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16. Assessing the correlation between ERP system implementation and business process maturity

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Abstract

Enterprise Resource Planning (ERP) projects continue to attract attention, as researchers seek to develop insights and understanding of the conditions required for successful project delivery. Having spent an entire career to-date in different ICT roles, the authors have experienced several ERP implementations. There is considerable literature on what constitutes precedent conditions for successful ERP project delivery, commonly referred to as critical success factors (CSFs) for ERP projects. Most of these factors are presented from a project-centric context, that is, they are activated at the advent of an ERP project and recede with project closure. One distinctive factor which attracts attention by its seeming absence from literature on CSFs is the level of maturity of business processes in the implementing organisation. This study takes a closer look at business process maturity as relevant and important for ERP implementation success, and compares this with other CSFs. In this paper, an integration of business process maturity models, ERP implementation stages and systems characteristics through maturity stages is presented to formulate a conceptual framework to assess the correlation of ERP project implementation against organizational business process maturity.

Keywords

Critical success factors, Business process maturity, Implementation, Enterprise Resource Planning.

1. Introduction

The reasons for ERP systems failure remain constant despite all the lessons shared and expressed through research. Experience shows that a lack of attention on factors such as project management, support of top management, user or employee involvement, training and business process reengineering can all contribute to the high failure rates. Among the factors commonly cited as critical for implementation of ERP projects (Ehie & Madsen, 2005; Bhatti, 2005; Holland et al. 1999), business process maturity and business process competence do not immediately receive explicit mention, or they are at best implied. The failure of ERP systems is often a factor of misalignment between the processes embedded in the ERP system and those practiced in the implementing organisation. This paper focuses on the role of business process maturity and assesses it against other factors regarded as critical for ERP implementation.

2. Purpose of the research

While literature on critical success factors for ERP implementation gives as much attention to business process reengineering as the other factors, there appears to be no explicit mention of the role of organisational business process maturity in relation to ERP implementation projects. The

purpose of this study is to investigate the nature of the relationship between business process maturity and ERP implementation.

3. Main research question

The most common among the critical success factors (CSFs) for ERP implementation include top management support, change management, project management, user training and business process change or reengineering (Muscatello and Chan 2008; Finney & Corbett 2007; Nah & Delgado 2006; Ehie & Madsen 2005; Bhatti 2005; Holland et al. 1999). The lack of specific attention on business process maturity in the literature on CSFs for ERP implementations led to the formulation of the research question “*How can the correlation of ERP project implementation be assessed against organisational business process maturity?*” This paper seeks to answer the research question while also validating business process maturity as a critical consideration for ERP implementation.

4. ERP implementation overview

Organisations approach ERP implementations differently, however the most common approaches are “vanilla” implementation and custom implementation. In a “vanilla” implementation, the ERP solution is implemented and configured as packaged. No modifications are made to the software, and this means that the implementing organisation consciously adopts all the processes embedded in the system. A critical consideration in this approach is that any existing business processes that differ from their matching modules in the ERP system are discarded or modified to match those in the ERP system. In this approach, the focus of business process reengineering is the adaptation of existing business processes to the ERP processes, and this requires extensive user involvement and training as the organisation adopts new ways of working (Kraemmerand et al. 2003).

In custom implementation, an extensive review and analysis of an organisation’s business processes is undertaken prior to the choice and acquisition of an appropriate ERP system. The primary emphasis in this approach is to ensure as close a match as possible between the organisation’s business processes and the processes provided by the ERP system, with the resultant gaps often necessitating either custom configuration of certain system modules, or complete or partial custom programming in order to adapt the system to the organisation’s processes.

5. Business process maturity

The relationship between business process maturity and ERP system implementation is the focal point of this paper. Process maturity refers to the condition of a process, and reflects the extent to which instances of a distinct process type are managed, documented and performed (Röglinger et al. 2012). Van Looy et al. (2011) describe organisational process maturity as a measure of the degree to which business processes are capable of delivering higher performance measured over time. Consequently, a growth in organisational maturity implies a growth in process capability or, as per Spanyol (2004)’s definition, process competence.

Process maturity is a broader concept than process capability (Van Looy et al. 2011) and, consequently, the terms ‘organisational maturity’ and ‘process capability’ can be used to properly stress their difference in scope. However, notwithstanding this difference in scope, a strong positive relationship exists between both concepts: an increase in overall maturity indicates an increase in each capability, with the latter being part of the former. Based on these definitions of process maturity, it can be concluded that the significance of business process maturity to ERP systems lies

in the fact that the design of an ERP system is based primarily on standard or, more commonly, best-practice processes which are accepted as optimised and therefore at a higher level of maturity.

Table 1 Generic Process Maturity Stages and Descriptions

STAGE OF MATURITY	DESCRIPTION OF MATURITY STAGE
5	The entire set of enterprise business processes are being managed for improved performance
4	The full set of customer-touching processes is being managed for continuous improvement
3	Significant success with process redesign projects realized, and a few key end-to-end business processes managed for continuous improvement
2	Some prior success with process redesign projects, but not much sustainable process management
1	Broad awareness of the need to improve and manage business processes exists, but little action so far
0	Not much awareness of the need to improve and manage business processes exists

Source: Spanyi, 2004, p. 2.

6. Conceptual framework

The conceptual framework presented in this paper derives from an integrative alignment of business processes with technologies (ERP systems) that automate such processes. The interplay between ERP systems implementation and business process management practices, which include business process maturity assessments, business process modelling and business process reengineering, is emphasised to reflect the extent to which the level of business process maturity can support effective ERP system adoption and successful implementation.

More often the implementation of an ERP system leads to organizational change (Kraemmerand et al. 2003), which comes primarily in the form of business process reengineering. Often, an ERP implementation results in organisational processes and procedures being standardised according to best practice processes and procedures built into the ERP system.

Since ERP systems pave the way for business process reengineering, this clearly then suggests that a similar effect takes place with business processes – with each refinement of the ERP system there must be an equivalent process to refine the business processes to continue to maintain fit and alignment between the business processes and the ERP system as configured, or to be configured. This phenomenon then becomes continuous and has implications for the business process management practices in an organisation. Drawing from the assertion by Kraemmerand et al. (2003), that implementing an ERP system can be regarded as a radical techno-organizational innovation since it requires the simultaneous implementation of new technology, new business processes, organizational structures and individual (employee) changes, it can be argued that there is a need for a strong fit between an organisation and the ERP system as a success factor, a view supported by Morton & Hu (2008). Since organisation structures are designed to support

organisational processes, this can therefore be deduced to imply organisational business process and ERP fit. This argument is consistent with the assertions by Chen (2001) and Kraemmerand et al. (2003)

When viewed against a discussion on business process maturity and/or business process competence, the concept of business process reengineering and ERP system implementation suggest that there is a need for a deeper focus on business process management practices if an organisation wishes to adopt an ERP system for improving enterprise-wide performance. Since an ERP implementation constitutes radical organisational change (Kraemmerand et al. 2003), such an initiative requires a more considered integration of processes, people roles, knowledge and user competencies (Worley et al. 2005).

Emphasis is placed on conditions required for successful ERP implementation, and these are primarily presented within the context of human resource-based business processes, that is, a focus on business processes and the people who are intended to use the processes. These conditions are:

- focus on human resource aspects in business processes modelling, both for “as-is” or “to-be” processes prior to the ERP project;
- clear roles and competencies required to use the new business processes and therefore the ERP system, as well as distinction made between the competencies of a person (gained competencies) and the competencies required by an activity (required competencies); and
- knowledge levels required in the use of the new processes and ERP system.

According to Worley et al. (2005), a well considered integration of processes, roles, knowledge and user competencies as part of the ERP implementation journey minimises failure and increases the chance of successful adoption and use of the system by employees. User competencies for ERP system follow the same maturity progression as that followed by business processes. In business process management practice, some organisations deliberately perform continuous assessments of their process maturity as a basis for continuous business process improvements.

6.1 ERP implementation: an iterative, continuous process towards maturity of use of the system

Whether in the context on business processes or the use of an ERP system, *maturity* is considered to be a critical factor - Holland & Light (2001) developed what they call “*Stage Maturity Model for Enterprise Resource Planning Systems Use*”, which is a model used to assess the stage of maturity of an organisation’s use of an ERP system. The model comprises three stages of maturity of ERP system use, namely,

- *Stage 1*, where organizations are managing legacy systems and starting the ERP project;
- *Stage 2*, where implementation is complete and the functionality of the ERP system is being exploited across the organization; and
- *Stage 3*, in which organizations have normalised the ERP system into the organization and are engaged in the process of obtaining strategic value from the system by using additional systems and/or functionality such as customer relationship management, knowledge management and supply chain planning.

Holland & Light (2001) conclude that organisations may display characteristics of more than one stage during their ERP lifecycle, although one stage is likely to dominate as they often implement a series of overlapping projects and move gradually towards increased maturity in the use of the ERP. This perspective of ERP use maturity aligns well with the stages of *maturity* in Table 1 above.

6.2 ERP implementation approach

Having analysed a significant number of ERP research literature, the authors contend that while most literature cites common factors as impacting ERP implementations (Table 2), there still exists a significant level of discord between different authors when it comes to the right approach towards ERP implementation where business process is concerned. Different researchers express different viewpoints regarding the right approach to ERP implementations, while others offer no conclusive guidance on the same subject.

Morton & Hu (2008), having acknowledged that ERP system implementation generally requires an organization to adopt the standardized business processes embedded in the software, go on to argue that the very nature of ERP systems, that is, integrated, embedded processes, is a key factor contributing to implementation failures. As a first step in the ERP implementation, a process modelling project should be undertaken, aimed at optimising a company's business processes first, and then at making the optimised processes and standard ERP software processes consistent (Worley et al. 2005). The process modelling phase is recognised as being a key issue for allowing a successful ERP implementation leading to an optimal use of the ERP system.

According to Jarrar et al. (2000), implementing an ERP system involves reengineering existing business processes to the best possible business process standard, that being the ERP system which is built on best practices that are followed in the industry, and they too argue that successful ERP installation requires that all the processes in a company have to conform to the ERP model. An ERP implementation often results in standardization of organisational processes and procedures, and therefore ERP systems require organizational adaptations, such adaptations being defined as business process change or reengineering to match the embedded ERP processes, in order for the organization to achieve the benefits inherent in such systems. The implementing company must reengineer its business processes to 'fit' the standard software and the pre-configured processes embedded in the software, and avoid modification of the software code to 'fit' the organization's current business processes.

Citing business process reengineering as one of the critical success factors for ERP implementation, Bhatti (2005) also supports the assertion that when implementing ERP systems, organizations should be willing to change their businesses to fit the ERP software in order to minimize the degree of customization needed. Surveys prove that the most important criteria used in selecting an ERP system is the best fit with current business procedures, and the aim of management should be selecting the most compatible ERP system with the organizational processes, because trying to change the ERP system to match organisational processes will not make sense and is likely to result in extended implementation periods, cost overruns and complexity for future upgrades and maintenance of the system (Basoglu et al. 2007)

This argument though, while plausible and consistent with views expressed by other authors, fails to provide a practical way out of the contradiction – selecting an ERP system that represents best fit with organisational processes does not guarantee that such fit will be 100%, and therefore there may still be sets of organisational processes that are not catered for by the standard ERP system package; therefore, some choices and decisions will still need to be made regarding whether the processes not provided for, in whole or in part, by the standard ERP system, must be reengineered to fit the ERP system, or whether the ERP system processes must be modified to accommodate the organisational processes.

Some degree of ERP customization is inevitable and perhaps even acceptable in order to ensure alignment between the business processes and the ERP system. The authors argue that the higher the maturity of business processes in the organisation, the closer such alignment will be.

6.3 Explaining the framework

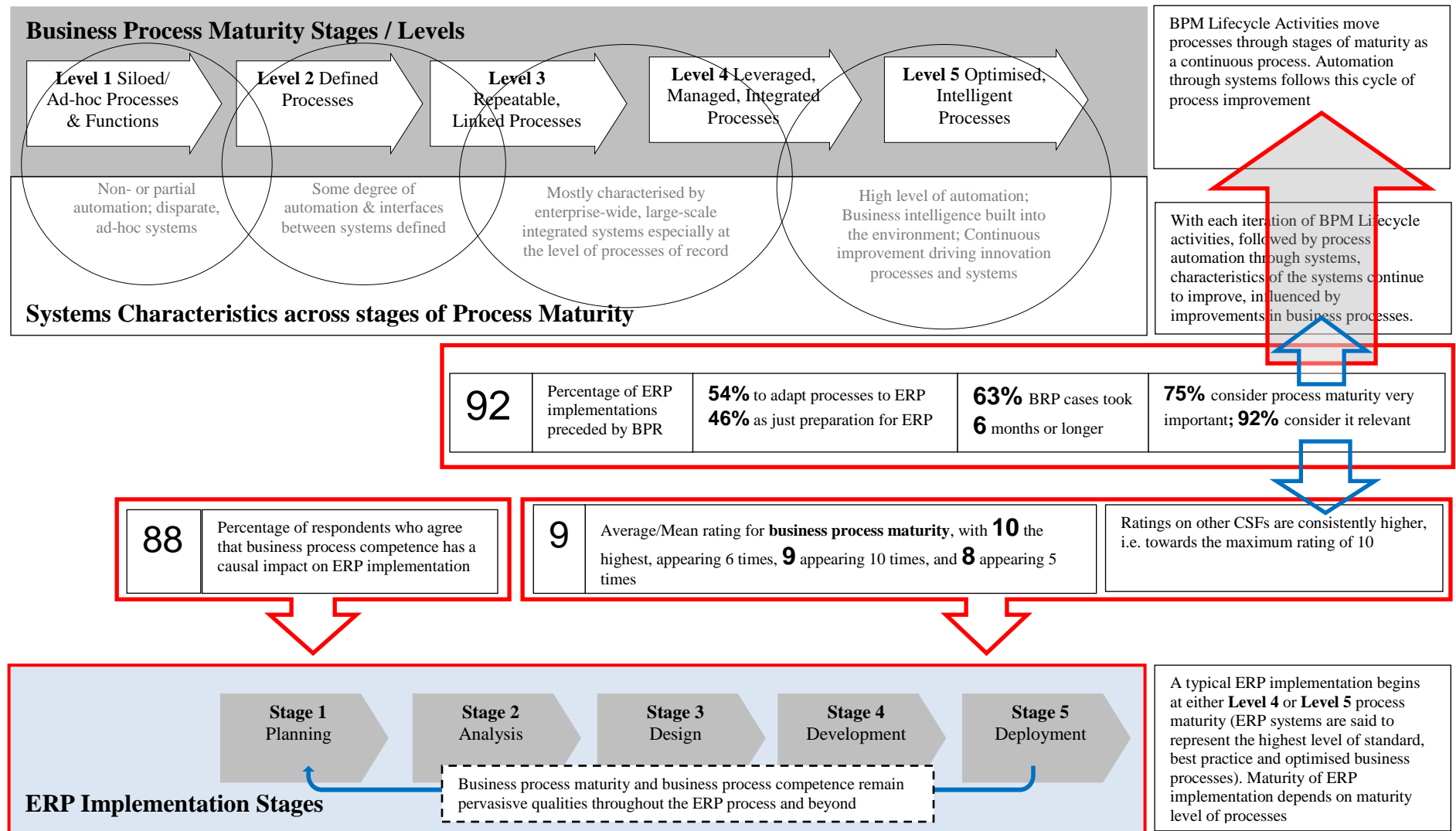
The impact of CSFs at different stages of ERP implementations is explained by Somers and Nelson (2001) - critical success factors can be viewed as “situated exemplars that help extend the boundaries of process improvement, whose effect is much richer if viewed within the context of their importance at each stage of the ERP implementation process”. In their assessment of CSFs, Somers and Nelson (2001) adopt an ERP implementation as a staged or phased process (*see ERP Implementation Stages in Figure 1 below*).

BPM Lifecycle activities move processes through stages of maturity as a continuous process (*see Business Process Maturity Stages/Levels in Figure 1 below*). Automation through systems follows this cycle of process improvement or process maturation. With each iteration of BPM Lifecycle activities, followed by process automation through systems, characteristics of the systems continue to change and improve, influenced by improvements in business processes. A typical ERP implementation begins at either Level 4 or Level 5 process maturity (ERP systems are said to represent the highest level of standard, best practice and optimised business processes). Maturity of ERP implementation depends on maturity level of processes.

An integration of business process maturity modelling and ERP implementation stages model results in the framework as depicted in Figure 1 below. The Systems Characteristics across the stages of Process Maturity reflect maturity condition similarities between process maturity and system (ERP) maturity depending on the stage of implementation of an ERP system. The authors contend that it is at business process maturity levels 4 and 5 where an optimal implementation of ERP can be achieved. It is at these levels of maturity that users in the implementing organisation, or at a minimum the business process champions, would have help facilitate a much closer alignment between organisational processes and the ERP system, or even influence or drive positively and optimally the business process reengineering efforts that would precede both the choice of ERP system as well as the implementation of the chosen system. These assertions are supported by the results of the study, as also indicated in Figure 1 below, as follows:

- 92% of the respondents confirm that their ERP implementations were preceded by a business process reengineering project;
- 92 of respondents consider business process maturity relevant, while 75% consider it *very important*, for ERP implementation;
- In 54% of the instances of ERP implementation, business processes reengineering was undertaken to adapt organisational processes to the ERP system, while in 46% of the instances it was merely a necessary preparation of modelling and documenting the processes

Figure 1 Conceptual Framework for the impact of business process maturity on ERP implementation



Authors' adaptation from ERP and BPM literature

7. Results of the study

7.1 Background

The study was designed and structured to focus specifically on two domains – business process management and ERP implementation, in order to elicit the views of the respondents regarding the importance of business process maturity when implementing or considering to undertake implementation of ERP systems. Respondents in this study comprised individuals who have experience or exposure to ERP system implementation projects, whether as ICT practitioners, independent ERP system consultants or users of ERP systems.

Founded within the context of widely researched critical success factors for ERP implementation, the statistical analyses chosen for this study are informed by the research question “*How can the correlation of ERP project implementation be assessed against organisational business process maturity?*”

7.2 Results

Business Process Domain

Within the business process domain, respondents were requested to indicate, based on their respective ERP implementation experiences, whether the project was preceded by any form of business process reengineering and what made that process necessary; how long the business process reengineering took, as an indication of the extent to which business process reengineering is considered a key precedent condition for ERP implementation, as well as the composition or proportion of participants on the business process reengineering initiative.

Further questions related to how respondents view business process maturity in the implementation of ERP systems; rating the importance of certain ERP stakeholders in the development or reengineering of business processes; whether respondents consider business process maturity a relevant consideration for ERP implementation, and lastly, whether respondents consider business process competence to have any causal link to ERP project success.

- 22 (92%) of respondents indicated that business process reengineering was undertaken before the ERP system was implemented, which in simple terms supports the assertion of BPR as a critical pre-requisite for ERP system implementation.
- In 14 (54%) of the instances, the reason for undertaking business process reengineering was to adapt organisational business processes to the ERP system processes, while in 12 (46%) of the instances it was purely a preparatory exercise to formally prepare for the ERP implementation by merely documenting existing processes.
- Most of the business process reengineering initiatives took six (6) months or longer (63% of the cases), while only 37% of the cases took 6 months or less.
- On average, business process users accounted for 36%, management 17%, ICT 23% and consultants 24% representation in the business process reengineering project teams, with the highest representations per stakeholder participant indicated as 70%, 40%, 55% and 50% for business process users, management, ICT and consultants respectively.
- On the importance of participation/participants in the business process reengineering, business process users/employees rated an average of 9/10; management rated 9/10 while ICT and consultants participation rated 8/10 each.

- 18 (75%) of the respondents consider business process maturity very important when implementing or planning to implement an ERP system, while 6 (25%) believe it is important but not a critical issue.
- Business process maturity is regarded as a relevant consideration or factor for ERP implementation in 22 (92%) of the cases, while only 2 (8%) of the respondents do not see it as relevant. Not only is business process maturity considered relevant when implementing ERP projects – it is also considered very important, as shown in Figure 3 below.
- 21 (88%) of the respondents believe that business process competence has a causal impact on ERP project success, while 3 (12%) believe that it has no impact whatsoever.

ERP Implementation Domain

In this domain, key focus is on the assessment of critical success factors for ERP implementation. Business process maturity was added to a selection of other critical success factors and included for rating. The critical success factors constitute independent variables in this study, while the ERP implementation process constitutes the dependent variable. However, a key point to make in this analysis is that the statistics are applied to relationships between the independent variables themselves, that is, the critical success factors, and not between the factors and the ERP implementation process.

This is so, firstly because the study is not based on any observation of any particular implementation of an ERP system, and secondly, the emphasis is on testing whether business process maturity as a proposed factor is in tandem with the already known and validated critical success factors. In essence, the rating scales used in this section are intended to assess the level of correlation between the critical factors for ERP, with business process maturity included in order to determine how respondents perceive its importance to ERP implementation in comparison to the other factors.

- Almost every respondent had rated one or more factor at a maximum rating of 10, while three had the lowest rating of any factor at 4, 4 and 3 out of 10 respectively. The lowest rated factor by a respondent was organisational culture at a rating of 3.
- The lowest mean per respondent was 7, while the highest stood at 10, which is equal to the maximum rating any respondent could give to a factor. Similarly, the lowest mean rating per factor was 8, while the highest was 9 – from these facts, it is evident that most of the factors have been rated towards or close to the maximum rating of 10 by most respondents. Further evidence of this phenomenon is that the mode, or most frequently appearing rating per respondent was 10 (appearing 11 times), followed closely by a rating of 8 (appearing 6 times) and then by a rating of 9 (which appeared 4 times):
- The standard error shows a range from a minimum of 0.10 and a maximum of 0.56 across all the responses and the 13 factors. While the sample was not large enough, this nevertheless suggests that on average, there is a 95% level of confidence that the observed sample mean range for all the factors is plus minus 0.46 standard errors from the population mean.
- While the sample variance shows a range from 0.14 to 4.06, this is merely the effect of extreme rating values rather than the general tendency of the responses.

8. Conclusion

Based on the foregoing analyses, the results of this study compare favourably to the results of other studies of critical success factors for ERP implementation projects. The research question “*How can the correlation of ERP project implementation be assessed against organisational business process maturity?*” served as a basis for the choice of statistical tests selected for data analysis in this study. These tests further provide a basis for assessing the correlation of “Business process maturity” to ERP project implementation. While the research question sought to assess the aforementioned correlation, the assessment took the form of comparing “Business process maturity” to other commonly cited critical success factors for ERP implementation, and therefore,

- The use of the arithmetic mean as a statistical test serves merely as a basis for determining central tendency of observations, in this study the ratings given to the different factors, and as a reference point for other descriptive statistical analyses and interpretation of the data;
- Correlation analysis provides an indication of the strength of relationships between “Business process maturity” and the other factors, i.e., assessing whether respondents who rated certain factors high have similarly rated “Business process maturity” high too;
- The standard deviation as a test in this study provide a basis for determining the level of spread or dispersion of each respondent’s ratings from the average (mean) of the ratings thus assigned to each factor by all the respondents;
- The correlation of “Business process maturity” with ERP implementation is thus assessed by inference, in that the chosen factors have been validated by past research, as indicated in the literature review, to be critical for successful implementation of ERP systems;
- The coefficient of variation represents the ratio of the standard deviation to the mean, and based on its inherent application, serves as a useful statistical test for comparing the degree of variation of the ratings of the factors from one respondent to another.

In attempting to provide a more elaborative context for the assessment of business process maturity as a distinctive factor for ERP implementation, a considerable amount of literature on business process management was reviewed in combination with equally considerable literature on critical success factors for ERP implementation.

Given the limitations on observing ERP implementations in progress, a key consideration in this study was to change the approach, in order to then assess how business process maturity as a factor ranks in comparison to the other commonly cited factors for ERP implementation. The results, as indicated above, validate business process maturity as a distinctive critical factor for ERP implementation.

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