the business rules, processes and functionality. Respondent17 explains: "*most importantly estimating the impact allows incorporating any mitigation and measures to overcome risks as part of the project plan.*" Considering these implications enables a reliable estimation of resources needed to support the upgrade, thus helping to determine whether to pursue a full upgrade or not. Impact analysis enables accounting for resources and costs, and preparing measures to overcome any risks to assure no hidden surprises will cause rolling back the project. The impact analysis feeds into the decisions to determine if it is valuable to pursue the upgrade or not.

~~4.2~~4.3 UPGRADE STRATEGIES

Albeit organisations define upgrades differently, the process involves configuring either the system's technical or functional features. Organisations undertake a technical upgrade to reduce operational costs; this is achieved by attaining continuous vendor support and being within licencing agreements. Respondent 14 reports: '*Technical upgrade keeps the system within the supported product window of the vendors."* The technical upgrade was therefore implemented to leverage latest technology features to the system's underlying core. Functional upgrades are undertaken to offer new processes, improve usability and reduce modifications. Respondent 2 explains that: "*the business users identify functionality, which they would like to adopt, and normally this will result in a functional upgrade*." Respondent 9 explains: "*we upgraded because there are some major changes within the business. Also, some of this is to rationalise the tools used within the business, adding functionality that the new tools offer*." There was some indication that functional upgrades are dependent on the system's technical aspects, for example, the new version requires a consistent, compatible and stable technical platform to support new functionality introduced. If the system cannot support these changes, a technical upgrade is required before undertaking a functional upgrade, thus suggesting both upgrade strategies are necessary to fulfil organisation requirements.

~~4.3~~4.4 DERIVED MODEL EVALUATION WITH RESPONDENTS

Seven out of ten respondents strongly agreed that the model presented intelligible, unambiguous concepts and a flow of processes, and wanted checkpoints implemented for each process to assure objectives are met (Table 7). All respondents suggested that the approach is useful, whilst three suggested it could reduce failures. Four respondents indicated that while nomenclature for processes is different, the proposed approach could support upgrade decision-making. One respondent suggested almost all ES upgrade decision-making is not documented, yet recording decision processes provides organisations with greater visibility and accountability that could reduce failures in upgrade projects. Five respondents suggested that the model could explain the various decision processes to different stakeholders, and four advocated its use for training support staff about upgrade decision-making. One stakeholder suggested that patching is incorporated as an integral part of the upgrade strategy, as some organisations opt to implement relevant patches and bolt-ons to satisfy bespoke requirements, especially when a complete upgrade cannot be justified. Other advice was to offer greater flexibility in the approach to addresses granular level steps required when upgrading specific systems such as ERP or CRM. The respondents' views suggest that the model's systematic approach could support an organisation during the ES upgrade decision-making process.

<Insert Table 7 about here>

5. Discussion

Two main perceptions were observed regarding upgrade decisions. First, the decision can be deduced using common sense and intuition depending on the vendor's support life cycles. Second, the decision depends on attaining relevant information and, assessing the available options and alternatives to support the selection of an appropriate upgrade strategy. These different decision process activities account for the upgrade driver's influence and assessment of technical, functional and the impact of the changes to be introduced. The outcome supports the selection of an appropriate upgrade strategy. By suggesting that reaching a decision to upgrade is dependent upon functionality mapping, measuring the impact and determining the effort required, an antithesis to previous theory is proffered as these authors (Khoo, 2006; Ng and Gable, 2009; Khoo et al., 2011) suggested that these activities would occur post-upgrade decision. As undertaking these processes prior to upgrading allows aligning resources, define achievable objectives, and identify risks and mitigation strategies, which are important competencies and capabilities identified by Teoh (2010) to support implementation and upgrade; thus can facilitate making informed decisions. Based on the findings, the organisation's requirements and goals must be supported by identifying the need to upgrade, understanding the value and establishing the challenges of upgrading. This can be achieved by undertaking technical, functional and impact analyses to establish the 'as-is' and understand the 'to-be' system settings. These activities identified suggest that upgrade decision-making predominantly follows a systematic approach that is interpreted via an Upgrade Decision Support Model (UDSM).

5.1 UPGRADE DECISION SUPPORT MODEL (UDSM)

The upgrade decision-making process consists of two phases (Figure 4); the output emanating from these two phases represents fundamental elements for generating informed decisions by providing relevant information, alternatives and preferences. First, the *exploration phase* focuses on identifying the need to upgrade including understanding business requirements which involve exploring, collaborating and communicating with all stakeholders to comprehend their needs. During this phase, the proposed new version's capabilities must be researched using either external consultants or through vendors' information outlets.

<Insert Figure 4 about here>

Second, the *assessment phase* is concerned with analysing and evaluating the existing and new version to determine deliverables and associated challenges; such knowledge acquired optimises the selection process to fully satisfy an organisation's requirements. The *assessment phase* comprises of four processes whose output outlines the deliverables, effort and resources required to achieve upgrade goals:

1) The *technical analysis* includes a frame of reference to assess the existing version's functionality to ensure this remains undisturbed and fully operational during upgrading, and that the system operates as intended post-upgrading. Regression testing can analyse the type of change that affects functionality. These changes could relate to technical aspects, business rules, codes and data dictionary objects. Test outcomes determine any compatibility issues, which normally arise when existing modifications and functionality do not accomplish their intended purpose due to the introduction of new technological features. Undertaking a technical analysis reaps the full advantage of upgrades and ensures compatibility between new and existing versions. While technical analysis was one of the critical success factors proposed by Beatty and Williams (2006), this study's findings suggest that it should be implemented as an integral part of upgrade decision-making.
2) A f*unctional gap-fit analysis* takes advantage of functionality improvements via comparison of enhancements to existing versions to determine what changes best reflect business needs. The *functional gap-fit analysis* involves understanding the required changes, processes and configurations to assess their effectiveness, and analyse how this would affect its operation within the new version. Several respondents suggested that to perform the gap-fit analysis requires consultation with vendor documentation. However, similar to the work of Zarotsky et al. (2006), this study posits that vendor documentation is not well-suited to optimising enhancements. Ng and Gable (2009) propose an alternative gap-fit analysis that can yield detailed explanation of functional enhancements to derive informed decisions. The functional gap-fit process demonstrates the importance of understanding the new version benefits, functionality and how it maps to the requirements, which is similar to Riis and Schubert's (2012) strategising process.
3) *An impact analysis* assesses how changes implemented disturb existing business processes and identify challenges introduced. Volume and sizing testing can measure the impact; this involves inputting voluminous data into the system to measure the

hardware performance and input/ output capacity of the existing hardware and supporting systems. Risk-based testing affords an alternative technique that gauges system performance and user interaction with the system. Measuring the impact before deciding to upgrade helps define the effort required but also minimises downtime and disruption by identifying and incorporating strategies that help mitigate upgrade challenges.

4) *The strategy selection* ensures that the optimal upgrade strategy is adopted. The need to upgrade and the output from technical analysis, functional gap-fit analysis and impact analysis contribute to identifying the upgrade strategy. Three logical pathways are proposed (Figure 5) to highlight the selection of the strategy based upon interrelationships between the decision processes. First, the unbiased pathway is triggered when the upgrade strategy is not predetermined. The pathway commences by exploring the need to upgrade, conducting a technical analysis, functional gap-fit analysis, impact analysis and select the strategy (denoted by Ax in Figure 5). The output from the technical analysis and functionality gap-fit analysis determines the decision outcome; four possible outcomes are to perform a technical upgrade, functional upgrade, both or defer the upgrade. Second, the technical pathway is triggered when the upgrade strategy is pre-defined as a technical upgrade and technical analysis and impact estimation would be performed (Bx denotes the flow in Figure 5). There are instances where a technical upgrade may disrupt the system's objects, and the impact assessment determines whether these changes are significant to warrant a functional upgrade. If significant, the functional gap-fit analysis process is executed to determine the functionality required to address these changes (illustrated in Figure 5 as B3a and B3b).

<Insert Figure 4 about here>

Even though these occurrences are rare, it demonstrates the importance of undertaking an impact analysis before making the decision to upgrade. Third, the functional pathway is triggered when the upgrade strategy is predefined as a functional upgrade. The sequences of processes in the assessment phase are technical analysis, functional gap-fit analysis and impact analysis (denoted by Cx in Figure 5). Undertaking these processes ensures that the system architecture and infrastructure are technically capable of accommodating functional changes - it also determines the impact that will be introduced by the new version's features and functionality to the existing system landscape. In both the second and third pathways, three upgrade decision outcomes are possible, namely to: i) continue with the preliminary upgrade selection; ii) expand the upgrade scopes to include both upgrades; or iii) postpone the upgrade.

6. CONCLUSION

The ES upgrade decision-making processes include establishing the need to upgrade, understanding the new version features and functionality, undertaking a technical assessment of the existing system, and assessing the impact of these changes to the organisation and current system. These different activities and their interrelationships enabled a novel Upgrade Decision Support Model (UDSM) to be developed. While no claim is made that the formulation of the processes and practices presented as part of UDSM is exhaustive, these processes play a major role in establishing timelines, allocating resources and planning for contingency to any anticipated issues. Despite sample size, the research acquired an in-depth understanding of upgrade decision-making processes and their interrelationships.

This study is significant for several reasons. First, from a theoretical standpoint, the UDSM not only extends existing upgrade decision models but also: provides a systematic approach that evaluates the new version's functionality, technical requirements and the upgrade implications as integral processes of ES upgrade decision-making; suggests that driver interactions assist to define the need to upgrade instead of the upgrade decision as proposed in earlier studies; and postulates that upgrade decisions should potentially take account of stakeholders' perspectives to offer a detailed understanding of the upgrade implications and benefits. By doing so, organisations can comprehend when and why there is a need to upgrade their systems, which also allows justifying the upgrade and realising the benefits to support long-term organisational goals, such as lowering operational costs. The study focused on enterprise systems; however, the UDSM with minor context specific adjustments could offer more granular level decision-making in various technological upgrade situations. Second, from the organisational viewpoint, the USDM can: streamline decision-making by providing a formalised strategy for reaching the decision to upgrade, which could provide greater visibility and accountability. Additionally, it contextualises the various processes that must be followed during upgrade decision-making to the different stakeholders and support staff. While these processes proposed are considered common practices, surprisingly often organisations ignore this structured approach during upgrade decision-making. The study highlights that decision makers can make informed decisions regarding upgrades by adopting the proposed decision processes as it facilitates assessing the feasibility of the upgrade, along with planning appropriate strategies and contingencies to support a structured upgrade processes. Additionally, some proposed steps in UDSM encourage organisations to learn from previous experiences which ensure the upgrade project yields the desired outcomes.

The authors acknowledge that the upgrade approach and costs between different systems such as ERP and CRM even from the same vendor may vary. However, the proposed model provides a generic decision-making processes that can be used when upgrading any system within the landscape. This is important as most vendor-specific strategies, methodologies and best practices to manage and support upgrades are aligned to a specific

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Formatted: Font: Not Italic, No underline, Underline color: Auto product (system), while organisations have various systems from multiple vendors. Adopting such a comprehensive approach could potentially provide information to assist in making an informed decision about ES upgrades to reduce risks associated with lack of objectives and improve operational excellence.

Because the study was designed using qualitative survey logic, future research work is needed to expand and extend these findings to a wider-range of ES upgrade phenomenon. For example, the proposed model could be extended to assist decision makers to select an optimal upgrade strategy. The respondents' experience and views are pertinent to large organisations they represent, hence, the proposed UDSM is based upon this context. Therefore, other methodological approaches could be utilised to offer a broader understanding and provide a probabilistic generalisation of the decision-making processes. Upgrade projects are a continuous process, so the decision process may evolve over time. A longitudinal study should therefore be undertaken to establish any similar or conflicting arguments and produce generalizable outcomes. Alternatively, studies could apply change management concepts to explore the full upgrade cycle to provide a detailed understanding of the dynamic nature of ES upgrade and its interactions, from people, process and technology aspects.

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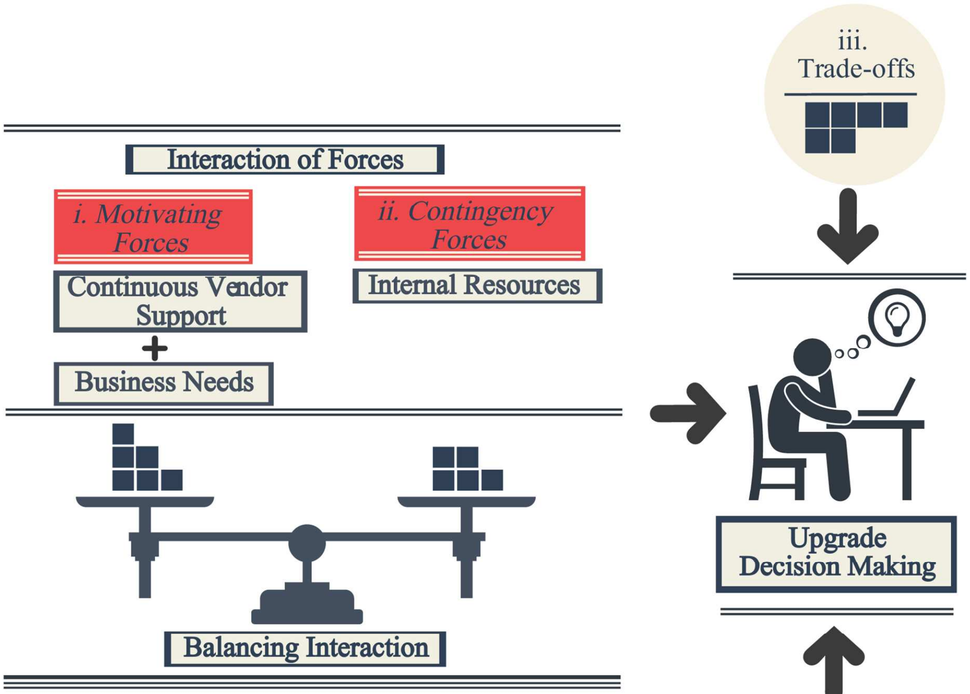
Table 1 - Summary of upgrade decision models

Studies	Context	Description
Ng (2001)	Decision-making framework for maintenance and upgrade	The framework proposed guidelines for managers to justify costs and benefits of decision alternatives and provides a reference for reducing maintenance costs, improving maintenance activities and controlling upgrade frequencies.
Mukherji et al. (2006)	A decision support model for optimal timing of investments in information technology upgrades	The model proposes a decision model to optimise the timing of upgrades. The model takes into consideration the different costs involved in upgrading information systems. Based on the model, it is stipulated that the best time to investment on upgrades is when "the gap between new technology and current technology reaches a critical threshold"; and this is mostly normally technology cost, change management cost and opportunity cost. However, it is acknowledged that other factors influence the timing of upgrades in addition to costs.
Seibel et al. (2006)	A statistical upgrade decision support model	The model incorporates four decision attributes, namely: business goals, licence cost, current product retirement status and external factors. The interaction of these attributes forms the basis of a decision to upgrade or not to upgrade with an expectation efficacy of 76.6%.
Khoo (2006); Khoo and Robey (2007); Khoo et al. (2011)	Packaged software upgrade decision model	The model reflects on how different organisational needs and market demands influences upgrade decisions and account for the risks and mitigation strategies. This approach avoids stressing rational upgrade decisions.
Vaidyanathan and Sabbaghi (2007)	Customer decision framework for integration and upgrading of SCM software systems	A decision framework is proposed to support managers who are considering upgrading their SCM. Eight key elements are proposed: i) software quality; ii) cost of SCM integration and upgrading; iii) product certainty; iv) product stability; v) internal business perspectives; vi) customer services; vii) new hardware requirement; and viii) customization. These factors reflect the organisation needs, albeit each factor will influence the decision differently.
Ngwenyama et al. (2007); Morgan and Ngwenyama (2015)	An integrative model for enterprise software upgrade decision analysis	The model offers a systematic evaluation of the upgrade decision, focusing timing of upgrade decision. As such, it integrates real options and learning costs to provide insights to upgrade timing decision. However, the model focuses on costs and does not outline the decision processes.
Teoh et al. (2008); Teoh (2010)	Competency and Capability Development Model	A competency and capability development model is proposed that focuses on the formation of competencies and capabilities to support Small to Medium Enterprises (SME) during ES implementation and upgradation. While the model does not outline the decision processes, it suggests some of the core capabilities such as aligning organisational strategies to resources, envisaging opportunities, identifying identify and managing risks and assessing resources that can be used to support upgrade decision-making process.
Otieno (2010)	ERP upgrade decision model	The model highlights the interactions of different forces that either motivate or constrain the decision to upgrade. This model provides insights as to why and when organisations upgrade their systems, thus providing practical strategies and recommendations to support practitioners during upgrade projects.
Ng (2011)	A conceptual upgrade decision model	The model draws from symbolic interactionism, institutional theory and incentive theory to identify how intrinsic and extrinsic factors influence the decision to upgrade. Indicating that an organisation would only decide to upgrade if they perceive the new versions would provide palpable benefits.

Figure 1 - Representation of existing upgrades decision models



i. Motivating forces positively influence upgrade decisions, for example business needs.
ii. Contingency forces constrain upgrade decisions, for example internal resources.
iii. Trade-off concerned with essential versus nice to have features and functionality.
vi. Risks these are potential upgrade challenges.

Table 2 - Drivers that influence upgrade decisions adapted from (Feldman et al., 2016)

Context	Description	Drivers
Technological	Upgrades support organisations to reduce the effort required for, and costs of maintaining multiple versions of the system through standardising and improving functionality (Vaidyanathan and Sabbaghi, 2007). Upgrading also allows leveraging the latest technology features to gain better scalability (Seibel et al., 2006; Khoo and Robey, 2007), and support integration and merging with other systems (Olson and Zhao, 2007). The new version streamlines processes to improve the system's usability (Claybaugh, 2010; Claybaugh et al., 2017).	- Improve usability. - Adapt new functionality. - Attain better scalability. - Leverage the latest technology. - Standardise functionality. - Merge systems across the organisation.
Organisational	Upgrading provides an opportunity to evaluate, consolidate and restructure existing business operations to ensure continuous improvement (Ng, 2006). The new version improves performance by automating the processes or aligning business strategies with new functionality (Otieno, 2010). Upgrading costs is a critical consideration when contemplating an upgrade. For example, high initial costs due to testing and reapplication of modifications could sway organisations not to upgrade. However, the potential of reducing the overall operational and maintenance costs such as licensing fees can positively influence upgrade decisions (Ng, 2006). While top management involvement is minimal during upgrade projects, their participation plays a significant role in supporting upgrade decisions and the selection of upgrade options (Olson and Zhao, 2007).	- Top management involvement. - Continuous improvement. - Automate existing business processes. - Restructure and consolidate business processes. - Reduce maintenance and operational costs.
Environmental	These factors are initiated by external stakeholders, such as vendors, partners, consultants and legal entities (Khoo, 2006). For example, vendors use high support pricing schemes for older versions and sometimes remove support for these, as a strategy to encourage organisations to upgrade (Kremers and van Dissel, 2000). The threat of losing support or not paying a high premium for support are primary reasons why some organisations upgrade their ES (Ng, 2006). Another key factor is compliance with legislation, standards, mode of operating, especially in highly regulated environments such as the banking industry (Khoo and Robey, 2007; Ng and Wang, 2014).	- Attain continuous vendor support. - Comply with legislation and national standards. - Acceptable structure and mode of operating.

Figure 2 - An abstract of ES upgrade decision-making processes

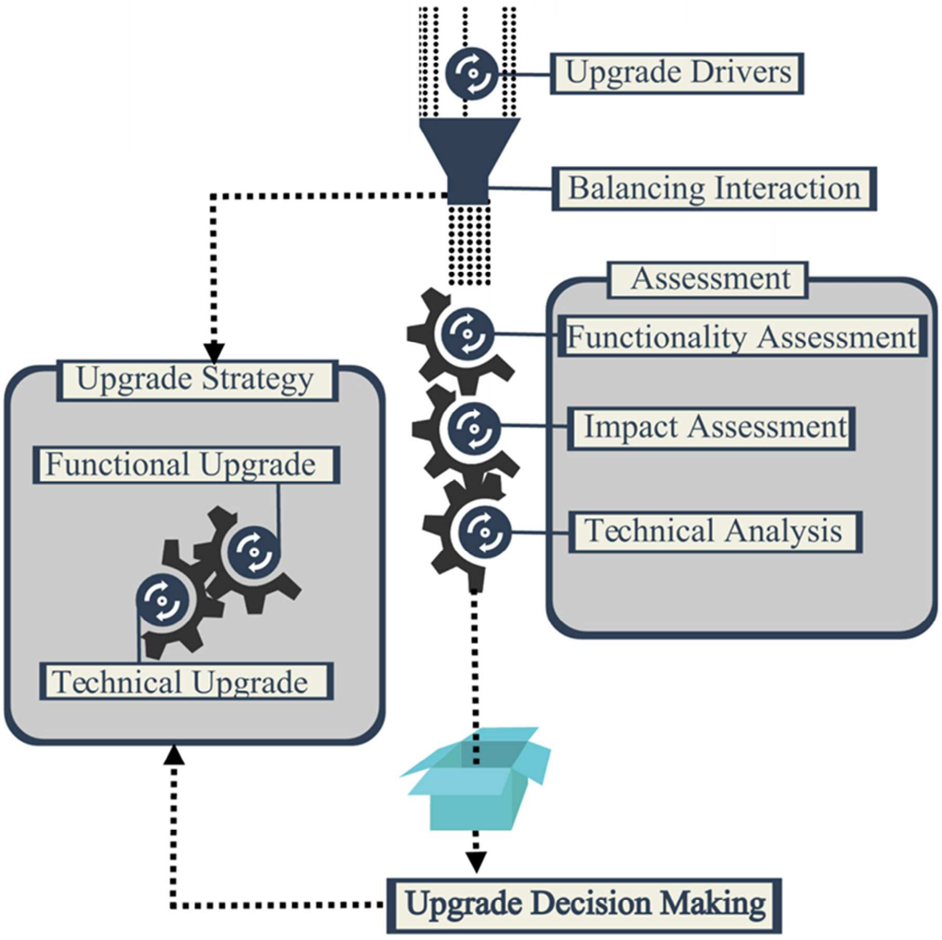


Figure 3 - The study design based on a qualitative survey logic

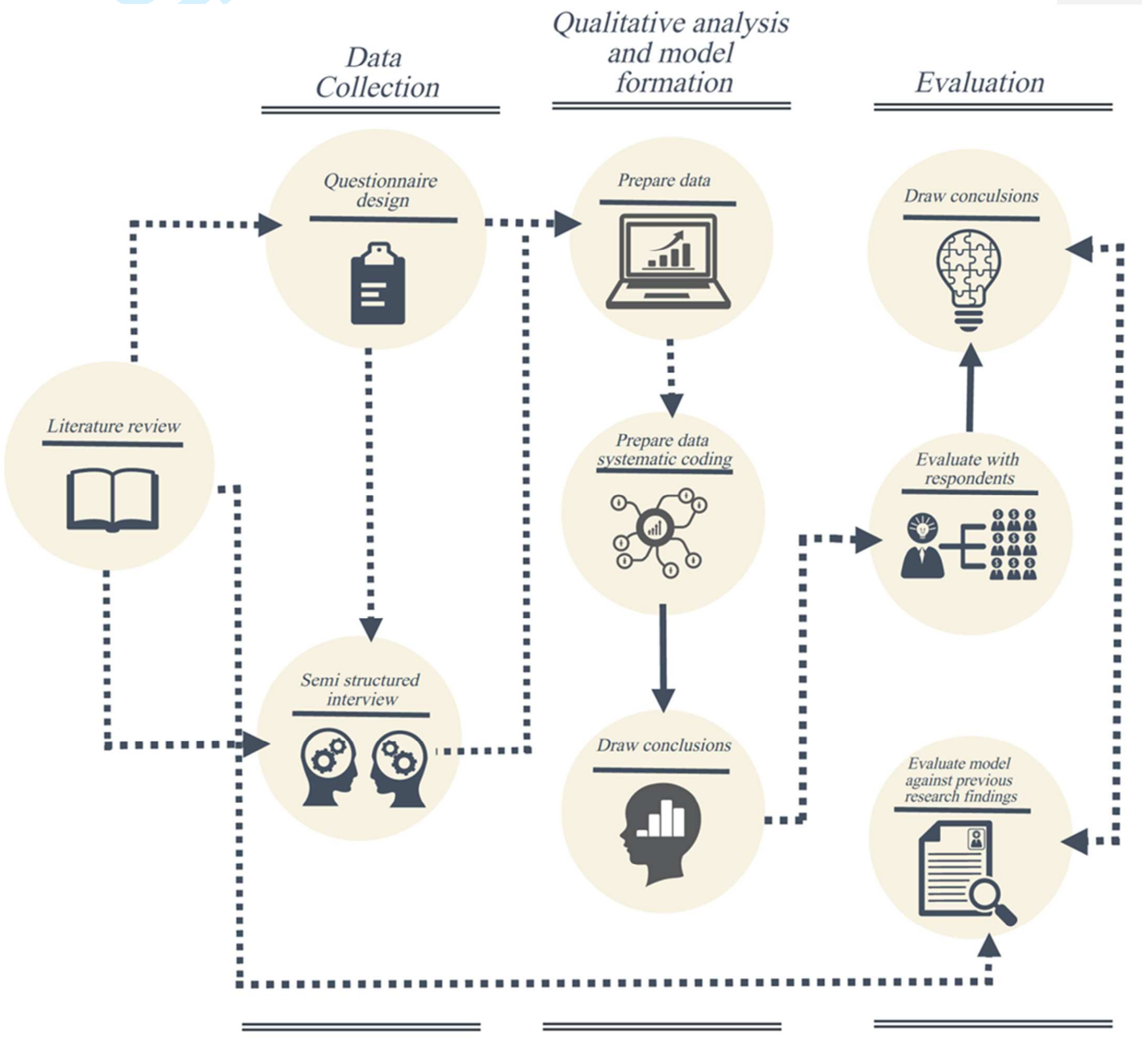


Table 3 - Respondents' current roles in their respective organisations

Role	Count
Solution Architect	7
Project Manager	10
Systems Analyst	4
Functional Lead	9
Technical Lead	7
Database Administrator	4
Systems Administrator	2
Chief Financial Controller	1
Database Administrator	1
Information Systems Manager	1

Table 4 - Respondents' experience in years

Experience	**Count**
< 1 year	0
≥1 ≤ 2 years	1
≥2 ≤ 4 years	5
≥4 ≤ 6 years	4
≥6 ≤ 8 years	14
> 8 years	17

Table 5 - List of implemented and upgraded systems in the organisations involved in this study

Enterprise Systems	Count
Enterprise Resource Planning (ERP)	16
Customer Relationship Management (CRM)	6
Supplier Relationship Management (SRM)	5
Supplier Chain Management (SCM)	4
Business Intelligence (BI) systems	9
Human Resources Management (HRM)	10
Integrated Service Management	2

Table 6 - An example of the final coding framework after reduction of the segments groupings

Categories	Patterns	Segments	Initial coding framework	Count
Upgrade drivers	Technological		*- Integration of different systems*	25
			- Reduce maintenance costs	32
			- Improve usability	18
			- New features	26
	Organisational	Upgrade costs	*- Reduce operational costs*	27
			- Licensing fees	24
			- Infrastructure costs	14
		Business continuity	*- Support users requirements*	24
			- Continuous improvement	29
			- Standardise functionality	26
		Management strategic direction	*- Automate business processes*	18
			- Consolidate business processes	23
			- Consistent system architecture	16
	Environmental	Vendor dependency	*- Attain continuous vendor support*	36
			- Leverage the latest technology	20
		Compliance	*- Comply with legislative guidelines*	32
			- Implement national standards	14
			- Structure and mode of operating	14
		Consultants' influence	*- Knowledge and experience*	19
			- Trust and relationships	19
Decision processes	Exploration		*- Communicate with stakeholders*	33
			- Identify the need to upgrade	25
			- Evaluate the benefits and improvements	15
			- Gain an understanding of new version	30
	Assessment	Technical analysis	*- Review the current landscape*	27
			- Evaluate technical components	20
			- Examine custom and standard codes	16
			- Assess the data dictionary objects	16
		Functional analysis	*- Assess the current system version*	26
			- Explore business processes	18
			- Appraise new version's functionality	33
			- Requirements mapping	28
		Impact analysis	*- Measure the impact of proposed changes*	23
			- Evaluate the effort and resources	19
			- Identify system break points	13
Upgrade strategies			*- Technical*	28
			- Functional	32
			- Both	20

Table 7 - An example of the responses from the evaluation of the findings

Questions	Responses	Count
The proposed concepts and flow of events make sense.	- *Strongly Agree*	7
	- *Agree*	3
	- *Neither*	0
	- *Disagree*	0
	- *Strongly Disagree*	0
How do the phases and decision processes reflect ES upgrade decision-making occurring in your organisation?	- *The model captures most the decision processes*	9
	- *Sometimes the upgrade strategy is predefined*	3
	- *Provides more visibility and accountability*	1
Do you think the approach will be useful in supporting upgrade decision-making process?	- *Offers strategies that can help to reduce failures*	3
	- *Can be used for training*	4
	- *A good visual guide to explain ES upgrades to stakeholders*	5
How can the approach be improved?	- *Checkpoints should be implemented for each process*	3
	- *More granular level steps required*	4
	- *Patching and bolt-on should be one of the possible upgrade strategies*	3

Figure 4: ES upgrade decision support model - highlighting the decision phases and processes

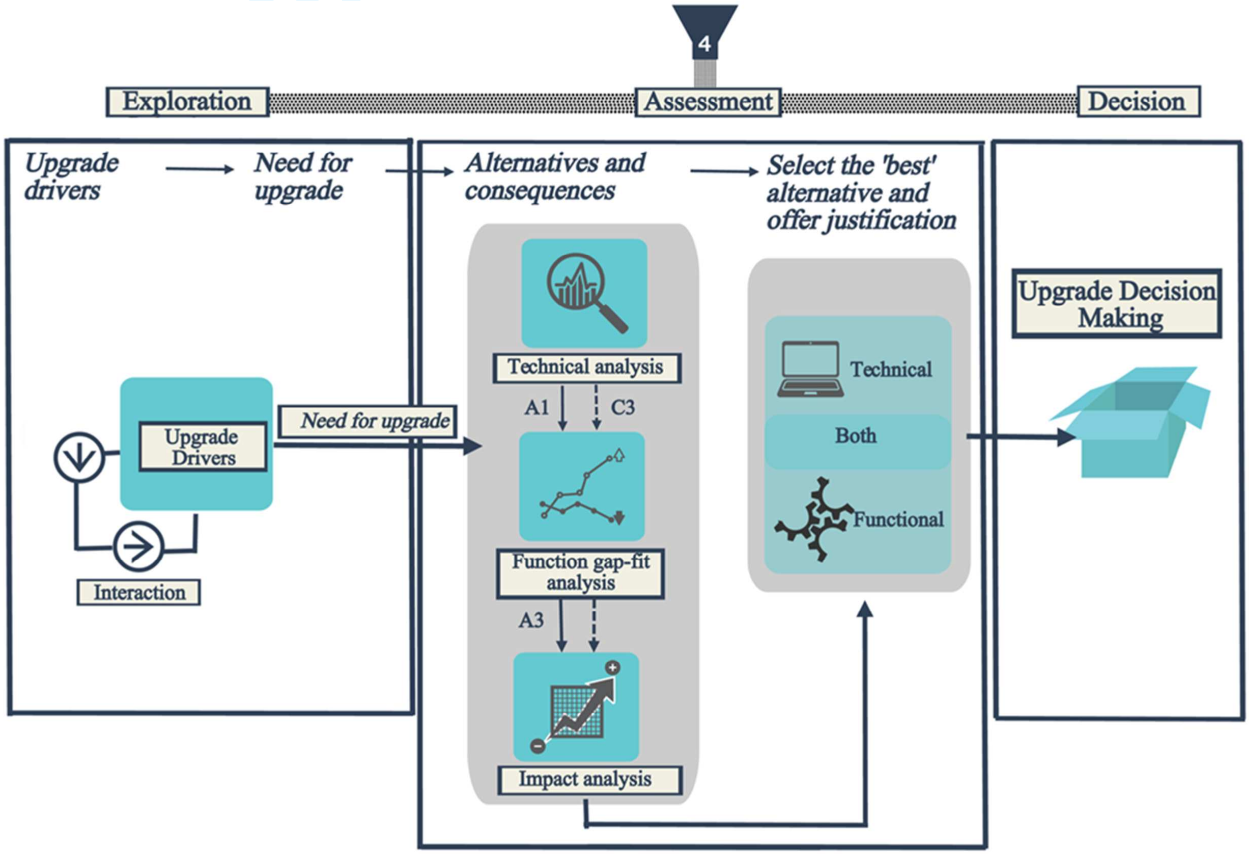
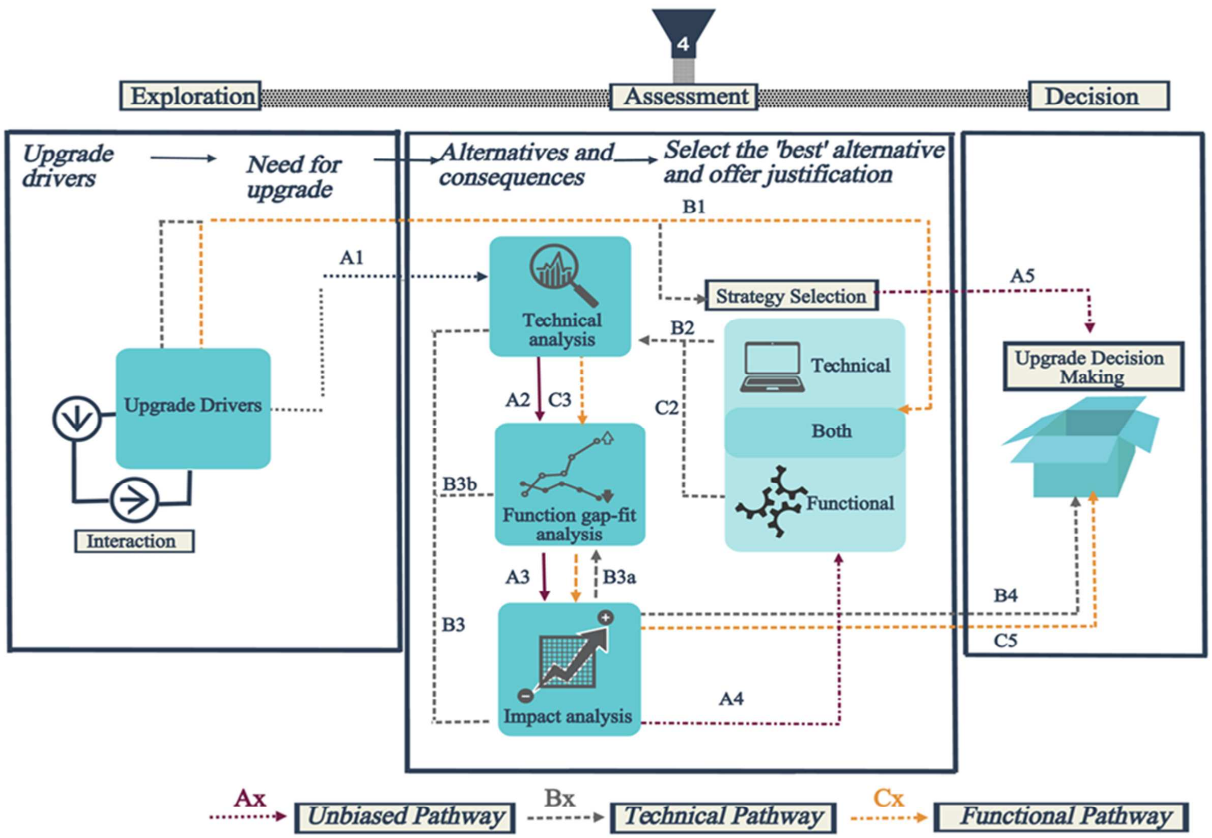


Figure 5: Highlighting the decision process pathways



Ms. Ref. No.: JEDT-08-2017-0076
Title: A Systematic Approach for Enterprise Systems Upgrade Decision-Making: Outlining the Decision Processes

REVIEWERS' COMMENTS AND AUTHORS' RESPONSE

The authors wish to extend thanks to the referees for their constructive comments and suggestions. While the paper reads much improved because of addressing this positive feedback paper, the size of paper has increased significantly to reflect the consideration of these valued and constructive suggestions.

Each individual comment has either been addressed or defended as appropriate (refer below) and a final file resubmitted for your consideration. Once again, thank you.

No.	Reviewer	Authors' Response
	Referee No.1	
1	Thank you for your positive feedback. We do appreciate the time you have given to help us improve the quality of the paper.	
2	Check the first reference and correct appropriately	Thank you. The reference has be corrected. The authors and paper details for this reference (Author et al., 2016) was removed intentionally to preserve anonymity during reviews.
3	The diagrams are not clear, it is better to redraw them	Thank you. We agree with your observation and have re-drawn or improved on the quality of the illustrations to offer better clarity and readability.
4	Ng papers were over cited, hope it is not a self-citation.	We agree that Ng is heavily cited due to extensive work in this area and relevancy to the study presented in this paper. However, this is not a self-citation.
5	There is a need for better explanation of the findings and inclusion of implications	We acknowledge the merit and value of this suggestion. We built on the explanation and revised the narrative in sections 4.1, 4.2.1,4.2.2 and 4.2.3 to offer better explanations of the implications of the findings
6	There is a need for improvement of the paper in respect to the implications	Thank you. We agree with you suggestions, we revised some of the explanations in the conclusion to highlight the implications.
	Referee No.2	
7	We are delighted to read your constructive comments and suggestions. Thank you.	
8	As suggested, the explanatory base related to the survey/interviews should be strengthened.	Thank you for these constructive comments and suggestions. We have extended sections 3.1.1 and 3.1.2 providing insights to the main themes for the semi-structured interview guide and questionnaire.
9	An explanation of skipping some of the driver perspectives should be provided	We acknowledge the value of this suggestion. However, all the perspectives were considered as part of the categorisation. We have extended section 4.1 (UPGRADE DRIVERS) to clarify the reasons for offering this broad categorisation that encapsulates all the perspectives.

10	I have been missing which questions were asked to understand the results presented in the paper in the overall context. It is recommended to provide the reader with some insight hereon. Table 7 gives a flavour but not more.	Thank you for your constructive feedback. As described in our response no 8, we have provided a summary of the core concepts behind the questionnaire and semi-structured interview guide.
11	The discussion of the interview/survey results comes rather short giving the impression that it has only scratched the surface with simple and common-sense questions (see table 7). I assume that this was not the case. If so, it should be elaborated in more detail as the assessment of the practitioner provides eventually the case for the model.	We concur with your observation and as described in response no 5.
12	The design of the figures could be reviewed for the font style, as its size might be critical for print. Otherwise, the visualisation is well done.	Thank you. We agree with your observation and have re-drawn or improved on the quality of the illustrations to offer better clarity and readability.
	Referee No.3	
13	Thank you for your positive feedback. We appreciate your comments and suggestions offered.	
14	The author should justify the use of five point Likert in page 8, line 14.	Thank you for the suggestion. We have subsequently revised the sentence to read as follows, "Closed-ended questions used a five-point Likert item or boolean coding of the upgrade drivers to establish the soundness of previous upgrade decision factors. Multiple options answers were used for other questions like the type of upgrade strategy selection."
15	Sample of Questionnaire and the Interview guides should be attached as an appendix.	We acknowledge the merit and value of this suggestion. However, providing a sample of the questionnaire and interview guides would increase the length of the paper significantly. However, as described in our response no 8, we revised the sections 3.1.1 and 3.1.2 to offer more details to the questionnaire and semi-structured interview guide.
16	There is no clearly stated implication for the research.	We acknowledge the merit and value of this suggestion and have made amendments as described in response no 6.