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Explaining the Network of Factors that Influence the Timing of and Decision to Upgrade Enterprise Systems

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Abstract. The Enterprise System (ES) forms the core of e-Business, providing support for operations, and analytical information for real-time decision-making. A well-functioning ES can enable organizational success and thereby create economic and social value. Once installed, upgrading an ES is important for improving performance, automating business processes, and reducing maintenance efforts. But ES upgrades also cause business disruption and downtime. As a result, many organisations cannot gauge when to upgrade ES. This paper explains the network of factors that influence the timing of and decision to upgrade ES and answers, why and when do organisations decide to upgrade their ES? Literature on upgrades, although scarce, presents opposing views on the timing of upgrades. Moreover, studies investigating this also appear to be dominated by studies from high-income countries where these systems are developed. Other countries potentially face different challenges. Hence, this phenomenon was investigated in South Africa, a middle-income country, through three qualitative case studies. The findings suggest that upgrade decisions are tightly controlled by executive committee approval and are aligned to the organisation's strategy. In addition, the business calendar and risk management play a vital role in the timing of and decision to upgrade ES. The paper presents an explanatory model of how factors impact one another. The model should be useful to organisations wanting to upgrade their ES and extends the current ES upgrade literature.

Keywords: Enterprise Systems, Enterprise Resource Planning, ES upgrades

1 Introduction

The backbone of Information Technology (IT) infrastructure, an Enterprise System (ES) is 'a customizable application suite that includes integrated business solutions for the major business processes and administrative functions of an enterprise. The value from ES is broad, providing real-time decision-making and organizational, human and social benefits [1, 2]. Enterprise Resource Planning (ERP) systems are the central component of this suite [3]. Value from ES is only realised post-implementation [4], when a core activity enabling value, is to extend and improve the system by upgrading [5]. An ES upgrade enables leveraging of new functionality which can improve performance, automate business processes and reduce maintenance efforts [4]. However, despite these benefits, deciding when to upgrade is a problem organisations face [6].

The timing of upgrades has been found to be driven by vendor's influence as opposed to the organisation's strategic objectives [6]. In other cases, the timing is influenced by customer need, economics and version availability [4]. The industry perspective [7] highlights that 'CIOs who take a business-strategy-first approach to ERP will deliver 60% increased business value over those who take a vendor-first approach'. As there is limited and contradictory research on upgrades [4], this study responded to the call for further understanding of the ES upgrade phenomenon. This study focused on answering the following question: 'Why and when do organisations decide to upgrade their Enterprise Systems?' To answer the question, this paper first reviews the relevant literature on ES upgrades. The research approach is then described. Subsequently, the factors which were found to influence the timing of and decision to upgrade ES are described and discussed, and an explanatory model is presented before the paper concludes.

2 Literature Review

An ES delivers many benefits. These benefits include improvement in productivity and profitability, internal integration, improved information and processes, improved customer service [8], as well as quality of work life [1]. Real-time fact based decision making is enabled by analytical information stored in the ES [8]. An ES can elevate the synergy between departments, create better competitiveness and produce more effective and efficient processes, which is critical in a global economy [9]. Organisations have become reliant on integrated ES for timely service delivery, improving operations and managing supply chains across the globe [6]. A stable ES also supports good quality information [9]. Analytics increases ERP value, impacting improved internal operations and downstream sales [2].

Business and IT alignment delivers great value to organisations. To leverage this value ES capabilities need to align with organisations' strategic objectives [10]. These changes occur post-implementation and are considered an extension of an ES implementation [11]. One of the post-implementation phases is an upgrade [11]. Upgrades are essential for continuous enhancement and system stability [4]. An upgrade is a major change process [12] which adds functional improvements and enables new IT usage and business strategies. When migrating from one version of an innovation to another, a question of timing afflicts each organisation [13]. Hence it is argued that it is not a question about whether to upgrade but rather about when to upgrade [11]. Authors cite business disruption as one of the key reasons for not upgrading sooner [11]. Yet, Barth and Koch [12] note that the objective of an upgrade is to restrict business disruption. Industry analysts [7] recommend that when adopting an ES, whether an upgrade or implementation, organisations needed to answer the following four questions: (1) What do we do? ES is not what you do. It is there however to add value. (2) Why now? Is it due to the market? If so, this is not a good enough reason to disrupt the business. (3) Are we ready? Upgrades are there to offer business value and often businesses may not be receptive to a new way of doing things therefore these innovations deliver poor value. (4) Can we delay?

Yet vendors are stated to exert pressure on organisations to upgrade despite no business requirement [6]. In a prior study [11] an Irish organisation waited twelve years before upgrading despite vendor de-support. In a more recent study [4], Irish and UK organisations were noted to upgrade to the latest version despite any improvements. This decision was taken due to vendor dependence and fear of vendor de-support. Based on these conflicting findings the decision of when to upgrade is complex. In order to maximise upgrade benefits, a comprehensive approach to decision-making is needed [14]. The decision to utilise an innovation is known as adoption [15]. There are adoption theories which we reviewed. The T-O-E model has been used to identify factors that influence the adoption of ES upgrades [16]. T-O-E focuses on technology, organisation, and environment. The Frambach et al. [15] organisational innovation adoption framework includes these categories and includes social network and supplier factors. Hence the five categories: organisational, technological, environmental, supplier and social network, were chosen to be used in this study. A summary of extant research on upgrade adoption is classified according to these five categories in Table 1.

Table 1. Factors influencing the decision to upgrade ES.

Categories	Factors	Source:	[13]	[11]	[4]	[15]	[6]
Supplier	Communication		X				
	Vendor influence		X	X	X		
Social network	Network participation						X
	Social Influence						X
Environmental	Competitive pressures		X	X	X		
	Regulatory requirements					X	
Technological	Relative advantage		X	X	X		
	Costs		X	X	X		X
	Version similarity		X				
	Compatibility				X	X	
	Complexity						
	Customisation				X		
Organisational	Org. innovativeness /strategic posture		X				
	Org. strategic objectives				X	X	
	Resource competence		X	X			

3 Research Methodology

The intent of this research was to study the ES upgrade phenomena and understand and explain why and when organisations decide to upgrade their ES. We adopted an interpretive philosophy as we acknowledged respondents playing an active role and rather than looking at them, we looked with them, while seeking understanding by using dialog [17]. By selecting an inductive approach, we were able to collect data and develop a theory based on the results of data analysis. Table 1, derived from the literature, was used as an investigative lens to scope the analysis. We chose three South African ES upgrades as case studies. The upgrades were within a retail, healthcare, and financial services organisation, which we will refer to as E1, E2 and E3 respectively.

Prior to collecting data, ethics approval from the University’s ethics committee and organisational permission were secured. Primary data was obtained through interviews. Walsham [18] states that interviews are key to accessing the interpretations of informants in the field. The seven semi structured interviews were each approximately forty-five minutes long. The interview protocol developed asked open ended questions mainly based on the five literature categories. We approached participants from middle and executive management and took on heterogeneous purposive sampling to gain diverse perspectives [19]. Data was collected during 2020. Due to the COVID-19 pandemic, the countrywide lockdown and social distancing requirements, Microsoft Teams and Zoom were utilised for interviews. The respondents and case organisations are listed in Table 2. Secondary data comprised two documents. When citing responses, we use the respondent or document code, followed by the case, for example R1_E1.

Table 2. Case Organisations and Data Sources

Case	Em- ployees	Industry	Docu- ments	Inter- views	Position	Years ex- perience
E1	10000+	Retail	D1,	R1	IT Director	30-35
			D2	R2	Senior IT Manager	30-35
				R4	Systems Manager	15-20
E2	350-499	Healthcare		R3	Chief Information Officer	25-30
E3	3500+	Financial Services		R5	Project / Change Manager	25-30
				R6	Digital Manager	15-20
				R7	Development Manager	10-15

The process first followed the data preparation phase as follows: Interviews were digitally recorded using MS Teams and Zoom and were imported into Otter Notes for transcription. Transcripts were then exported to MS Word and edited by removing repeating words and sensitive data. Transcripts were also edited while listening to audios to ensure accuracy. Thematic analysis [20] using NVivo software was then utilised for data analysis and reporting of interviews and project documents. To ensure trustworthiness of data analysis one should consider credibility, transferability, dependability and confirmability [21]. Some strategies to improve these were adopted such as purposive sampling, maintaining version control in analysis and triangulation of multiple data types.

4 Case Descriptions

Feldman et al. [4] found that half the organisations in their study upgraded whenever a new version became available and half did not. In this study all the organisations preferred to be a version or two behind. As a large organisation, E1 used several ESs, and did not upgrade as soon as a new version is released. Accordingly, it took the organisation more than twenty years before upgrading their Retail Merchandising System (RMS). It took championing for five years, before the Executive Committee (Exco) approved the upgrade. E1 owned the RMS source code and built enough skills in-house

to be self-sufficient, thus, not relying on vendor support. In 2020, they upgraded their RMS. E2 has a small IT department with six permanent staff and their model relies on outsourced IT functions for ERP implementations, hosting, upgrades as well as support. Their ERP system was on premise with Platform as a Service (PaaS). E2 was considering and investigating the options of migrating to the cloud version. Even though it was learnt, after the interviews, that this may be a migration rather than an upgrade, how they made the decision was still deemed useful and relevant to this study. E3 is part of a larger group, referred to as HoldCo, where HoldCo is the major shareholder of E3. Their ES portfolio comprises ERP Financials, CRM, Policy Administration, Claims and ad-hoc solutions that add to the Policy Administration system. When it came to upgrading their ES, the company was leading (not bleeding) edge and looked at individual applications and trying to keep them as current as is feasible and safe.

5 Findings and Discussion

In this section we answer the three questions posed. We identified twenty themes that influence the timing of and decision to upgrade ES within the cases studied. Eight of these themes were not found in the literature. An explanatory model was generated and we describe timings chosen by organisations.

5.1 What Factors Influence the Timing of and Decision to Upgrade ES?

While South Africa is a middle-income country [22], we could not determine whether the differences between literature findings and our findings were due to the middle-income context. The themes identified are categorised under organisational, technological, environmental, supplier and social network and are now discussed.

Organisational. Organisational factors were considered the most important. Five organisational themes emerged.

Exco Approval. Exco Approval is common across organisations. Although literature highlights the importance of management support in upgrade decisions [4], in this study it was found that no ES decision can be made without the Exco Approval. R3_E2 referred to the need of the IT Department to present business cases or motivations to the Exco, and only if these were successful could the upgrade decision be made. As mentioned by R6_E3, the Exco controlled the finances for updating any technology.

Risk Management. Once finances are secured, organisations don't necessarily adopt the latest version as and when it is released but rather opt to be a version or two behind. R3_E2 and R5_E3 referenced not wanting to be first to market or on the latest version. This ensured stability and as a way of learning from the experiences of others who have already adopted these versions. In addition to adopting leading edge over bleeding edge, at least one participant in each case mentioned their respective organisations aversion of risk. Therefore, should the current system version become dated, the organisation

will only upgrade their ES if there are stable versions available. This impacts the relative advantage that could be derived. Although, Feldman et al. [4] referred to this in literature as a management strategy, in this study the respondents referred to management avoiding the disruption that comes with employing new unstable versions.

Business Requirement and Buy-in. As a business initiative, upgrades require support and buy-in from the business. As noted by R2_E1, *'IT decisions are ultimately business's decisions'*, therefore an upgrade will require collaboration between business and IT. In certain scenarios, R6_E3 mentioned that the requirement for an upgrade would come from business and that way business buy-in and support would exist. While this theme on its own would not influence whether to upgrade, it will influence the timing of an ES upgrade. Participants and secondary data confirmed that the business would drive the timing of an ES upgrade in terms of the business calendar. R4_E1 noted: *'I think our business decides when the upgrade will happen. And the timing of that upgrade and the project...it is very much based around the business calendar.'*

Organisation Strategic Objectives. Organisations noted that they upgrade their ES to support their strategic objectives, whether it be improving customer experience or employing the best systems: *'depending where the organisation is going, are they planning acquisitions...for which there are limitations in your existing applications? Are they branching into new lines of...products of any kind new services, you need to make sure that your application will be able to support the business needs going forward'* [R1_E1]. Additionally, when an organisation plans to introduce these strategies will influence the timing of the ES upgrade: *'Again, it would be based on when do we plan to introduce certain strategical...imperatives that would drive the timing of when you choose to upgrade'* [R1_E1]. This contradicts literature that found that the timing of ES upgrades is not driven by the organisation's strategic objectives [6]. When advocating for a new upgrade, literature notes that it would be more favourable if the IT function is perceived to be more strategic [13].

Resource Competence. One participant mentioned that from an ES upgrade decision perspective, the organisation will consider the complexity from a resource perspective and whether additional resources or different skills are required to maintain it: *'we would look at our complexity from an upgrade perspective... does that require... the rescaling of your organisation, of your people that would support the new technologies'* [R1_E1]. Participants also mentioned that resource competence could influence the timing of an ES upgrade due to availability: *'The last upgrade that we did now... we contracted resources locally and in India, to assist with upgrades. And if those skills are not available, you cannot do the upgrades as simple as that... So, the availability of skills does have some influence on the scheduling of the upgrade.'* [R5_E3]. The availability of the right skills to influence an ES upgrade is consistent with literature that notes that resources possessing the right technical expertise, provides organisations with greater confidence in committing to an ES upgrade [13].

Technological. There were eight technological themes which emerged.

Cost. Research [11] notes that the cost of an upgrade has a major influence on an ES upgrade timing. Our analysis also suggests that a lack of funds can cause a delay in the ES upgrade and relying on extended support agreements is an alternative if possible. Researchers only mentioned the availability of funds related to adopting the new version. We noted that the cost to upgrade or not to upgrade can equally influence the decision to upgrade. ES respondents mentioned the cost to maintain customisations on current versions: *'as soon as it is starting to cost you more to keep the old dog running then to move forward with the new and improved...that is a real factor.'* [R4_E1]

Compatibility. The reliance of one system version upon another as well as maintaining compatibility within the architecture stack was found to influence the decision to upgrade an ES: *'we went on a project this year to implement Claim Centre, and so it did influence the decision last year to upgrade Policy Centre before we can put down a Claim Centre'* [R6_E3]. Architecture compatibility was noted by Feldman et al. [4]. Additionally, if an upgrade is not adopted, it could cause systems to move out of step and compromise support from vendors: *'products started moving out of step with one another. And as soon as you are upgrading one and not the other. Your versions start becoming strained. And...the vendor will not necessarily support combinations you are on.'* [R4_E1]. Compatibility would not only influence the timing of an ES upgrade but also which ES to upgrade first. *'if we upgrade this system to a newer version, then it will no longer be able to talk to these systems. So we have to upgrade this at the same time...So we really want to upgrade this, but we cannot let us do this one first...So compatibility would most definitely impact the timing decisions for upgrades'* [R5_E3]. This theme is consistent with literature. Feldman et al. [4] stated that when there are inter organisational systems, overcoming compatibility is one reason for upgrading.

Outdated Technology. Analysis notes that outdated technology can be inflexible which can influence the upgrade decision. Outdated technology is prone to customisations which decreases flexibility and impacts costs over time. R7_E3 noted: *'One of the hindrances of legacy systems is that it prevents you from being agile...So that in itself can also trigger the decision to upgrade an enterprise system, which did in our case.'*

Relative Advantage. Respondents note that the ability to leverage additional features and functionality that can benefit business and feed into the strategy of the business can influence the decision to upgrade ES: *'Yes...that is how we knew that it had everything that we needed for a future strong foundation for future omni-channel experience'* [R2_E1]. Claybaugh et al. [13] argue that benefits such as globalisation, greater systems integration, and operational cost reduction can influence the upgrade decision. These benefits are classified as organisational objectives.

Security Vulnerabilities. Feldman et al. [4] noted that security issues can lead to upgrades. This was found in the study. Besides the risk of no patches being written and released, running a system that is unsupported also opens the door to hackers creating security vulnerabilities. *'Running any software that is unsupported carries an extreme risk that you cannot expose...to the enterprise organisation.'* [R5_E3] *'where the*

vendor is no longer supporting in terms of writing patches for that particular version... You are forced to upgrade to a version where there are actually patches... security vulnerabilities come in probably every single day' [R6_E3].

Cloud Transition. As the cloud hype increases, more and more organisations are becoming aware of the impending transition to the cloud. Analysis showed that when transitioning to the cloud, organisations need to consider the customisations already in place. To facilitate the transition to cloud an organisation also needs to be as close as possible to the latest version. Participants mentioned the Cloud Transition can influence the decision to upgrade ES: *'I think what... pushed a lot of organisations further and quicker is the Cloud Transition... which means you need to be as close as possible to what their versions are if you want to be able to transition' [R4_E1].*

Customisation. The findings were consistent with literature, in terms of customization causing delays in ES upgrades. In this study the opportunity to restrict customisation was also found to be key in influencing an ES upgrade. In addition, the effort it took to maintain and support the customised version also influenced the decision to upgrade: *'security was key. How do you keep this new enterprise system more independently replaceable and less tied up with customisations and other unknown integrations?... We were going to get to a point where we would have to start creating and maintaining features that were available to us in newer versions... you do not want to be there. If you can upgrade and get some of those features out the box, that is where you want to be.'* [R4_E1] *'there was a lot of customisation in the financial system before we started the upgrade... we actually... minimised the customisation' [R5_E3].*

Complexity. One participant mentioned that due to ease of use being compromised, end users may resort to using parallel systems because of complexity of the new version and that can be a factor considered when deciding to upgrade their ES: *'in any IT system, if your system becomes too complex to use... users may not want to use the system and before you realise, you find users are doing parallel systems' [R3_E2].* In addition, one participant referred to the complexity of the ES upgrade itself and referenced resources needed to support it and keep it running: *'we would look at our complexity from an upgrade perspective... in terms of ability to keep the updated version, the new version running and operating.'* [R1_E1]. Complexity was found to influence Business Requirement and Buy-in in terms of ease of use and can influence Resource Competence in terms of the skills needed to support the version.

Environmental. Innovation adoption can be in response to changing conditions within the environment which can force upgrades [4]. We found three themes.

Regulatory Requirements. Organisations need to comply with regulatory requirements. In line with the literature [14], changes in regulatory requirements were found to influence the upgrade decision: *'if there are changes that happen because of regulation... for example, your financial software, let us say there is new regulations coming in, and in order to meet those regulations, your software needs to be updated, then that would*

drive the need for it. So yes...regulation can definitely influence the decision to update your software' [R7_E3]. Analysis also suggest that participants believe if organisations were first to comply with legislature, that it would result in a competitive advantage and revenue opportunities. 'I mean if we can change our systems too before anybody else, it means it is a competitive advantage' [R3_E2].

Competitive Pressure. Participants referenced staying competitive and being more re-active in the marketplace as factors influencing an ES upgrade decision. It was also mentioned that pressure from competitors could force a decision and timing: *'for us this was really like putting down the foundation that allows you then to ultimately build out serious and new competitive advantages' [R2_E1]. 'if your competitor goes to market with something which you believe you should as well, the sooner rather than later would drive your desire to do it shortly as opposed to in time' [R1_E1].*

Business Partners. A participant explained the significance of a broker within the insurance industry and how as a business partner, they offer brokerage services which forms part of the sales operations within the organisation. These business partners were found to influence ES upgrade decisions. *'They are an extension of our sales op...I think that the decision to upgrade or not upgrade is definitely influenced more directly by the broker and the role of the broker... if 95% of your business comes through brokers, they definitely have a voice in the organisation' [R5_E3].*

Supplier. Three Supplier themes influencing an ES upgrade emerged.

Existing Relationship. Claybaugh et al. [13] proposed that the quality (satisfaction and commitment) of the relationship with ES vendors influenced the organisation's decision to upgrade their ES. However, in this study the quality of the relationship E2 had with the vendor had no bearing on the decision to adopt an ES upgrade. In one case the relationship with the vendor had broken down: *'It is a very good system, but we do not particularly like the organisation' [R3_E2].*

Communication. Participants highlighted that through an existing relationship with vendors, vendors could provide communication in terms of new releases or risk via documentation or recommendations. This creates awareness and can influence the decision to upgrade ES. Hence this theme on its own will not influence an ES upgrade, it will create awareness which together with other factors can influence an ES upgrade decision. *'they... gave us all the information that we needed. They put us in touch with all the potential SIs [system implementers] that we would be looking at to tender on the project... we got a lot of documentation from them upfront' [R2_E1].*

Vendor Influence. Participants referred to the constant reminder in the marketplace that a version was approaching its end of life which will result in the end of support. Once this occurs, the system is vulnerable to risk. Hence, this influences the decision to upgrade ES. *'I think the most obvious one is obviously when you are running systems that*

are reaching end of life of support...running any software that is unsupported carries an extreme risk that you cannot expose...the enterprise to' [R5_E3].

Social Network. One Social Network theme emerged which we termed 'Network Participation'. Participants mentioned the influence of user groups, Gartner groups and collaboration with other ES upgrade adopters can influence the decision to upgrade ES. Participants also highlighted that organisations could leverage significant benefits such as cost reductions through network participation, that in turn would influence the upgrade timing. *'When decisions are made here on products to choose or upgrades to take...Gartner groups...will be highly influential, because I think big corporates or those who use enterprise systems want to know that they are using what is right' [R4_E1]. 'we may discuss doing things differently so that it can benefit us all and save cost...instead of each...of us hosting our own Vendor2 instance, separately, we can maybe agree, let us host it...together [R3_E2].*

5.2 Why Do Organisations Decide to Upgrade Their ES?

An explanatory model (Figure 1) was derived which depicts how the factors impact one another which we now describe. We found that the IT departments in these South African companies are continuously assessing the status of ES and how well it serves business needs. Aligning business needs and ES capabilities can be achieved by collaboration, analytics, and add-ons within the ES [2]. As ES upgrades are huge IT investments [6], and a complex exercise that could cause major business disruption, decisions are governed and planned in formal executive committees. The ES upgrade decision is precipitated by a myriad of internal and external factors. Factors directly or indirectly impact the Exco approval.

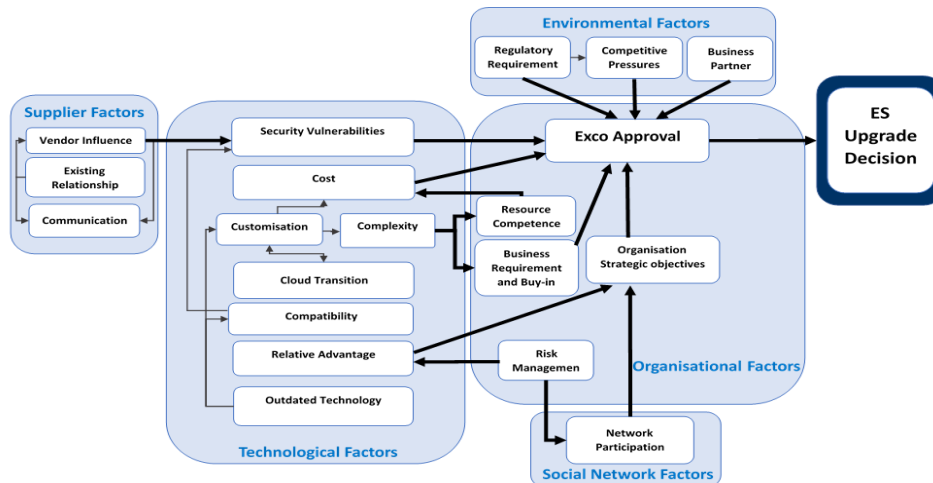


Fig. 1. Factors impacting ES upgrade decisions

One of the most significant factors influencing ES upgrades was the organisation's strategic objectives which the ES needs to support. When these are no longer aligned, organisations will decide to upgrade ES. Other unavoidable factors directly impacting the Exco approval and why organisations upgrade are classified as environmental. These include regulatory requirements, competitive pressure, and business partners. From an insurance context, brokers as business partners influence ES upgrades. From a technological perspective, factors directly impacting Exco approval and why organisations upgrade were cost and security vulnerabilities. Indirect factors from a technological point of view were outdated technology, relative advantage, cloud transition, customisation, complexity, and compatibility. Compatibility was found to influence security vulnerabilities. Security vulnerabilities emerge when ESs are no longer supported by vendors. And this nudge or push from vendors was identified as vendor influence.

5.3 When Do Organisations Decide to Upgrade Their ES?

Organisations were found to upgrade their ES when the ES no longer serve the business needs. However, the decision of when to upgrade can only be made once the Exco has approved. In this study, five factors were found to influence when organisations decide to upgrade ES: (1) When it is convenient for business – Business is driven by a business calendar and often upgrades are adopted within a less disruptive period. (2) When a stable version is available with sufficient support to prevent disruption. (3) When resources are available – provided you are sourcing external resources. (4) Within the regulatory compliance due date. (5) Before vendor support is due to end.

6 Conclusion

This study explained the network of factors influencing the timing of and decision to upgrade ES. We analysed three upgrade case studies in South Africa. We found that ES upgrades were considered or undertaken where the promise of cost reduction, improved customer experience or increased efficiency through later versions existed. Other factors impacting the decision, included compatibility, regulatory compliance, cost, and security vulnerabilities with emphasis placed on Exco approval, business convenience and calendar for the timing. In addition, organisations also need to position themselves aptly as ES progress and transition to the cloud. It is noted that 'vendors are manufacturing another Y2K by forcing customers to upgrade to new cloud versions of their software, which has forced the tipping point of cloud ERP' [23]. While vendor influence persists, organisations decide what is best for them. Perhaps it is as simple as knowing and reaffirming, what do we do? Why now? Are we ready? And can we delay? [7] and to foster mutual collaboration and strategic alliance with vendors.

This study had limitations. The generalisability of the research may be limited, as only large organisations were used in this study. Due to the COVID 19 pandemic and social distancing, interviews were not done in the same room and recordings at times were not clear which compromised the interpretations made and as only seven

interviews were performed the findings are incomplete. The use of a cross-sectional time horizon made information recalled by respondent's time-dependent and their confidence of recall may be questionable. This might be applicable to organisations who had upgraded months before the study was conducted. Additionally, the narrow research timeframe resulted in no member checks and we also were unable to determine which factors applied to the case study context. Future research could be to conduct cases within different types of organisations and in different countries. For example, more agile medium sized organisations might consider different factors. A longitudinal study would also add more clarity.

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