

https://dspace.org/

The causal relationship between critical factors and post implementation success of Enterprise Resource Planning software

Naidoo, Devaraj

2018
https://hdl.handle.net/10539/30958

Downloaded from a DSpace repository. https://dspace.org/

The Causal Relationship between Critical Factors and Post Implementation success of Enterprise Resource Planning Software

Devaraj Naidoo

1660848

Protocol Number: WBS/BA1660848/365

A research article submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Business Administration

Johannesburg, 2018

DECLARATION

I, Devaraj Naidoo, declare that this research article is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in the Graduate School of Business Administration, University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Devaraj Naidoo

Signed at ……

On the …….. Day of …… 2018.

DEDICATION

This research is dedicated to my parents for providing the platform for me to achieve my dreams.

ACKNOWLEDGEMENTS

I hereby acknowledge my family and friends for their support during my studies. Special mention to Amanda Naidoo for always willing to assist and Jyothi Maharaj for the constant encouragement. I would also like to thank my supervisor Sean Riley for all his input and advice during this research and all participants of my survey for dedicating the time to completing when requested.

Lastly, I would acknowledge my manager for always providing the support to pursuit this journey.

SUPPLEMENTARY INFORMATION

Nominated journal:	Management Dynamics
Supervisor:	Sean Riley
Word count †:	12448

† Including abstract references, etc.

ABSTRACT

Enterprise Resource Planning (ERP) software is an essential business tool for organisations to process information and aid in driving business strategy. Organisations are increasing spending up to 2% of annual income on ERP software implementations. However, implementing such software is only one part of the process. To obtain the appropriate returns on investment, the organisation must first implement the ERP software successfully and then realise the post implementation benefits.

Numerous failures of ERP implementations have been well documented. Organisations have spent multiples of the implementation cost on projects that have not gone to plan. In addition, organisations have failed to realise post implementation benefits that were promised prior to implementation.

An ERP implementation by its very nature impacts all functions of the organisation. Expert opinions are required for understanding the current business processes and the impact the ERP will have within the organisation and externally when conducting business in future. Such an implementation is a complicated system of top management, external consultants, users, and other stakeholders coming together to develop and deploy the new ERP software.

This paper models such a complex scenario to predict post implementation benefits that is derived. The methodology used is Fuzzy Cognitive Mapping (FCM) to map the complex system of an ERP implementation project. The relationship between the critical input factors, critical general factors and post implementation benefits is determined via a survey of professionals who have been part of an ERP implementation both from within and external to organisations. The output from the survey is used to simulate the factors using FCM to predict post implementation benefits. The results of research provide a basis for understanding the critical factors that should be present for organisations to derive post implementation benefits of an ERP implementation.

This analysis will assist organisations when planning to implement ERP software to determine what critical factors organisations must manage to derive post implementation success of implementing ERP software.

Keywords: Enterprise Resource Planning (ERP), Fuzzy Cognitive Mapping (FCM), Prediction Model, Critical Factors, Top Management Support, User Involvement, Project Management, Business Process Reengineering, Change Management, Business Planning and Strategy.

1. INTRODUCTION

The advent of globalisation has caused businesses to operate in and adapt to an ever-changing environment. In order to manage the impact of globalisation effectively, businesses and senior managers need information to mitigate risks and stay ahead of the competition (Turbide, 1999) As a result Enterprise Resource Planning (ERP) software is now a pre-requisite to manage most businesses.

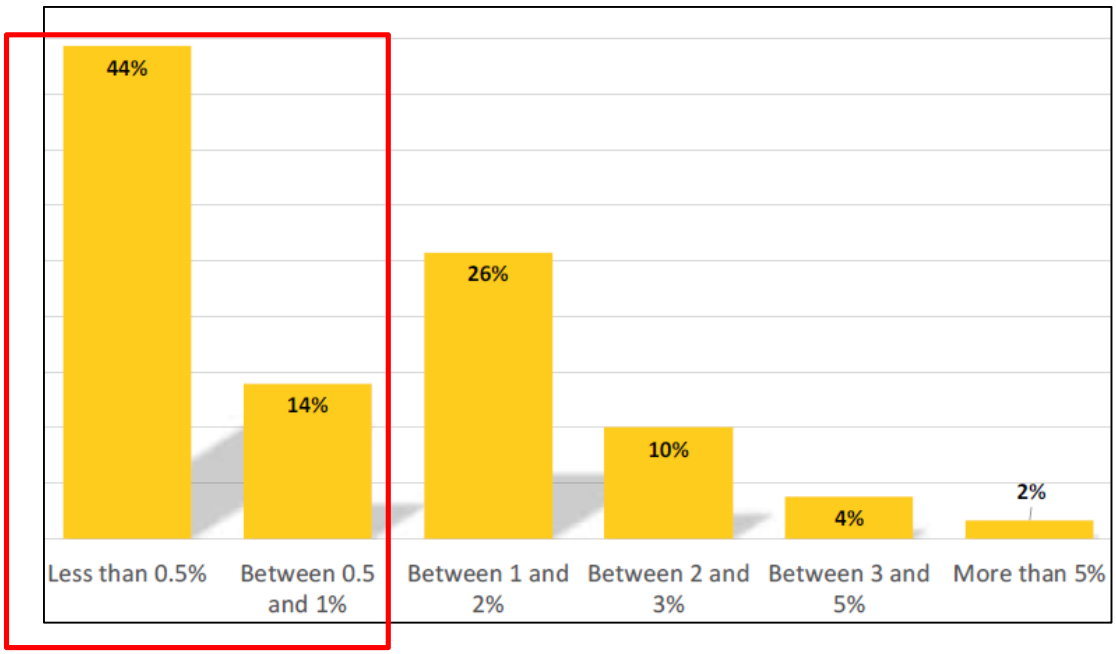
Modern ERP provides management with real time information and ensures that information processing is completed efficiently by avoiding data duplication. ERP also makes process orientation mandatory and ensures information is complete by integrating functions of the business such as sales, finance, operations and human resources (Grabot, Mayere, Lauroua, & Houe, 2014). This results in reduced production, inventory and raw material costs while significantly decreasing shipping time to customers (Somers & Nelson, 2001). This reduction in business cycle time, can be used as a competitive advantage by organisations. In addition to these benefits, it should be noted that an ERP can produce a number of intangible benefits which is difficult to quantify (Xu, Ou, & Fan, 2017).

The ERP project should be one of the levers the organisation has at its disposal to enable its strategy, and like any other business enabler for example purchasing additional delivery vehicles or increasing its sales force.

ERP software promises the managing and extracting of information at a “click” of a button, hence ERP implementation investments by companies could be at least 1% to 2 % of its annual revenue including cost of the software and implementation (Turbide, 1999). In recent research conducted by consulting company Panorama Consulting Solutions in United States of America, they found that in 2018, at least 84% companies that participated in their research are still investing up to 2% of annual revenue (Panorama Consulting Solutions, 2018).

FIGURE 1

ERP COST AS A % OF ANNUAL REVENUE



Source: Panorama Consulting Solutions, P. C. (2018). 2018 ERP Report. Retrieved from Greenwood Village, CO 80111: https://www.panorama-consulting.com/resource-center/erp-software-research-and-reports

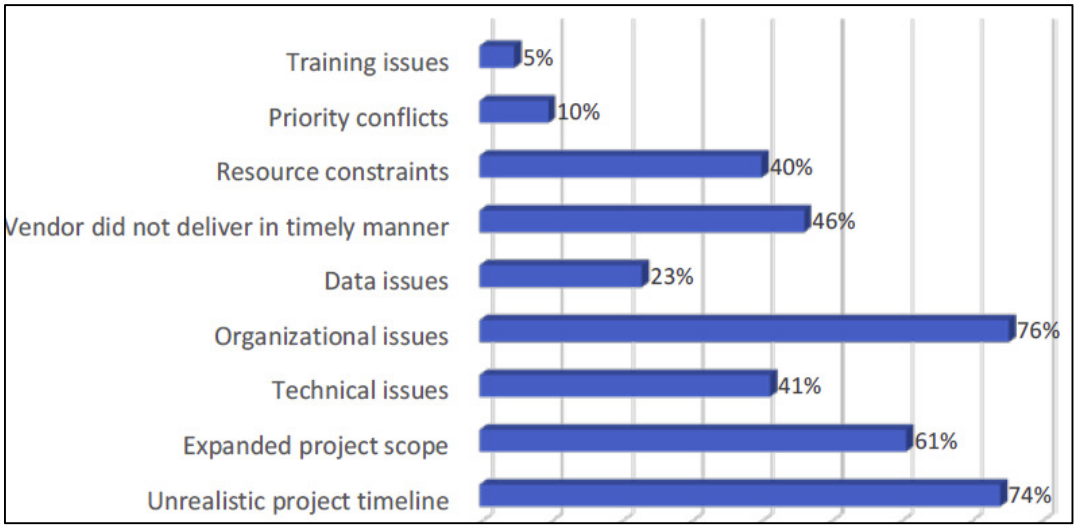
However, over the years, companies have spent multiples over this due to problems with implementations. When confronted with an ERP implementation, organisations are made aware of the benefits associated with implementing an ERP package. The costs or the difficulties arising from the implementation process is not always clearly understood (Turbit, 2003).

It is estimated that 50% of ERP implementations failed to meet the expectations of the businesses (Jasperson, Carter, & Zmud, 2005). Some business, which encountered failures are Woolworths in Australia, Target in Canada, Hershey, Nike and Hewlett Packard in the United States of America (Frulinger & Wailgum, 2017). Although information is not readily available for South Africa, the City of Johannesburg's billing crisis is well publicised (Bauer, 2012).

In the Panorama Consulting 2018 ERP report, 64% of respondents exceed their budget for ERP implementations. Further to this, 79% of respondents reported that they exceed the project timeline that they initial had. Reason for exceeding the timelines is detailed below.

FIGURE 2

REASONS FOR SCHEDULE OVERAGES



Source: Panorama Consulting Solutions, P. C. (2018). 2018 ERP Report. Retrieved from Greenwood Village, CO 80111: https://www.panorama-consulting.com/resource-center/erp-software-research-and-reports

The report also noted that organisations take on average 17.4 months to implement an ERP software (Panorama Consulting Solutions, 2018).

ERP Vendors have enhanced the power of new technologies with cloud-based ERP platforms. This is easier to deploy, and IT infrastructure costs are reduced as there is no need for servers and other costs. A good internet infrastructure is all that is needed (Shivam, C., Akash, Vinod, & Uma, 2017).

An ERP implementation requires the participation of most parts of the business (Turbide, 1999). This is true whether the ERP is on premise or cloud based. A failure in implementing an ERP software correctly could cost some company millions of rands in implementation costs and in lost revenues. It can also cause enormous damage to the company's brand as customer loyalty and satisfaction

becomes eroded. There is a great deal of research that has been undertaken globally to understand the critical factors (CF's) that influences successful implementations. Some of these CF's are managed extremely well while organisation sometimes feel others do not need as much attention. Organisations also need to consider that the CF's during implementations must be managed to ensure the full post-implementations benefits are derived to take full advantage of ERP software.

This study identifies the key relationships between CF's for ERP implementations, the achievement of post-implementation benefits and the relationships between these. It further identifies the combination of CF's that will determine post-implementation success. Post-implementation success can in some cases be realised in stages and over several years depending on the organisations view of ERP software. Some organisations take a short term view, wanting to get users working on the new ERP software while others take a longer term view and see ERP implementation as a journey that continues after "go-live"(Willis & Ann Hillary, 2002).

2. LITERATURE REVIEW

2.1 Enterprise Resource Planning (ERP)

Enterprise Resource Planning (ERP) evolved from Materials Requirement Planning II (MRP). ERP integrates all functions of the business and is a tool that management can utilise to manage a business effectively. ERP software standardises, streamlines and integrates business processes across finance, human resources, procurement, sales and distribution, production and other departments (Wailgum & Perkins, 2018).

An ERP software that is properly implemented can assist a business to gain a competitive advantage in its market (Barker & Frolick, 2003). In order to gain this competitive advantage, businesses need to match their business requirements to the capabilities of the chosen ERP software and this is where a number of organisations face enormous challenges leading to massive investment costs and potential failures (Ramburn, Seymour, & Gopaul, 2013).

One of the main problems relating to ERP software is the implementation. Organisations have not been able to adopt the processes within the ERP software or had to give up competitive advantage on previously customised processes (Indihar Stemberger, Bosilj Vuksic, & Kovacic, 2009).

2.2 Critical Factors (CF's)

Critical factors are used interchangeably in literature comprising of both success and failure factors. Critical success factors can be defined as those factors which, if successfully managed, will result in success for the organisation (Rockart, 1979). While Somers and Nelson (2001) defined critical success factors, as examples of items which when concentrated on will result in greater reward.

Princely (2008), stated that critical success factors are vital areas that must yield positive results for organisations to compete. These are parts of the business that require special attention to deliver increased results in an organisation.

There have been many studies, which focused on the CF's that influence post implementation success of ERP implementations. Some of the CF's identified in literature include:

2.3 Business Plan and Long -Term Vision

An ERP project must be clearly defined in the business plan and long-term vision of an organisation. This will ensure that the purpose and need for the ERP software is evaluated against other priorities of the organisation and the appropriate resources and capital is allocated to the project. In addition, the stakeholders of the organisation must be aware that the decision taken will have long-term implications for the organisation (Olivier, Mario, & Robert, 2009).

The business plan must clearly state the goals of the ERP project namely, the costs, benefits, the implementation strategy being considered, and any other issues that should be addressed (Kronbichler, Ostermann, & Staudinger, 2009).

An ERP implementation is like any other strategic initiative an organisation is contemplating for example launching a new product. Therefore the same care should be taken to evaluate the decision on the ERP software, it's costs and the benefits that will be derived (Laughlin, 1999). The capabilities of the selected ERP should be matched with the capabilities required to support the long-term strategy of the organisation (García-Sánchez & Pérez-Bernal, 2007). Furthermore, organisations that adopt a multi-national strategy needs to take into account the ERP software that will support this strategy, failing which organisations will end up with fragmented ERP solutions across different countries and expensive customisation requirements (Madapusi & D'Souza, 2005).

Integrating the different functions of the firm within an ERP environment will not itself lead to the benefits of the ERP software implementation. Organisations must know the strategic objectives they would like to meet by implementing a particular ERP software (Muscatello & Chen, 2008). In research conducted by Princely (2008), it was concluded that the ERP software that is acquired to support organisational goal, mission and vision results in a higher probability of success.

2.4 Top Management Support

When embarking on an ERP implementation, it is imperative that the scheduling of the project makes adequate accommodation for the participation of top management (García-Sánchez & Pérez-Bernal, 2007). Top management support can be defined as the willingness of senior management within an organisation to provide direction, authority and resources during the implementation of an ERP software (Princely, 2008).

Research indicates that implementations do not succeed when top management do not fully participate in the projects (Somers & Nelson, 2001). Princely (2008), also concluded in research that when top management support an ERP project, the success level of adoption in that organisation is also high.

ERP software implementations require the commitment of all functions of the business. This leads to differing priorities, which can cause disagreements. Top management can assist in speedily resolving some of these issues by providing the necessary guidance and resources (people, funds and equipment) for the project. Further, top management should take a leadership role in the project and provide the necessary guidance and strategy for the implementation. This can be achieved by creating a steering committee for project teams to be accountable and discuss progress (Zhang, Lee, Zhang, & Banerjee, 2003).

Bueno and Gallego (2017), concluded in their study that by enhancing communication techniques during a project, this results in increased top management support. This can be achieved by setting up forums between project team and manager or between software partners and managers or between end users and managers.

In addition top management should upskill themselves on the technology or software with an understanding of its capabilities and limitations (García-Sánchez & Pérez-Bernal, 2007). This was confirmed by Bueno and Gallego (2017) in their research stating that increased training efforts improved top management

support. However, they also found that increased complexity in the technology did not lend itself to increasing top management support.

Ngai, Law, and Wat (2008) have concluded that successful implementations require commitment and participation from top management while (Zhu, Li, Wang, and Chen (2010) concluded that by being involved in ERP post implementation review, leadership will be empowered to understand the capabilities of the ERP system and assist in decision-making going forward. The involvement of top management in ERP projects demonstrates the importance of the project to the organisation, which could lead to faster and greater adoption of the software.

2.5 Partner/Vendor Support

Once the ERP software is selected, the partner selected to assist the organisation on the implementation journey must have expert knowledge in the capabilities of the software. The consultants used must also have a good understanding of the organisation's processes as well as the industry in which the organisation is operating in. It is essential that the project team consists of members that have organisational knowledge supplemented by external consultants that have experience in ERP adoption from a technical point of view (Rothenberger, Srite, & Jones-Graham, 2010).

In addition, the consultants must possess the necessary skill to be able to communicate with the organisation's staff in order to mould the results of the implementation (Zhang et al., 2003). Doom, Milis, Poelmans, and Bloemen (2010), concluded in their study in Belgium that when organisations work closely with vendor/partners this ensures ERP success.

A plan must be in place for the successful transfer of knowledge of the consultants to users within the organisation (Finney & Corbett, 2007). Organisations must be mindful of unscrupulous behaviour of consultants and create mechanisms to regulate the behaviour of consultants such that appropriate knowledge is transferred to the organisation because they will require

certain skills post go-live that might not be available within the organisation (Haines & Goodhue, 2003).

2.6 Project Management

ERP implementation is normally a multi-year and multi-function activity. It is imperative that these projects are effectively managed to ensure that the project is completed within budget, timelines and scope. Project management consists of having an implementation plan, accurate time line, regular status update meetings, a project champion who provides effective leadership and team members who have a stake in the outcome of the project (Zhang et al., 2003).

A crucial element of project management is managing the scope of the project. When projects have increased customisation, this increases the scope resulting in additional costs and increases the time to complete the project (Somers & Nelson, 2001). By implementing project management, scope changes will be managed. This is achieved by adopting a defined process to handle user's requirements (Chen, Law, & Yang, 2009). Organisations undertaking an ERP project must define the project scope and instil measures to control the scope (Shahin & Sulaiman, 2011).

Effective project management will result in early identification of potential risks which could impact the successful implementation of the project (Kronbichler et al., 2009). Research conducted in emerging economic geographies like China and Mexico have concluded that project management is a critical factor for implementation success (Zhang et al., 2003),(García-Sánchez & Pérez-Bernal, 2007).

In research conducted by Chen et al. (2009), it was concluded that possessing project management skills on an ERP project improves the organisation's probability of a successful implementation. This was also concluded by Shahin and Sulaiman (2011) in their study that there is a positive relationship between project management and ERP implementation success.

It is not enough to have robust project management for an ERP project to achieve success, organisations must develop a level of maturity in project management on routine projects. This includes delivering routine projects on time, within budgets and realising the benefits the project set out to deliver (Badewi & Shehab, 2016).

2.7 Business Process Re-engineering / Improvement (BPR)/ (BPI)

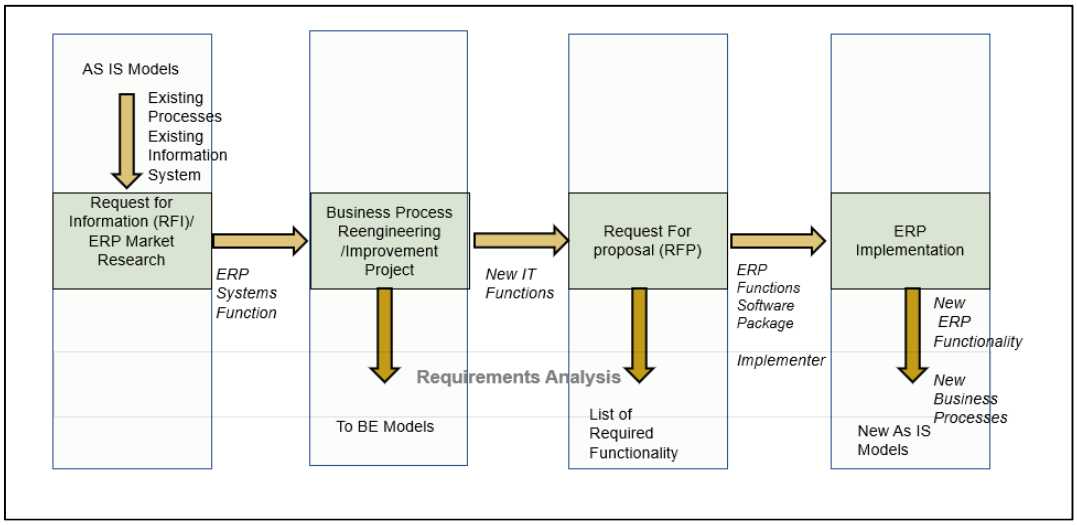
ERP software is designed around best practises; therefore, an organisation needs to re-design their current process to align to that of the chosen ERP software. Organisations should not customise the ERP software to align with its (the organisation's) current business processes (Ngai et al., 2008). Most companies fail to consider the extent to which their current processes will need to be adapted or completely changed, therefore management must communicate early in the project regarding the nature and extent of process changes required. There must exist the necessary trust between management and staff for these changes to be fully implemented and adopted (Zhang et al., 2003).

BPR is a critical success factor not only to large organisations but also to small medium enterprises (SME) as distinguished by Christofi, Nunes, Chao, and Lin (2013) in their study on ERP success in SME. They concluded that by improving business process this will give the SME a greater chance of success with an ERP implementation. This is because SME have business process deficiencies and other issues inherent to operations of the SME.

By successfully adopting the processes embedded in the chosen ERP software, organisations can expect the highest possible return on investment (ROI) from the implementation (Somers & Nelson, 2001). However, Panayiotou, Gayialis, Evangelopoulos, and Katimertzoglou (2015) noted that the task of acquiring knowledge of the ERP software functionality will determine the extent of the BPR exercise the organisation will undertake. They proposed the requirements engineering framework:

FIGURE 3

APPLIED FRAMEWORK FOR REQUIREMENTS ENGINEERING IN ERP SYSTEMS DEVELOPMENT LIFECYCLE



Source: Panayiotou, N. A., Gayialis, S. P., Evangelopoulos, N. P., & Katimertzoglou, P. K. (2015). A business process modelling-enabled requirements engineering framework for ERP implementation. Business Process Management Journal, 21(3), 628-664

The framework comprises of four stages: -

Stage 1: A request for interest (RFI) is used to obtain information regarding functionality of the ERP. An as-is process model is developed with necessary functionality of the ERP is determined.

Stage 2: Development of the to-be processes are concluded. These processes will be a result of taking into consideration the ERP functionality, the organisation's strategy and its mission.

Stage 3: Development of the request for proposal (RFP), these documents incorporates the ERP functionality and is based on the to-be design from the previous stage. This document will list the functional specifications for the ERP implementation.

Stage 4: The implementation of the selected ERP with the selected vendor. The implementation is based on the new business processes. The ERP software can be evaluated by comparing the new processes and can be compared to the RFP.

In research conducted by Chuck and Eric (2007), they concluded that the success for ERP implementations can be linked to BPR/BPI initiatives. Furthermore, they stressed the importance of top management support for BPR/BPI initiatives.

2.8 Training and Education (TED)

TED is vital for any ERP implementation as it empowers users to understand the functionality and the processes of the chosen software. An effective training programme will ensure that users are confident in their ability to perform the required processing of transactions and extracting of the relevant reports (Ram, Corkindale, & Wu, 2013). An ERP software integrates all functions of the business, by ensuring TED is carried out effectively and users are able to understand the impact of their function on other parts of the business (Zhang et al., 2003). It is imperative that the appropriate knowledge transfer takes place between expert external consultants and internal users.

The world is a dynamic place with ever changing demands placed on businesses to upskill and re-skill their employees, therefore businesses should ensure that continuous training takes place to meet these needs (Somers & Nelson, 2001). This was also highlighted by M. Beheshti, K. Blaylock, A. Henderson, and G. Lollar (2014) citing that ERP is continuously modernised and training needs to keep pace. In addition, they noted that training should take different forms for example seminars and as well as hands on training should be conducted. By upskilling users with the software, this will increase the acceptance levels of the software leading to faster benefits realisation (Kronbichler et al., 2009).

When calculating the cost of an ERP project, adequate provision must be made for TED. Several ERP implementations fail to include TED costs in the initial costing of the projects leading to reduced TED.

In research by Bradley and Lee (2007), it was concluded that TED is a leading indicator of employee perceptions of the effective, efficient and the ease of use of ERP software that is being implemented and management should ensure adequate budget is allocated for this exercise. Users themselves understand the importance of TED as a critical factor in ERP success, this was confirmed by Ewout and Per (2018) wherein TED was ranked fourth most important critical success factor for an ERP implementation by users.

2.9 User Involvement

In order to ensure a smooth adoption of the ERP software, organisations should involve users of the software when the business requirements are gathered and during the duration of the implementation (Zhang et al., 2003).

Resourcing requirements should be identified at the start of the project and organisations must be able to make resources available for the duration of the project (Somers & Nelson, 2001). The selected project team member should not be the resource that is available. It should be someone with the best knowledge of the organisational processes and requirements. Users should also be able to understand the need for business process re-engineering. This will require understanding the capabilities of the selected ERP software, therefore one of the actions concluded by Olivier et al. (2009) is that user training must be properly defined and carried out to coincide with go-live. However, selected users should also be trained to a higher level and be available after go-live of the project to support other users by assisting to resolve issues that arise and train or re-train users if need be. Vilpola (2008), suggested that a key driver for implementation success of an ERP software is “user ability” of the software, therefore an implementation model that focuses on users should be considered for adoption.

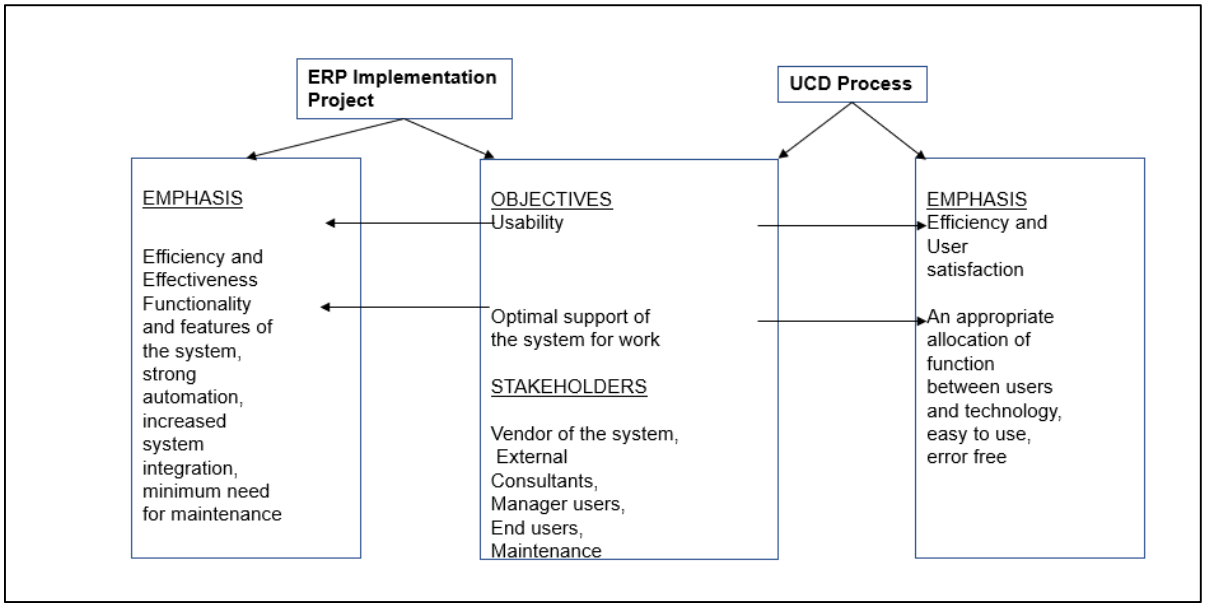
An implementation model like User-Centred Designed (UCD) (ISO 13407 1999) is a model that provides for the requirements of both the users and the organisation. The UCD model has four principles: -

i. Active involvement of users
ii. Distinction of users' tasks and the function of the technology
iii. Iteration of design solutions
iv. Multidisciplinary of design

A parallel can be drawn between the similarities between UCD and ERP software implementation see figure below (Vilpola, 2008).

FIGURE 4

COMMON OBJECTIVES OF ERP IMPLEMENTATION AND UCD PROCESS APPLIED IN ERP IMPLEMENTATION



Source: Vilpola, I. H. (2008). A method for improving ERP implementation success by the principles and process of user-centred design. Enterprise Information Systems, 2(1), 47-76

Vilpola (2008), further suggests that UCD can be applied to enhance the "user ability" of ERP software.

2.10 Communication

During any change project, the organisation has a need for information to allay fears that might exist. To ensure there is adequate communication, an open and honest communication policy must be implemented at the beginning of the project. Communication is a vital critical success factor in any project and is one of the recommendations for successful projects in USA and Europe (Ngai et al., 2008).

A communication plan must be written such that everyone is able to understand and interpret it. The plan should also set out the procedure and process for resolving any dispute that could arise during the implementation, that is, it should formalise the interactions within the organisation regarding the ERP project (Olivier et al., 2009).

Further, the project team should ensure that the organisation is informed of progress during the project. The organisation should not feel that the project team is working in a silo. Organisations must be aware of communication barriers during an ERP implementation. Examples of such barriers are limited IT-competence, knowledge of terms used by all in the team, attitudes and social influences resulting in managers not being able to participate in project meetings (Andersson, 2016). Constant relevant communication is therefore vital. In is also vital to understand the impact of communication quality on an ERP project. Aubert, Hooper, and Schnepel (2013), tested this notion. The results indicated that this was not always the case. It depends on the characteristic of success that is being evaluated. For example, communication quality played no role in understanding whether benefits were achieved but played an important part in user satisfaction during development process.

In the study by Ewout and Per (2018), communication was ranked a low eleventh out of the critical success factors they asked participants to evaluate. However, this should not detract from the importance of a good communication strategy in

an ERP implementation. The participants in the Ewout and Per (2018) had to rank a limited amount of critical success factors (thirteen) only.

2.11 Change Management

An ERP project will most likely require some changes to the way a person does their job. Change Management is the process of explaining this to them, dispelling any fears they may have and informing them of the benefits of the ERP software (Kronbichler et al., 2009).

Organisations should try to create an environment of openness to change and willingness to embrace new technology. This will assist them in their change management endeavours. This can be achieved through effective communication, dealing with fears of people, consistent and regular training and re-training if need be (Fiona, Janet, & Jinghua, 2001).

Education and training should be the pillars to launch an ERP project, which will assist with change management. Organisations must create a culture whereby change is everyone's task. It is estimated that over 50% of failures of ERP projects relates to lack of change management within the organisation (Somers & Nelson, 2001).

When implementing an ERP project, make change management an integral part of the project. This function should be controlled by people with the right skills, experience and must know the organisational culture so that they can engage the organisation with regards to the pending changes (Stapleton & Rezak, 2004).

2.12 Project Champion/Key Decision - Maker

ERP and other change projects should be publicised throughout the organisation to create awareness and buy-in for the project. The project champion or key decision-maker should be tasked with the responsibility of publicising the project (Sumner, 2000).

The project champion/key decision - maker should be a senior level person with sufficient knowledge of the business and authority to drive change within the organisation. This person should be accountable for the successful implementation of the project (Somers & Nelson, 2001).

In addition, other important tasks of the project champion/key decision-maker should be to mediate when conflict arises and manage resistance to the project as and when it arises. Transformational leadership is an important characteristic of a project champion/key decision-maker (Fiona, Janet, & Jinghua, 2001).

The project champion/key decision-maker should understand the ERP software being implemented in order for him to gain credibility when championing the project throughout the organisation. Shanks (2000), concluded a study on two ERP implementations, one successful and one unsuccessful in the same organisation. One of the first learnings to be adopted from the unsuccessful implementation was to appoint a project champion, someone who was able to make decision early in the project. This was also confirmed in research by Akkermans and Helden (2002) in which they analysed an implementation based on critical success factors identified by Somers and Nelson (2001) and found that the project commenced without a project champion and after a crisis a suitable champion was appointed.

2.13 Software Design, Testing and Troubleshooting

A strong technical team should be formed to work on the software design. The development activities that must to be completed should be clearly stated in the project plan. In addition, a robust testing plan must be adhered to and all customisations and testing plans should be documented. Developers need to cultivate a trust relationship with users, this will enhance the importance of testing to the users, resulting in proper testing being concluded prior to implementation of ERP software (Ewout & Per, 2018).

The technical team must be available to assist with trouble shooting at all stages of the deployment (Olivier et al., 2009). Kronbichler et al. (2009), notes that quality

assurance activities should be defined and implemented in the early stages of the project and the ERP implementation plan must make provision for testing of all interfaces to legacy systems and interfaces to any other software.

2.14 Post Implementation Success

Post implementation ERP success can be a controversial issue as it depends on whose perspective one is considering success from (Sondoss El, Assem Abd El Fattah, & Mohamed Hassan, 2008) for example a consultant delivering the project might have a different success measure to that of the organisation.

Markus, Axline, Petrie, and Tanis (2000), identified three phases in the "ERP experience cycle" with success metrics in each:

i. Success in the project phase
    a. Project cost relative to budget
    b. Project completion time relative to schedule
    c. Completed and installed system functionality relative to original scope
ii. Success in the shakedown phase
    a. Short-term changes occurring after system 'go live' in key business performance indicators such as operating labour costs.
    b. Length of time before key performance indicators achieve 'normal' or expected levels.
    c. Short-term impacts on the organization's adopters, suppliers and customers such as average time on hold when placing a telephone order.
iii. Success in the onward and upward phase
    a. Achievement of business results expected for the ERP project, such as reduced IT operating costs and reduced inventory carrying costs.
    b. Ongoing improvements in business results after the expected results have been achieved.

c. Ease in adopting new ERP releases, improved business practices, improved decision making, etc., after the ERP system has achieved stable operations.

While, Shang and Seddon (2002) developed a success framework from an organisational perspective as follows:

- Operational benefits: ERP supporting increased productivity among staff and reduced cycle time in processes that support customers, employees and suppliers.
- Managerial benefits: ERP supporting improved resource management, enhanced decision-making and improved performance at all levels of the organisation.
- Strategic benefits: Utilising the ERP in supporting business growth, business alliance, improved cost leadership, worldwide expansion, enabling digital strategies like e-commerce and the improvement in organisational competitiveness.
- IT infrastructure benefits: reduction in the support of legacy systems, increased systems capabilities for future business growth locally and globally and flexibility by integrating with external stakeholder systems.
- Organisational benefits: Improved collaborating between departments and improved morale among staff.

3. PURPOSE OF STUDY

ERP implementations are expensive exercises. The high failure rate of ERP implementations in achieving desired results has prompted this study. The study aims to assist organisations implementing ERP software to understand the relationship between critical factors and post implementation success. This will enable organisations to plan and understand decisions that should be considered regarding factors influencing an ERP implementation to have the best chance of success.

With the number of stakeholders both internal and external in ERP implementations, post implementation success is defined differently among stakeholders. External stakeholders such as consultants will seek to deliver a project within time lines and the budget. While success for internal stakeholders may vary with users, senior management and directors are looking to use the ERP software as a tool to easily drive and implement their strategy.

3.1 Study delimitations

Numerous factors influence the outcome of an ERP project. For this study, only the following critical factors listed were considered.

The critical input factors are: -

a) *Business Planning and Strategy*: Document where ERP project is defined, and ERP vision of the company is outlined – positive factor.
b) *Top Management Support*: Guidance and support provided by senior leadership within the organisation – positive factor.
c) *Multi Projects on the go*: The organisation is currently executing numerous projects over and above an ERP implementation – negative factor.
d) *Previous ERP Experience within Organisation*: Project team consists of individuals who have previously implemented ERP – positive factor.

e) *Partner Support (use of consultants)*: Engaging a consulting company to provide expert advice and knowledge to execute a successful ERP implementation – positive factor.

While general critical factors as outlined in the literature review were:

a) *Time*: The duration of time needed to implement an ERP software
b) *Budget*: The financial resources needed to complete an ERP implementation
c) *Project Management*: The process for ensuring scope, timelines and budget is adhered too
d) *Business Process Re-engineering*: Redesigning of processes to match that of the ERP selected
e) *Training and Education*: Programs to ensures all users are confident in using the ERP implemented
f) *User Involvement*: Ensuring organisation's staff participates in every facet of the ERP implementation
g) *Communication*: Flow of information with the organisation to ensure all stakeholders are informed regularly
h) *Change Management*: Process of dispelling fear among staff of the pending ERP implementation
i) *Project Champion and Key Decision Maker*: A senior level person with sufficient knowledge of the business and authority to drive change within the organisation
j) *Design, Testing & Troubleshoot*: A team responsible for development of the ERP software and well as ensuring the software is free from bugs and assisting with support once the ERP is live

Similarly, post implementation success for this study is as per Shang and Seddon (2002) Operational benefits: ERP supporting increased productivity among staff and reduced cycle time in processes that support customers, employees and suppliers.

- Managerial benefits: ERP supporting improved resource management, enhanced decision-making and improved performance at all levels of the organisation.
- Strategic benefits: Utilising the ERP in supporting business growth, business alliance, improved cost leadership, worldwide expansion, enabling digital strategies like e-commerce and the improvement in organisational competitiveness.
- IT infrastructure benefits: reduction in the support of legacy systems, increased systems capabilities for future business growth locally and globally and flexibility by integrating with external stakeholder systems.
- Organisational benefits: Improved collaborating between departments and improved morale among staff.

This definition represents an organisational point of view. This research is not limited to a specific industry or ERP software.

3.2 Study limitations

This study did not aim to investigate additional critical or post implementation success factors.

3.3 Assumptions

Only individuals that have experience in being part of an ERP project participated in this research. Input factors and critical factors affecting ERP implementations not only influences the outcome of the ERP project but also influences the management and extent of the input and critical factors itself.

4 Problem Investigated

ERP implementations are extensive exercises both in monetary terms and time dedicated by the organisation in completing such implementations. Over the years, several well documented ERP failures have occurred.

This research investigates if certain critical factors both input and general are managed, what will the likelihood of implementation success of an ERP implementation be?

5. Research Objectives

Research Question One:

The best-case scenario – having top management support, ERP outlined in business plan and part of the strategy of the organisation, prior implementation experience in organisation and vendor support what would be the outcome for post implementation success?

Research Question Two:

The worst-case scenario – having multi projects on the go and not having the positive input factors will result in lack of post implementation success.

Research Question Three:

How can the impact of having multi projects on the go be mitigated to obtain post implementation success in the different categories?

Research Question Four:

What is the predication of success for internal external factors vs external input factors?

Research Question Five:

What scenarios are likely for the organisations to obtain post implementation success in all five defined success criteria?

Research Question Six:

What is the best scenario for achieving success in any of the post implementation success factors?

Research Question Seven:

Which positive input factor will result in the highest predication of success?

Research Question Eight:

What is the perceived impact of engaging a partner to assist in the implementation of ERP software?

6. Research Methodology

In determining the causal relationship and the strength thereof between critical factors and successful ERP implementations, a fuzzy cognitive mapping process was undertaken. Fuzzy cognitive mapping is a process that identifies causal relationships between facts, things, process, and factors. A fuzzy cognitive map (FCM) allows one to determine how intricate factors and scenarios relate to each other in a complex environment Kosko (1993). Therefore, Fuzzy cognitive mapping is a prediction model that allows one to analyse outcomes of complex systems.

Papageorgiou and Stylios (2008), summarises the main features of FCM models as:

- Representation of human knowledge on the modelling and operation behaviour
- Exploitation of human's operator experience
- Selection of different factors
- Relations among different factors of the system
- Symbolic representation of system's behaviour
- Human-like reasoning
- Qualities for planning, decision making and failure detection.

Several factors influence the success of ERP implementations. In addition, ERP success can mean different things to different organisations as resources available for implementations are always limited. Managing one critical factor effectively given certain input factors might lead to less attention being needed for another critical factor or vice versa. Another scenario could be that the management of a combination of critical general factors, given the available critical input factors, will lead to the post implementation success that the organisation desires. It can therefore be concluded that any ERP implementation is a complex interrelationship of critical input factors and critical general factors that aims to achieve the organisation's desired outcome.

FCM can be utilised to model these complex scenarios which outcomes are determined by the convoluted interrelationships and interdependencies between the input factors (Stacey, 2016). FCM can style any coordination with three distinct characteristics - causality indicating positive or negative relationship, strength of the relationships and the dynamic connections between the nodes whereby a change in one node could influence the other node or nodes (Papageorgiou & Stylios, 2008). An ERP implementation can be described as a complex coordination of organisation staff, senior management, external consultants and other stakeholders.

In trying to understand the complex relationships within the fuzzy cognitive maps, one could “assign weighting e.g. 1 to -1 indicating positive or negative weighting in the relationship or one could use words e.g. “a little”, “somewhat” or “more or less”. This method of allocating weighting to relationship indicates FCM is ‘fuzzy”” Kosko (1993) p104. Therefore, as noted by Stacey 2016, FCM is a semi-quantitative technique.

Semi-quantitative techniques lie between qualitative and quantitative techniques, this is in conditions where dependable quantitative data is not readily available but certain well-defined qualitative techniques can be applied. Semi-quantitative techniques do not need to be precise and accurate to be valid because it uses approximations, results should not be viewed in absolute terms. Therefore the analyses must be viewed in relative terms and results can be practically understood as ordinal level data (Stacey, 2016). There have been numerous qualitative studies undertaken on the impact of Critical Factors on ERP implementations. However, very few have concentrated on the inter relationships between critical factors and how these impact post implementation ERP successes.

For this study, critical factors were divided between input and general. A FCM of critical input factors, critical general factors and ERP post implementation success was constructed. The input and general factors were determined from

the literature review of factors influencing ERP implementations. In addition, some of the critical factors were defined by the author and the literature review.

To determine the causal relationship and strength between the critical input factors, critical general factors and post implementation ERP success among organisations, a survey was conducted. FCM can also be defined as a modelling methodology used to take advantage of individuals experience and knowledge about a particular subject (Papageorgiou & Stylios, 2008). Hence, the target group for the survey is consultants and business representatives that have played roles in ERP implementations.

FCM is growing in popularity because it is simple and close to human reasoning. FCM can be used to model complex and dynamic systems (Vergini & Groumpos, 2016). An ERP implementation project is a complex undertaking. It is made even more complicated by the size of the organisations, the necessity to obtain expert opinion from all role players in an organisation and leading to multiple parameters that must be managed effectively to achieve success. Therefore, FCM is an appropriate tool to consider in analysing this complexity.

The survey requires participates to rank (weight) their understanding of the causal relationships between critical input factors, critical general factors and post implementation ERP success. This consists of participants ranking each critical input factor, critical general factor against all other critical factors and post implementation success as follows:

Whether the strength of relationship was perceived to be:

Extremely positive, moderately positive, slightly positive, neutral, slightly negative, moderately negative or extremely negative.

This data driven approach assisted in determining the weighting to understand the strength and directions of the causal relationship between the input factors, critical factors and post implementation ERP success. The calibration of the weightings of the relationships is as follows:

- Strong -+ 0.20
- Medium -+ 0.10
- Weak -+ 0.05

This survey is carried out considering all possible relationships however, the author identified that the following relationships to be one way as depicted in the table below (1 represents one-way relationships while 2 represents two-way relationships)

FIGURE 5

INDICATION OF ONE OR TWO-WAY RELATIONSHIPS BETWEEN FACTORS

	Business Planning and Strategy	Top Management Support	Multi Projects on the go	Previous ERP implementation experience within organisation	Partner Support (use of consultants)	Time Available	Budget Available	Project Management	Business Process Re-engineering	Training and Education	User Involvement	Communication	Change Management	Project Champion and Key Decision Maker	Design, Testing & Troubleshoot
Business Planning and Strategy		2	2	2	2	2	2	2	1	1	1	1	1	2	1
Top Management Support	2		2	2	2	2	2	2	2	2	2	2	2	2	2
Multi Projects on the go	2	2		2	2	2	2	2	2	2	2	2	2	2	2
implementation experience within organisation	2	2	2		2	2	2	2	2	2	1	2	2	2	2
Partner Support (use of consultants)	2	2	2	2		2	2	2	2	2	1	1	1	1	2
Time Available	2	2	2	2	2		2	2	2	2	1	2	2	2	2
Budget Available	2	2	2	2	2	2		2	2	2	2	2	2	2	2
Project Management	2	2	2	2	2	2	2		1	1	2	2	1	2	1
Business Process Re-engineering	1	2	2	2	2	2	2	1		2	1	1	1	2	1
Training and Education	1	2	2	2	2	2	2	1	2		1	2	1	2	2
User Involvement	1	2	2	1	1	1	2	2	1	1		2	1	1	1
Communication	1	2	2	2	1	2	2	2	1	1	1		1	2	1
Change Management	1	2	2	2	1	2	2	1	1	2	2	1		1	2
Project Champion and Key Decision Maker	2	2	2	2	1	2	2	2	2	2	1	2	1		1
Design, Testing & Troubleshoot	1	2	2	2	2	2	2	1	1	2	1	1	2	1	

Business planning & strategy and

a) Business Process Re-engineering – An organisations business planning and strategy will document the need for the ERP software to be implemented and detail how this will meet the strategic objects of the organisation. Part of the implementation will be to assess the current business process and conduct a gap analysis to the chosen ERP and decide the extent to which business processes will be reengineered.
b) Training and Education (TED) – The business plan will not define the training and education plan. The extent of the post implementation benefits will result from the planning and execution of training and education itself.
c) User Involvement – User involvement will be dependent on several factors including availability and capacity of staff to be involved in the project. The business planning and strategy will only outline the need for staff to be involved. Management will need to understand the current requirements of the organisation and the demands on the ERP implementation and free up the necessary skilled staff to be involved.
d) Communication – This falls under the execution phase of the project. The business plan and strategy will not detail the type of communication or a communication plan for that matter, this will be part of the project management.
e) Change Management - Change management also falls into the execution category and will be dependent on the project management execution.
f) Design, Testing & Troubleshoot (DTT) – This forms part of the execution phase of the project. The success of this activity will be dependent on project management execution.

Partner Support/Use of consultants and

a) User Involvement – User Involvement is an internal decision within the control of management. A partner on an ERP implementation can make recommendations but will not be able to take decisions regarding the availability of the organisation’s resources for the duration of the project.

b) Communication – Communication is also an internal activity conducted by the organisation. Partners can suggest and provide guidance but the quality and quantity of the communication process rests with the organisation itself.
c) Change Management – Change Management is a responsibility of organisation's management. Partner support will have little or no impact if management does not take the initiative.
d) Project Champion & Key Decision Maker – This is an individual that an organisation will have to identify and choose. A partner can outline the requirements, but management of an organisation will impact the effectiveness of this role by choosing the most qualified person to perform this task.

Previous ERP experience and

a) User involvement – management will be responsible for making individuals available for the project.

Time available and

a) User involvement depends on the organisation's management. Whatever the duration of the project is, it is management's responsibility to make users available to participate in the project.

Business Process Reengineering (BPR) and:

a) User involvement is a management decision and therefore re-engineering of business processes will not lead to involvement of users.
b) Communication – BPR will not impact communications, however communications will impact BPR as the organisation will need to understand the impact and extent of BPR.
c) Change Management – Change Management will impact BPR, as it is part of executing the project. BPR will not impact the execution of Change Management.

d) Project Management is part of the execution of the project and will impact BPR not vice versa.
e) Design Testing and Troubleshooting of the ERP implementation is also part of executing. At this stage, the BPR would be completed to match that of the chosen ERP.

Training and development and

a) Project Management – Project Management will influence TED however, TED are programmes that management has designated which must be completed. Therefore, project management will influence TED not vice versa.
b) User Involvement – user involvement is a management responsibility. The relationship will be the inverse
c) Communications – This relationship is inverse. Execution of the communication plan will influence TED.
a) User Involvement and Communication – communication will impact user involvement. Therefore, its relationship can be classified as inverse. User Involvement is a priority of management and it is their responsibility to plan such that users are involved in the project

Change Management and

a) Project Management – This relationship is inverse. – project management execution will impact change management
b) Communication – will impact change management. Hence this relationship is inverse only.
c) Project Champion and Key Decision – Project Champion and Key Decision Maker will impact change management. This relationship is inverse only

Project Champion and Key Decision and

a) User Involvement - Project Champion and Key Decision Maker will not impact user involvement. Management needs to that ensure users are available to participate in the project.

Design Testing and Troubleshooting (DTT) and

a) Project Management – DTT will not impact project management but project management execution will impact DTT
b) BPR: BPR precedes the DTT – hence DTT will not impact BPR.
c) User involvement will impact DTT not the other way around as user involvement is a management responsibility
d) Communication impact DTT not vice versa
e) Project Champion and Key Decision Maker – A project champion and key decision maker will impact DTT not vice versa

Qualtrics was the tool used to design and administer the survey. This method allowed for a standardised approach in gathering the relevant data. This also made distributing the survey to the appropriate target audience easier. The survey was distributed via e-mail and a social media network called LinkedIn. Forty-seven (47) people answered the survey, with forty (40) being respondents internal to organisations while seven (7) were external. Thirty-four (34) of the respondents participated in an on-premise implementation while thirteen (13) participated in a cloud implementation. On premise ERP implementation is ERP software hosted by organisation's servers while cloud implementation is ERP hosted by vendors in the cloud commonly termed SAAS - Software as a Service. Several ERP software was represented including SAP, Oracle, Microsoft Dynamics, Sun and other customised developed software.

Once the weight of the relationships was established, several questions were considered.

6.1 Validity and Reliability

The reason that validity of research must be safe guarded, is because terms or definitions could mean different things to different participants. While reliability is to safe guard consistency in results under similar conditions all the time (Bell, 2005). To ensure validity and reliability of the research, the definitions for the nodes of the FCM was provided in the survey forms. In addition, a pilot study of five recipients was analysed to ensure that the understanding of the meaning of the terms and the purpose of the survey is clear to the participants. The feedback from these participants was incorporated into the final survey that was released to the target audience. The pilot study participants were both representatives from ERP project team within organisations and external consultants.

6.2 Managing Ethical Issues

This research did not seek to ask any personal information. The survey questions asked about the respondent's experience of an ERP implementation and their perception of the relationship between critical input factor, critical general factors and post implementation success of that implementation. Furthermore, the survey explicitly asked for permission to participant and was conducted anonymously.

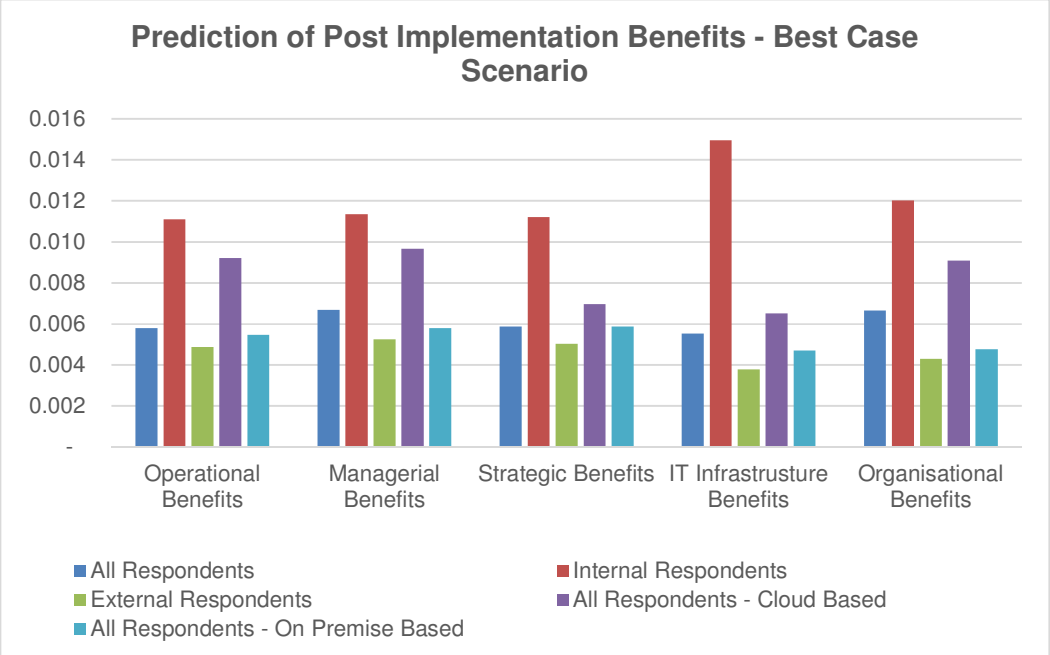
7. RESULTS

Research Question One:

The Best-case scenario is having top management support, the ERP project outlined in a business plan and part of the strategy of the organisation, prior ERP implementation experience within organisation and vendor support. In addition, the project team and the organisation are not distracted by other ongoing projects. The organisation's management, users and the project team can dedicate their effort to the ERP implementation. With this scenario what would be the prediction for post implementation success?

FIGURE 6

BEST CASE SCENARIO



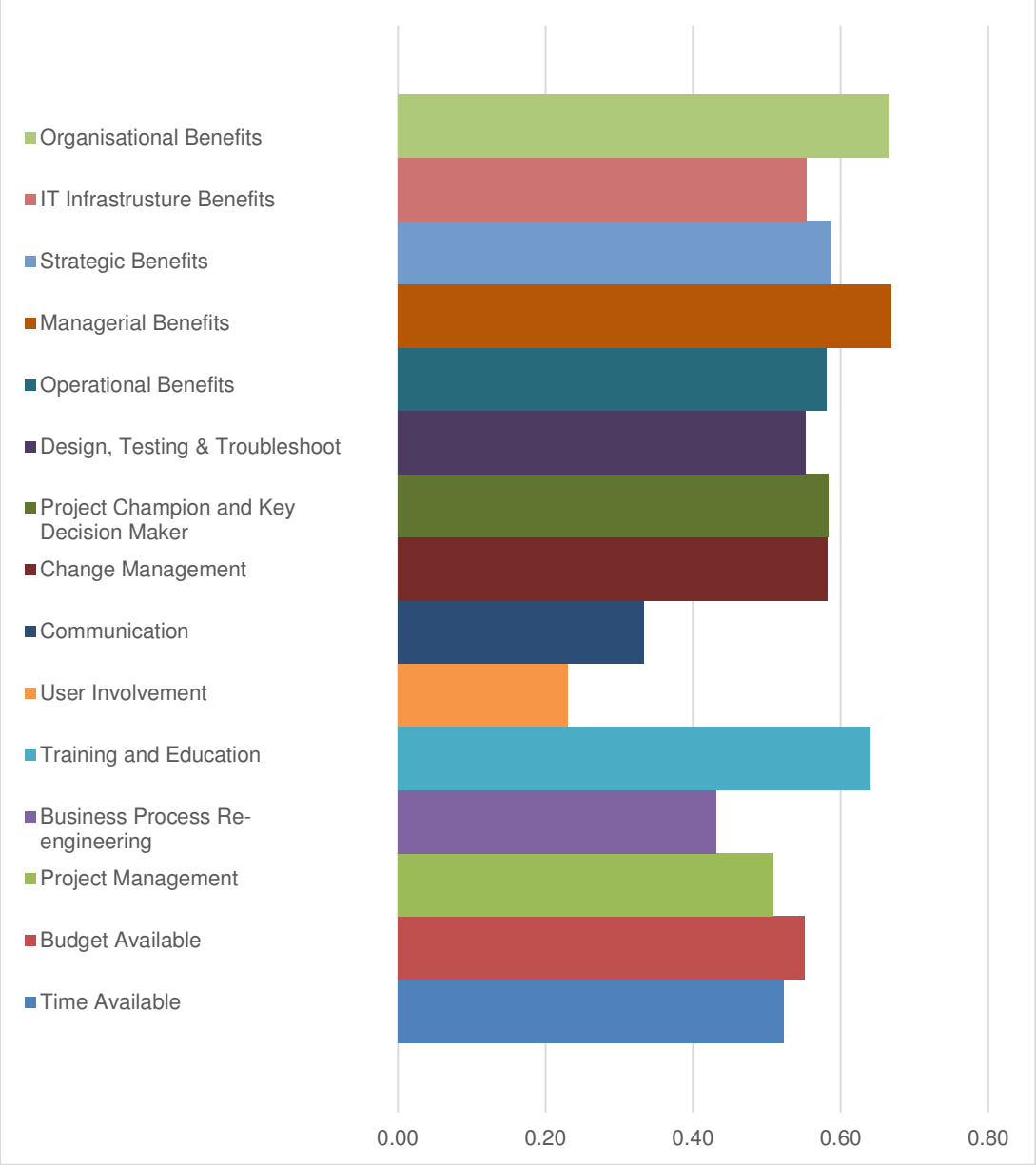
This scenario was analysed based on all respondents, internal respondents – these are respondents who were part of the implementation team within their organisations and external respondents – these are respondents who have implemented ERP projects as consultants to organisations. The results were

analysed between on premise ERP implementation – ERP software hosted by organisation's servers versus cloud implementation – ERP hosted by vendors in the cloud commonly termed SAAS – Software as a Service.

The results from the model predict that this scenario will have a positive impact on obtaining post implementation benefits of implementing an ERP software. In addition, the results predict that all five categories of post implementation benefits will possibly be achieved. This result does not change whether the respondents are internal or external to the organisation or whether the ERP being deployed is cloud or on premise.

FIGURE 7

BEST CASE SCENARIO - ALL RESPONDENTS

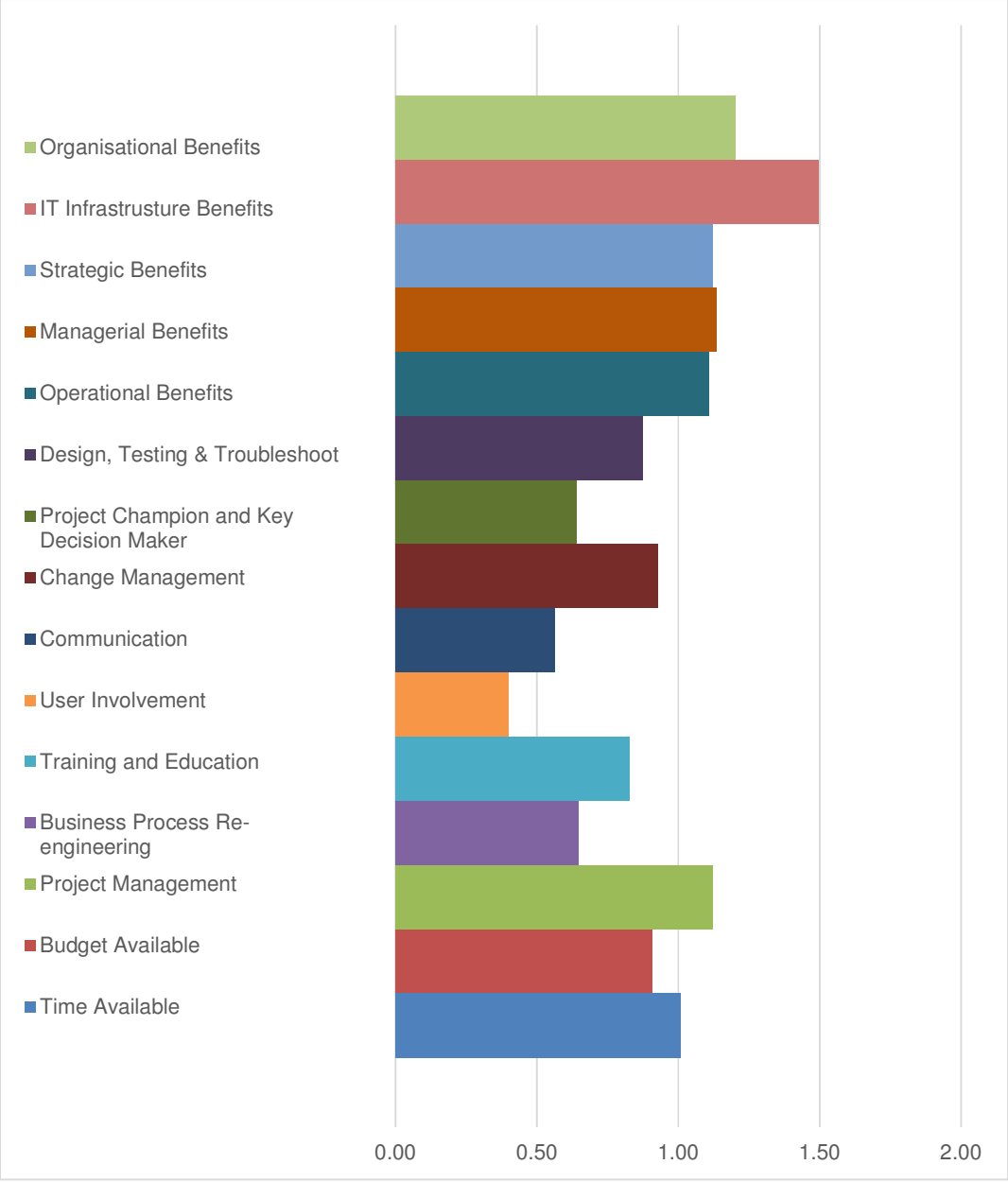


The model also predicates based on the respondents' answers that all critical general factors will also have a positive impact. The lowest positive impact on critical factor is user involvement. This can be due to most organisations being staffed to capacity with very little room to take on additional duties. When

embarking on an ERP implementation management will need to carefully analyse their current staff complement, whether there is capacity for such a strategic project as well as the mitigating strategies they might need to employ. Numerous studies have been completed indicating that user involvement is one of the most integral factors for ERP implementation success (Zhang et al., 2003), (Somers & Nelson, 2001) and (Olivier et al., 2009).

FIGURE 8

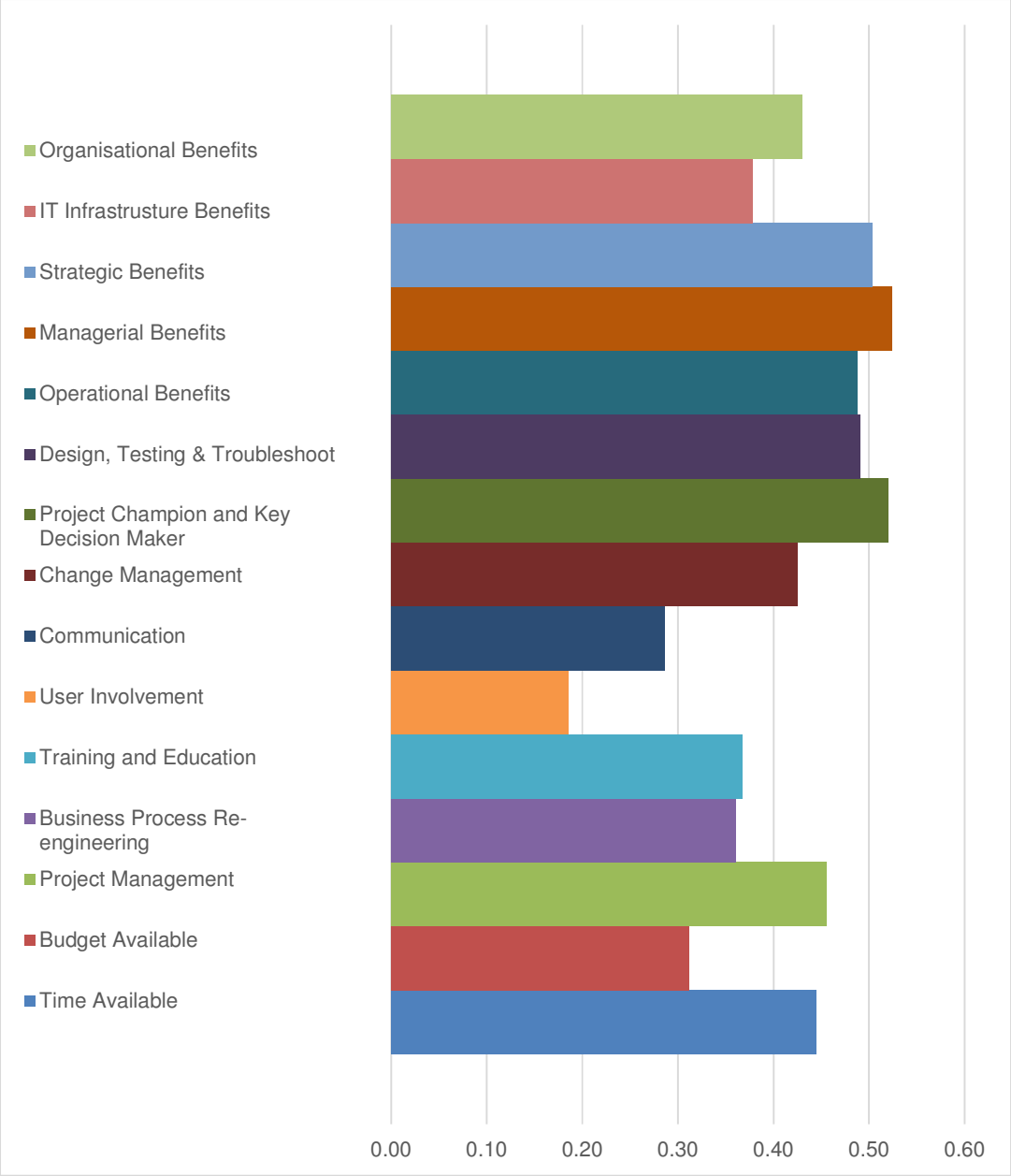
BEST CASE SCENARIO - INTERNAL RESPONDENTS



If we look at the model for respondents internal to the organisation, a similar picture emerges, with all five categories predicted to achieve post implement success and user involvement the least positive.

FIGURE 9

BEST CASE SCENARIO EXTERNAL RESPONDENTS



The results for respondents external to the organisation reflect a similar relationship to post implementation success across all categories. The results for

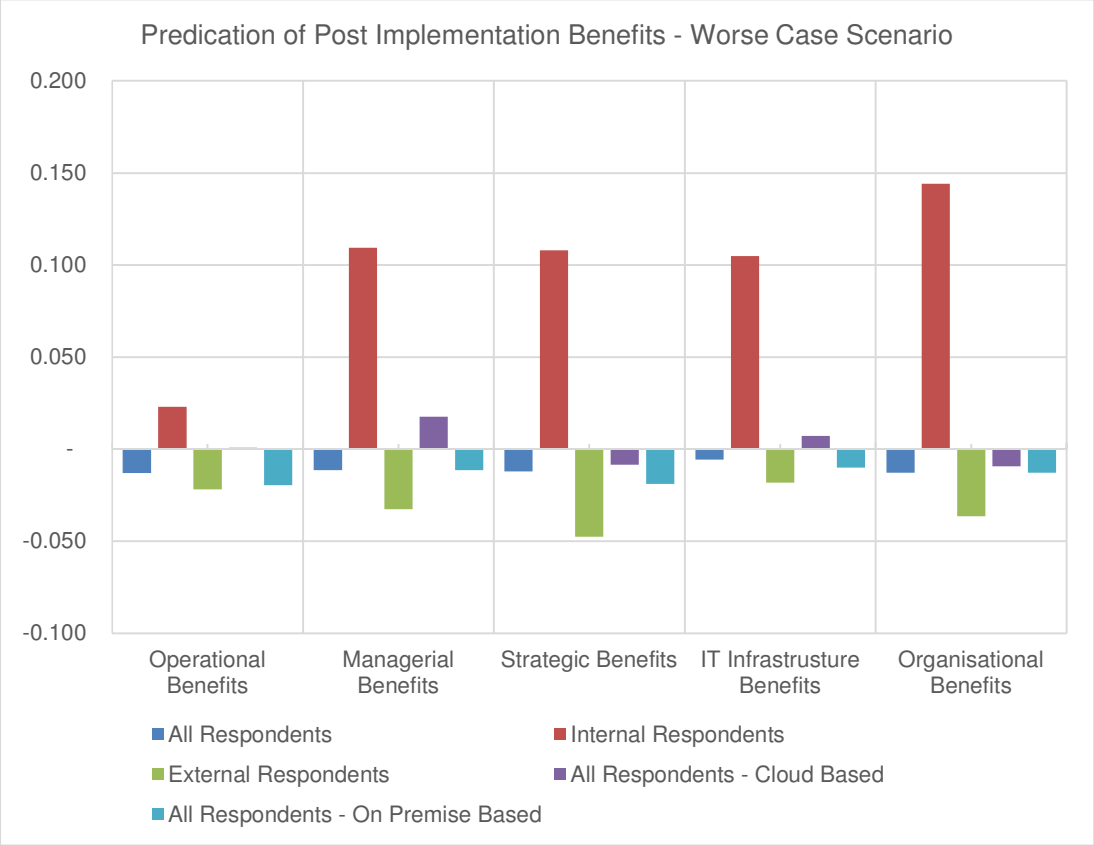
critical factors also produce similar results with user involvement being the one that must be managed closely. This prediction does not change whether the implementation is cloud based or on-premise ERP that is being deployed. Despite more organisations moving to adoption of cloud ERP (Panarama Consulting Solutions, 2018), it would seem that these input factors produce the same prediction of success.

Research Question Two:

The worst-case scenario – having multi projects on the go and not having the positive input factors of top management support, previous ERP experience, ERP documented in a business plan or utilising consultants will result in lack of post implementation success.

FIGURE 10

THE WORST CASE SCENARIO



The worst-case scenario is having multi projects on the go, not having Top Management Support, not having the ERP project documented as part of the organisation's strategy in its business plans, not engaging a partner (consultants) and not having any prior ERP implementation experience. This scenario was analysed based on all respondents, internal respondents – these are respondents who were part of the implementation team within their organisations

and external respondents – these are respondents who have implemented ERP project as consultants to the organisations. The results were also analysed between on premise ERP implementation – ERP software hosted by organisation's servers versus cloud implementation – ERP hosted by vendors in the cloud commonly termed SAAS – Software as a Service.

This scenario is predicted to result in none of the potential post implementation benefits being realised. Without any benefits, such a scenario will result in additional costs, staff becoming frustrated and erosion of shareholder value as ERP software and implementation is a costly exercise to the organisation. The impact of such failures also includes but is not limited to erosion of brand perception by customers. When we consider the prediction of internal versus external respondents, this picture changes in that internal respondents predict success in all categories. However, external respondents' prediction indicates none of the categories indicating success. This would indicate that internal stakeholders are bullish about realising success when previous ERP experience is not available within the organisation. Internal stakeholders lack the experience of an ERP implementation. While external consultants are bearish. This could be because of the experience an external consultant has across multiple implementations. The study did not ask participants about the number of implementations completed.

If we analyse cloud versus on premise implementation, the prediction on the worst-case scenario for cloud implementation, is success on only one category, this being operational benefits. While for on premise implementation the prediction is for none of the categories to achieve success. Cloud implementation such as SAP business by design or Oracle Fusion, is a quick deployment solution, therefore the prediction of success on at least operation benefits is that despite having multiple project, due to the nature of such implementation some post implementation benefits can accrue.

FIGURE 11

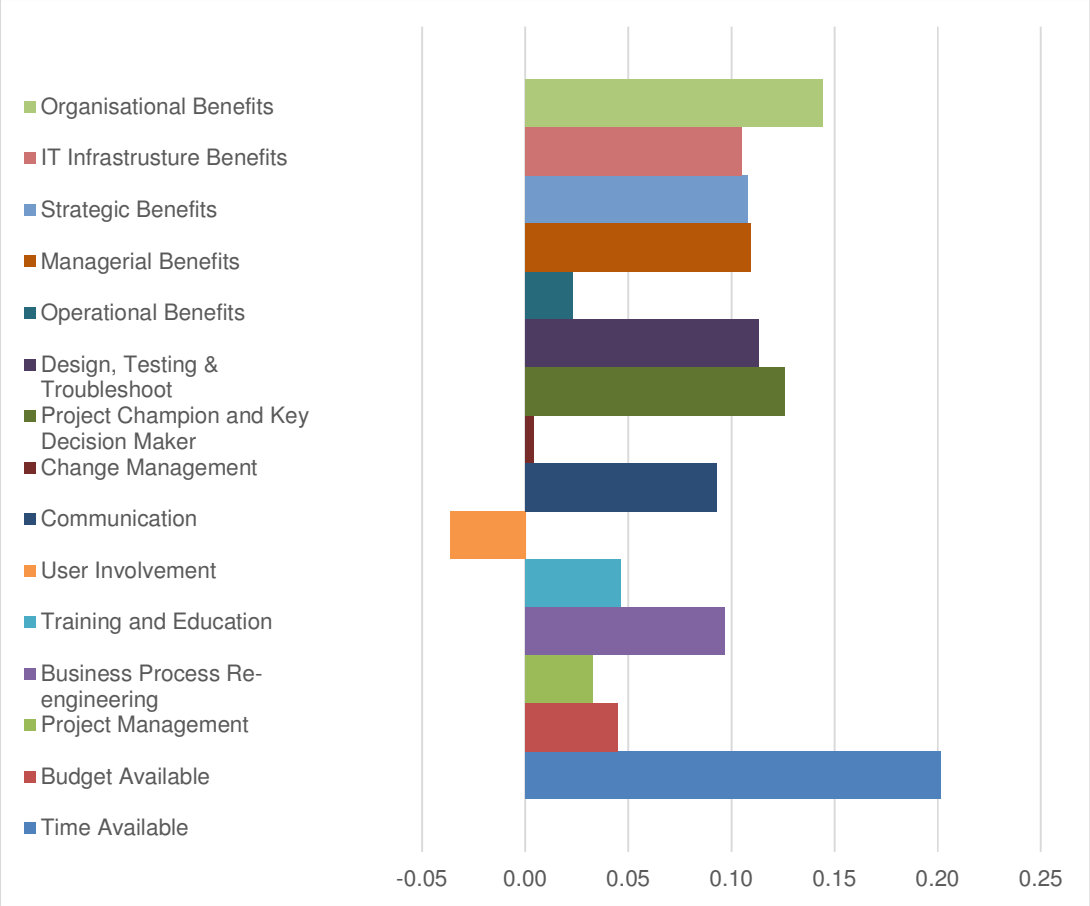
THE WORST CASE SCENARIO ALL RESPONDENTS



The model also predicts that in this scenario (worst case) nearly all the critical general factors was negative. The only critical general factors that render a positive relationship is time available for implementation and the impact of having a project champion and key decision maker. However, time available does not mean much in implementing an ERP software on time without any of the post implementation benefits accruing to the organisation. Also, having a project champion and key decision maker to facilitate the implementation does not guarantee success because such an implementation is a complex system of critical input and critical general factors that must be carefully managed.

FIGURE 12

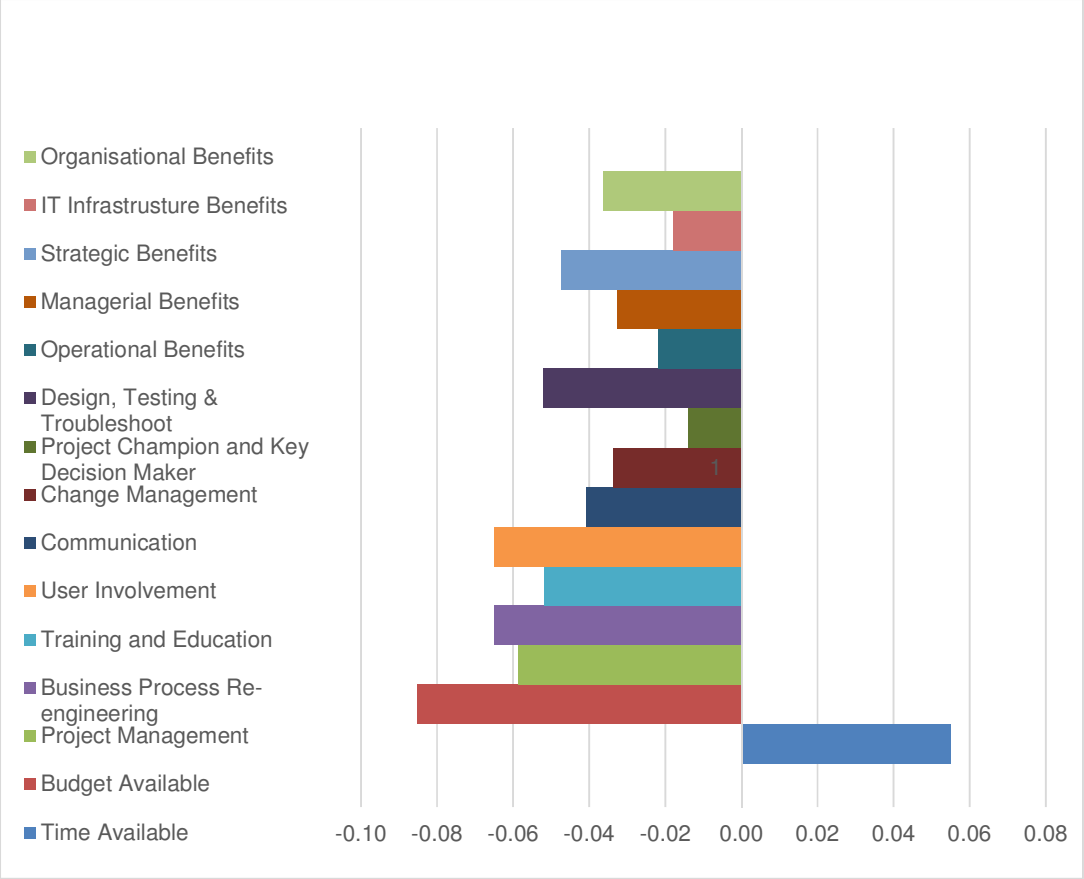
THE WORST CASE SCENARIO - INTERNAL RESPONDENTS



The picture changes with internal respondents only, there is a more positive perception on the prediction of success across all factors except for user involvement. Internal respondents understand the constraint of freeing up capacity for the organisation to take on another project amongst the others they are currently implementing. Therefore, by having multiple projects on the go, this is perceived by internal respondents to have a negative relationship on users being involved in an ERP project.

FIGURE 13

THE WORST CASE SCENARIO - EXTERNAL RESPONDENTS



Again, when external respondents are analysed, the picture is more bearish except for time available. External respondents have the knowledge and experience of multiple ERP implementations across various organisations and therefore perceive the relationship on these critical factors as being negative.

Marginal Impact Analysis

Research Question Three:

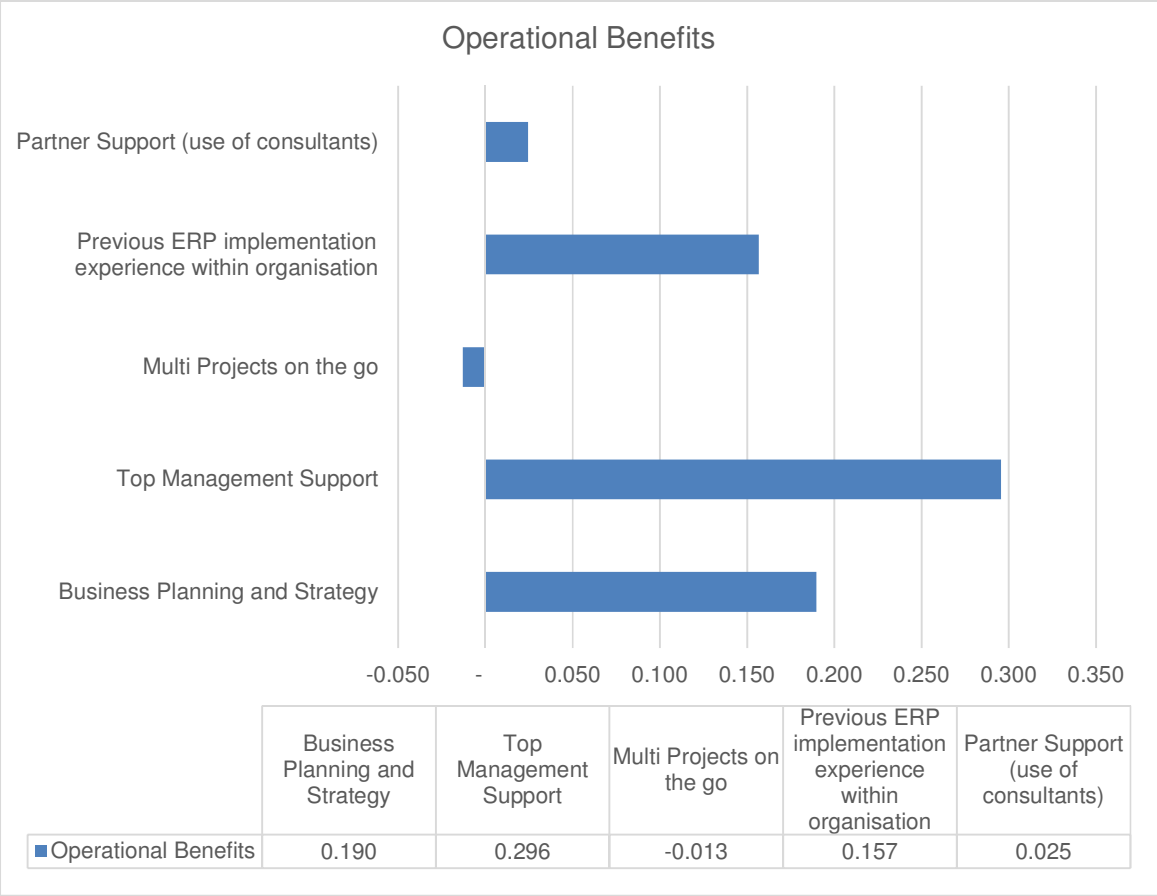
How can the impact of having multi projects on the go be mitigated to obtain post implementation success in the different categories? This question was analysed based on all five post implementation success factors as defined for this research.

Organisations are currently operating in ever changing environments. Management of these organisations are being challenged by shareholders to provide greater returns, customers who demand the quality of products at an affordable price, employees who are more diverse across all demographics and other stakeholders requiring the maintenance of their interests. It is common place for management to be faced with numerous projects requiring implementation to achieve their goals. An ERP could be one of the additional projects that must be implemented successfully to obtain post implementation success that will assist management in achieving their goals.

Marginal Impact - Post Implementation Success: Organisational Benefits

FIGURE 14

MARGINAL IMPACT OPERATIONAL BENEFITS



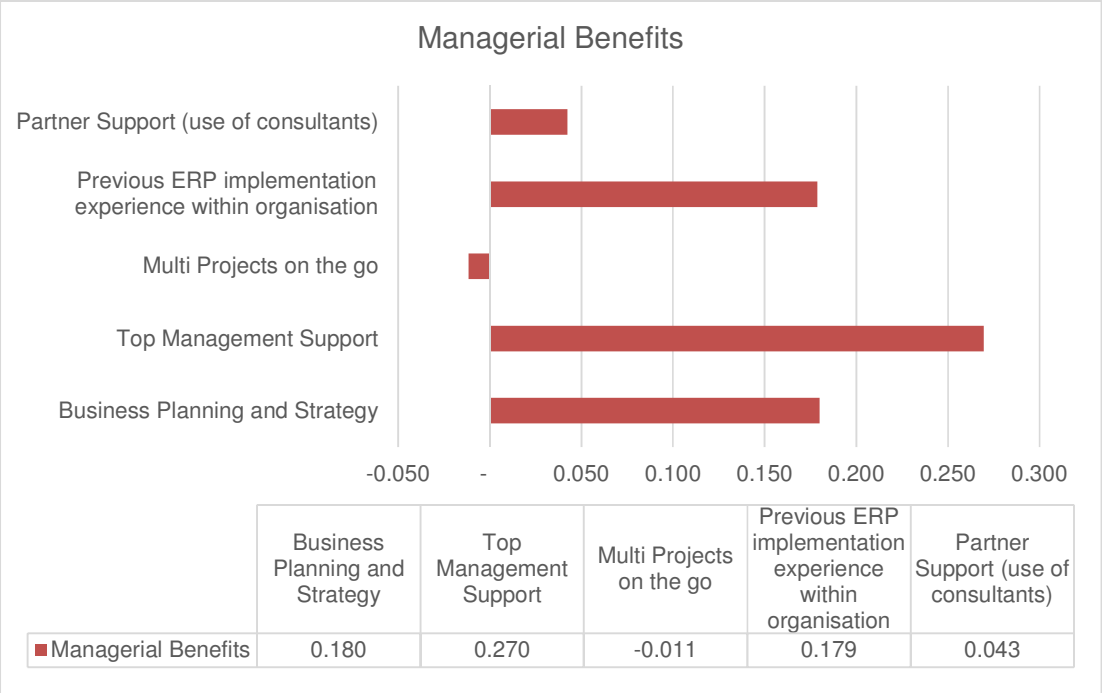
	Business Planning and Strategy	Top Management Support	Multi Projects on the go	Previous ERP implementation experience within organisation	Partner Support (use of consultants)
Operational Benefits	0.190	0.296	-0.013	0.157	0.025

The diagram above indicates that to achieve post implementation success of operational benefits, at the very least, management should engage a partner (consultant) to assist with the ERP implementation. The model predicts that engaging a partner (consultant) will neutralise the impact of having multiple projects on the go. This could be in the absence of the other input factors. From the results, having any of the other input factors will also mitigate having to concentrate on multiple projects on the go.

Marginal Impact - Post Implementation Success: Managerial Benefits

FIGURE 15

MARGINAL IMPACT MANAGERIAL BENEFITS



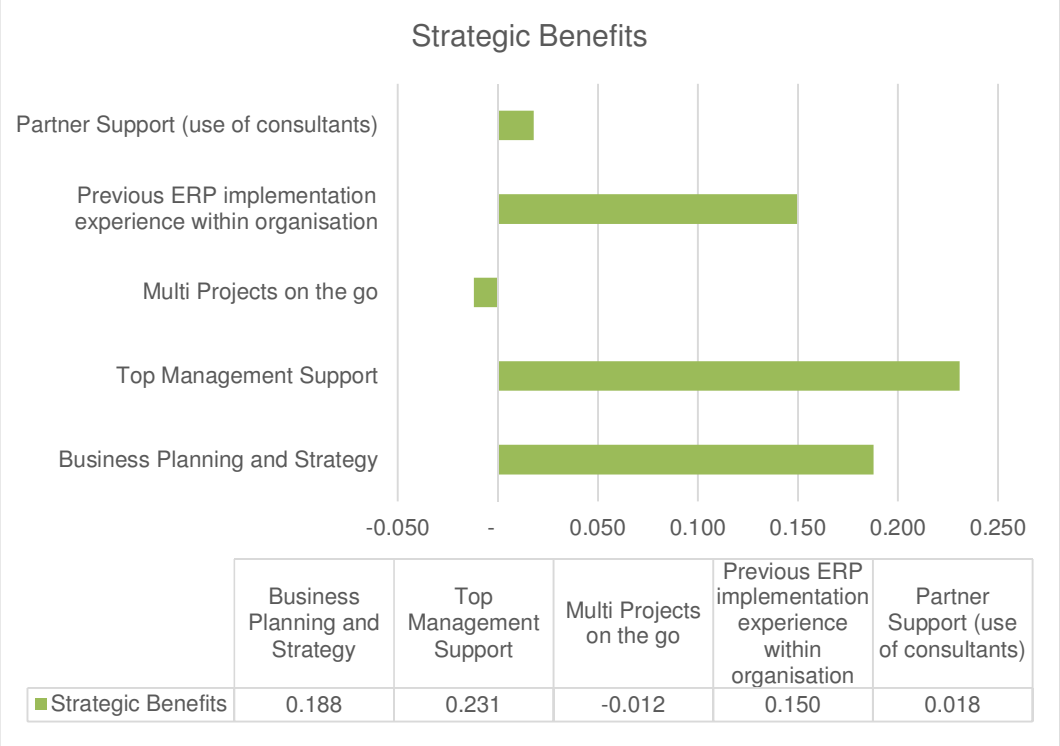
	Business Planning and Strategy	Top Management Support	Multi Projects on the go	Previous ERP implementation experience within organisation	Partner Support (use of consultants)
Managerial Benefits	0.180	0.270	-0.011	0.179	0.043

To mitigate the impact of multiple projects on the go to achieve post implementation success of managerial benefits, management should engage a partner (consultant) to assist with the implementation, at the very least. This is when the other input factors are absent. Any one of the other input factors alone (top management support, having previous ERP experience within the organisation and documenting the ERP project as part of a business) will also mitigate having multiple projects on the go.

Marginal Impact - Post Implementation Success: Strategic Benefits

FIGURE 16

MARGINAL IMPACT STRATEGIC BENEFITS



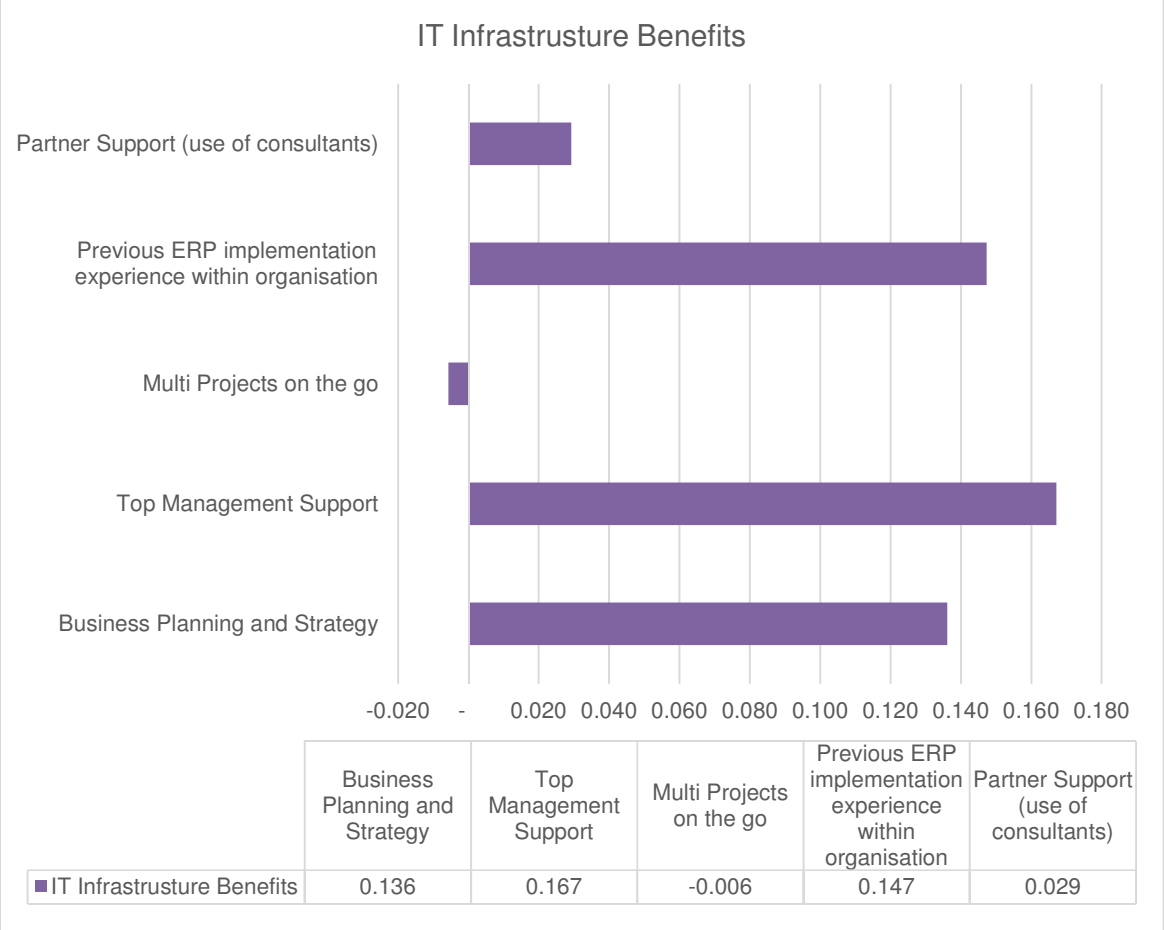
	Business Planning and Strategy	Top Management Support	Multi Projects on the go	Previous ERP implementation experience within organisation	Partner Support (use of consultants)
Strategic Benefits	0.188	0.231	-0.012	0.150	0.018

Similarly, with achieving post implementation success of strategic benefits, management should at least engage a partner (consultant) to assist with implementation if one of the other input factors is not available.

Marginal Impact - Post Implementation Success: IT Infrastructure Benefits

FIGURE 17

MARGINAL BENEFITS IT INFRASTRUCTURE BENEFITS



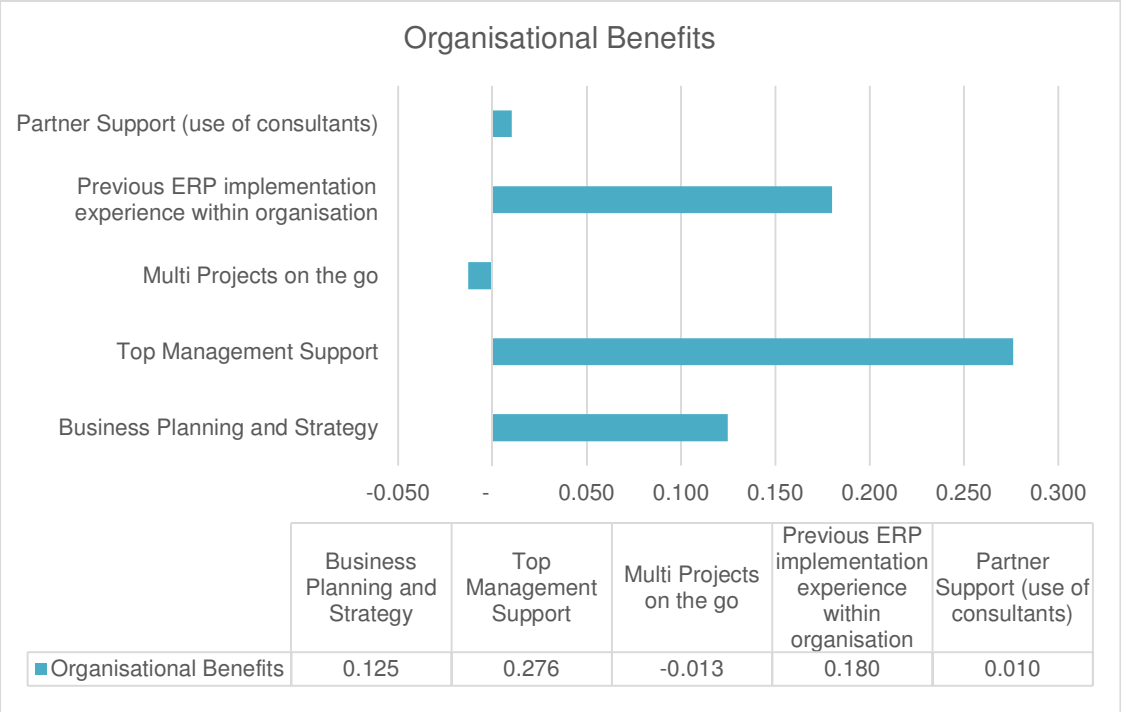
	Business Planning and Strategy	Top Management Support	Multi Projects on the go	Previous ERP implementation experience within organisation	Partner Support (use of consultants)
IT Infrastrusture Benefits	0.136	0.167	-0.006	0.147	0.029

Similarly, to mitigate having multiple projects on the go, the least management can do is engage a partner to support them with the ERP implementation if one of the other input factors is not available.

Marginal Impact - Post Implementation Success: Organisational Benefits

FIGURE 18

MARGINAL BENEFITS ORGANISATIONAL BENEFITS



	Business Planning and Strategy	Top Management Support	Multi Projects on the go	Previous ERP implementation experience within organisation	Partner Support (use of consultants)
Organisational Benefits	0.125	0.276	-0.013	0.180	0.010

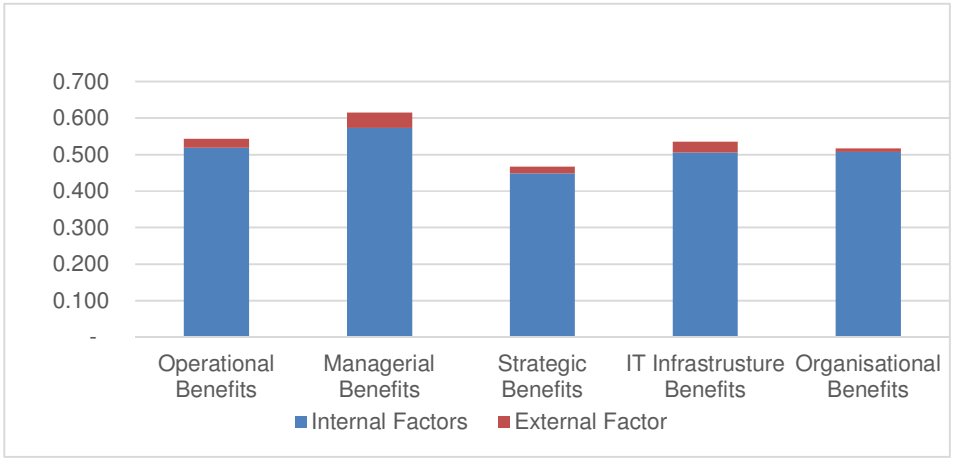
For organisations to achieve organisational benefits (Improved collaborating between departments and improved morale among staff), management of organisations must at least engage a partner to assist with the implementation plus document the ERP implementation in a business plan outlining the business case for such a project if the other input factors of top management support, previous ERP experience within the organisation is not available.

Research Question Four:

What is the prediction of success for internal external factors vs external input factors?

FIGURE 19

INTERNAL VS EXTERNAL FACTORS



Internal input factors are factors that the organisation controls. For this research, it was documenting the ERP implementation in a business planning and strategy document, top management supporting the implementation of an ERP software project, having multiple projects on the go and having previous ERP experience within the organisation. Having previous ERP experience within the organisation is classified as internal as management can hire such an individual and they will report to the organisation internally. External factors included engaging a partner or consultant to assist with the implementation. From the diagram above the marginal impact for prediction of success of external factors is minimum. The derivation of post implementation success across the different categories rests with internal factors. This indicates that input factors within the organisation drives post implementation success. Before embarking on an ERP implementation, the organisation must create an environment that will achieve success, and this will require these input factors to be present within the organisation. When these factors that are within the control of management, the organisation is better placed to achieve post implementation success.

Research Question Five:

What scenarios are likely for the organisations to obtain post implementation success in all five defined success criteria?

For the organisation to derive success in all post implementation success criteria, the model indicates that having multiple projects on the go must be supplemented by at least two of the other factors (Business Planning and Strategy, Top Management Support, Previous ERP experience or Partner Support). If the organisations do not have multiple projects that need to be implemented, then having any one of the input factors is predicated to result in post implementation success across all categories.

Research Question Six:

What is the best scenario for achieving success in any of the post implementation success factors?

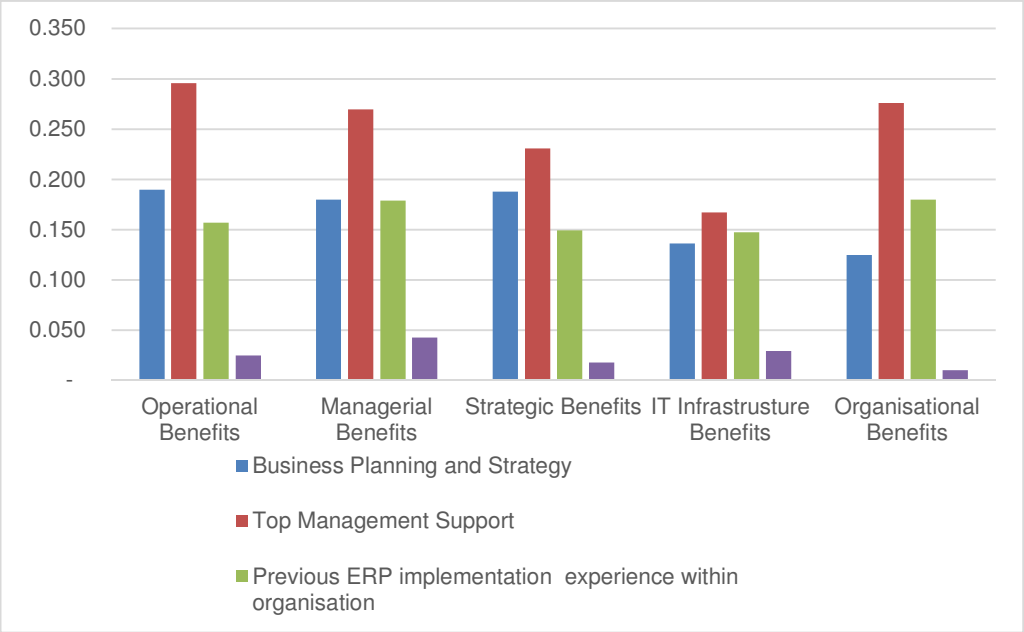
Without having multiple projects on the go, and by having anyone of the input factors, the model predicts that success will be achieved.

Research Question Seven:

Which positive input factor will result in highest prediction of success?

FIGURE 20

POSITIVE INPUT FACTORS



When comparing prediction of success across all positive input factors, top management support results in the highest prediction of success. This indicates that top management must be on-board and fully support the implementation of the ERP project if the organisation hopes to maximise post implementation success benefits across all categories. Research concluded by Somers and Nelson (2001), Princely (2008) and (Ngai et al., 2008) also confirms that top management support is a corner stone for ERP success. The same conclusion is drawn from internal and external respondents in this research when these are analysed separated.

Business Planning and Strategy is the second highest prediction of success for operational benefits, managerial benefits and strategic benefits after top management support. These benefits lead itself to a more strategic focus of the

organisations. Therefore, understanding how the ERP implementation assists with the enablement of strategy and documenting this as part of a business plan will assist organisations to achieve the return on investment of such an implementation. In addition, this should contribute toward the organisation achieving its overall strategy.

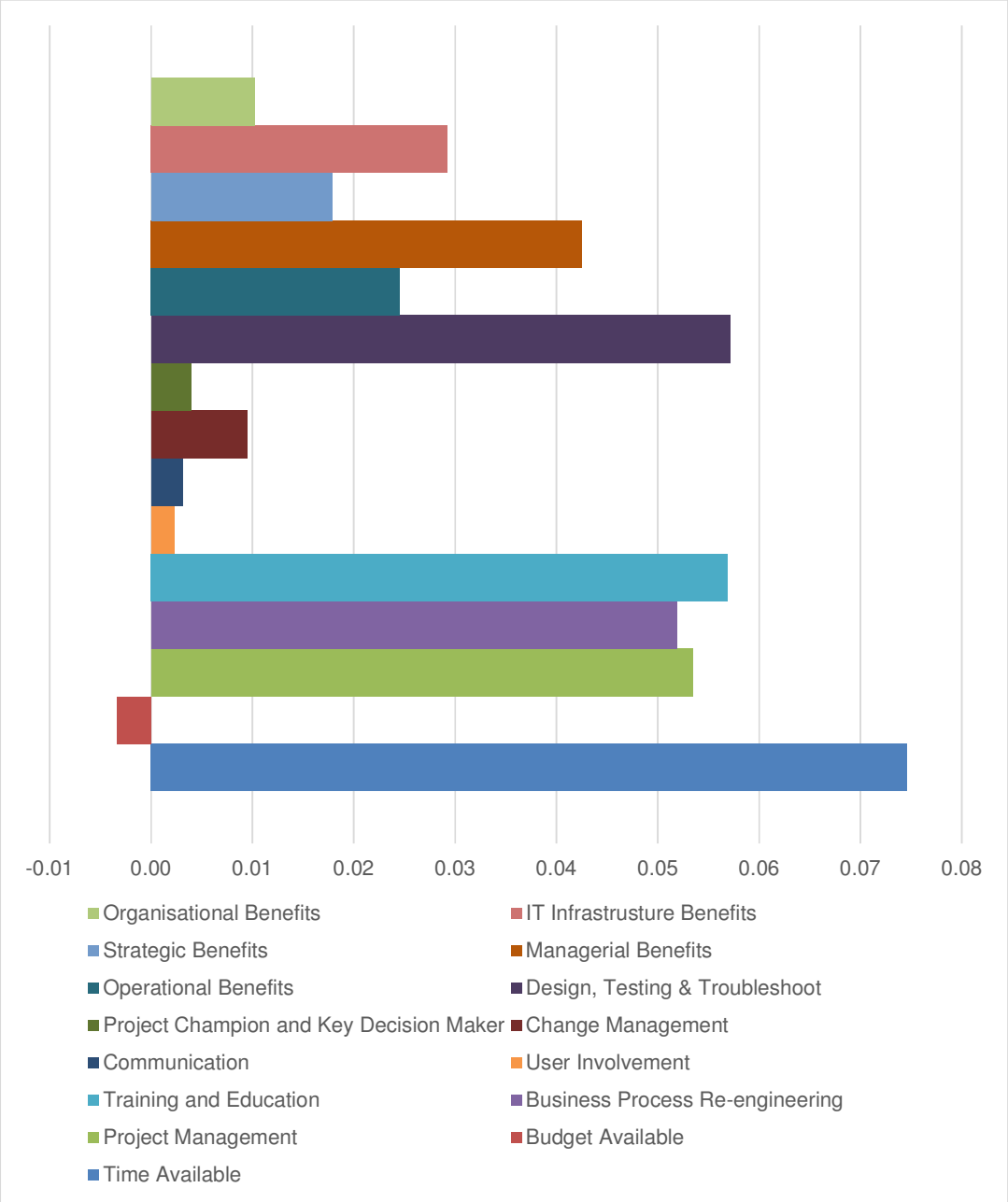
Having previous ERP experience within the organisation in an ERP implementation is predicated to achieve the second-best success in achieving IT infrastructure benefits and organisational benefits. With previous ERP experience, this leads itself to employees understanding the workings of such software and both the positive and negatives experiences of implementations. This enables employees to be more prepared for post implementation of a new ERP implementation. In addition, management can understand the learnings from previous implementation to reduce dependencies on legacy systems and understand the potential of latest technology to enable their strategies to grow the business.

Research Question Eight:

What is the perceived impact of engaging a partner to assist in the implementation of ERP software?

FIGURE 21

ENGAGING A PARTNER (CONSULTANT)



The model predicts that by engaging a partner alone (all other input factors absent), an organisation will achieve post implementation success in all categories. However, the model also predicts that budget available for an ERP implementation will be under pressure. This can be attributed to the fact that engaging consultants can be an expensive exercise.

When this is analysed based on whether the respondents are internal or external, internal respondents show a positive relationship regarding all input and output factors including budget. This could be due to organisations being able to budget for the consultants within their business plans. The key factor remains, the organisation must be able to manage the budget and the partner (consultants) on such a project.

External respondents only indicate that there will be a negative relationship on budgets. With the experience of implementations across multiple organisations, external respondents are faced with tight budget constraints to complete projects. According to Panorama Consulting 2018 ERP report, 64% of respondents in their study exceeded their budgets.

8. CONCLUSION

ERP implementations is a complex system of critical input factors and critical general factors that need to result in benefits to the organisation. The cost of such implementations should never exceed benefits if the organisation hopes to end up with increased shareholder value. However, it should be noted that a project such as an ERP implementation also requires the management of multiple critical factors for success to avoid costly disasters that are well documented. It is imperative that all input and general factors is closely managed to give the organisation a chance of success.

This research concluded that when critical positive inputs factors of top management support, ERP project documented in a business plan as part of the strategy, previous ERP experience and engaging a vendor, this is likely to end with a successful ERP project that derives post implementation success.

When these factors are not present, and the organisation also has multiple projects on the go, post implementation ERP success is limited. However, organisations can compensate for this by engaging a consultant with the appropriate experience to increase the chances for post implementation ERP success.

The ERP landscape is changing with the advent of cloud computing. More organisations are adopting this route (Panorama Consulting Solutions, 2018). When the results of this research looked at cloud implementation, prediction of success was much higher in certain aspects. The author believes that whether the project is on premise or a cloud implementation, the same assessments of input factors and general factors must be understood and managed to reap the benefits of ERP software.

9. Managerial Implications and Recommendations

From this research using Fuzzy Cognitive Mapping to predict outcomes of post implementation success, the managerial implications for organisation are:

Organisations need to assess whether they are ready to embark on such an ERP project. This requires organisations to critically assess whether the positive input factors of documenting the ERP project in a business plan as part of strategy is supported by top management, having previous ERP implementation experience within the organisation and whether they should engage a partner to support them on the project as outlined in this research is available to the organisation. By acknowledging these, the organisation can commence such a project. From the input factors, an important factor is having top management supporting such a project. With the support of top management, the potential for post implementation success is likely to accrue to the organisation.

However, we currently reside in a world that is everchanging with pressure on management to achieve stricter targets. It is inevitable that these factors will not be always available, and management will embark on many other projects all at once to achieve their targets. In scenarios like this, management should consider engaging a consultant on an ERP project to mitigate the risk of not accruing all post implementation success of implementing ERP software.

REFERENCES

Akkermans, H., & Helden, K. v. (2002). Vicious and virtuous cycles in ERP implementation: A case study of interrelations between critical success factors. *European Journal of Information Systems, 11*(1), 35-46.

Andersson, A. (2016). Communication barriers in an interorganizational ERP-project. *International Journal of Managing Projects in Business, 9*(1), 214-233.

Aubert, B., Hooper, V., & Schnepel, A. (2013). Revisiting the role of communication quality in ERP project success. *American Journal of Business, 28*(1), 64-85. doi:http://dx.doi.org/10.1108/19355181311314770

Badewi, A., & Shehab, E. (2016). The impact of organizational project benefits management governance on ERP project success: Neo-institutional theory perspective. *International Journal of Project Management, 34*(3), 412-428. doi:https://doi.org/10.1016/j.ijproman.2015.12.002

Barker, T., & Frolick, M. N. (2003). ERP IMPLEMENTATION FAILURE: A CASE STUDY. *Information Systems Management, 20*(4), 43-49.

Bauer, N. (2012). Jo'burg scrambles to clear billing crisis backlog. *Mail & Guardian.* Retrieved from https://mg.co.za/article/2012-03-19-joburg-scrambles-to-clear-billing-crisis-backlog

Bell, J. (2005). *Doing your research project : a guide for first-time researchers in education, health and social science* (4th ed.). Maidenhead, England; New York: Open University Press.

Bradley, J., & Lee, C. C. (2007). ERP Training and User Satisfaction: A Case Study. *International Journal of Enterprise Information Systems, 3*(4), 33-39,41-50.

Bueno, S., & Gallego, M. D. (2017). Managing top management support in complex information systems projects. *Journal of Systems and Information Technology, 19*(1/2), 151-164.

Chen, C. C., Law, C. C. H., & Yang, S. C. (2009). Managing ERP Implementation Failure: A Project Management Perspective. *IEEE Transactions on Engineering Management, 56*(1), 157-170. doi:10.1109/TEM.2008.2009802

Christofi, M., Nunes, M., Chao, G. P., & Lin, A. (2013). Towards ERP success in SMEs through business process review prior to implementation. *Journal*

of Systems and Information Technology, 15(4), 304-323. doi:http://dx.doi.org/10.1108/JSIT-06-2013-0021

Chuck, C. H. L., & Eric, W. T. N. (2007). An investigation of the relationships between organizational factors, business process improvement, and ERP success. *Benchmarking, 14*(3), 387 - 387. doi:http://dx.doi.org/10.1108/14635770710753158

Doom, C., Milis, K., Poelmans, S., & Bloemen, E. (2010). Critical success factors for ERP implementations in Belgian SMEs. *Journal of Enterprise Information Management, 23*(3), 378-406. doi:http://dx.doi.org/10.1108/17410391011036120

Ewout, R., & Per, H. (2018). Critical success factors for ERP system implementation: a user perspective. *European Business Review, 30*(3), 285-310.doi:10.1108/EBR-04-2017-0075

Finney, S., & Corbett, M. (2007). ERP implementation: a compilation and analysis of critical success factors. *Business Process Management Journal, 13*(3), 329-347. doi:http://dx.doi.org/10.1108/14637150710752272

Fiona, F. H. N., Janet, L. S. L., & Jinghua, K. (2001). Critical factors for successful implementation of enterprise systems. *Business Process Management Journal, 7*(3), 285-296. doi:10.1108/14637150110392782

Frulinger, J., & Wailgum, T. (2017, 7 January 2018). 15 famous ERP disasters, dustups and disappointments. *CIO Magazine.* Retrieved from https://www.cio.com/article/2429865/enterprise-resource-planning/enterprise-resource-planning-10-famous-erp-disasters-dustups-and-disappointments.html

García-Sánchez, N., & Pérez-Bernal, L. E. (2007). Determination of critical success factors in implementing an ERP system: A field study in Mexican enterprises. *Information Technology for Development, 13*(3), 293-309. doi:10.1002/itdj.20075

Grabot, B., Mayere, A., Lauroua, F., & Houe, R. (2014). ERP 2.0, what for and how? *Computers in Industry, 65*(6), 976-1000. doi:https://doi.org/10.1016/j.compind.2014.02.017

Haines, M. N., & Goodhue, D. L. (2003). Implementation Partner Involvement and Knowledge Transfer in the Context of ERP Implementations. *International Journal of Human-Computer Interaction, 16*(1), 23-38.

Indihar Stemberger, M., Bosilj Vuksic, V., & Kovacic, A. (2009). Business Process Modelling as a Critical Success Factor in Implementing an ERP System. *South East European Journal of Economics and Business, 4*(2), 89-96. doi:http://www.degruyter.com/view/j/jeb

Jasperson, J., Carter, P. E., & Zmud, R. W. (2005). A Comprehensive Conceptualization of Post-Adoptive Behaviors Associated with Information Technology Enabled Work Systems. *MIS Quarterly, 29*(3), 525-557. doi:10.2307/25148694

Kosko, B. (1993). *Fuzzy thinking : the new science of fuzzy logic / Bart Kosko* (1st ed.). New York: Hyperion.

Kronbichler, S. A., Ostermann, H., & Staudinger, R. (2009). A Review of Critical Success Factors for ERP-Projects. *TOISJ The Open Information Systems Journal, 3*(1), 14-25.

Laughlin, S. P. (1999). An ERP game plan. *The Journal of Business Strategy, 20*(1), 32-37.

M. Beheshti, H., K. Blaylock, B., A. Henderson, D., & G. Lollar, J. (2014). Selection and critical success factors in successful ERP implementation. *Competitiveness Review, 24*(4), 357-375.

Madapusi, A., & D'Souza, D. (2005). ALIGNING ERP SYSTEMS WITH INTERNATIONAL STRATEGIES. *Information Systems Management, 22*(1), 7.

Markus, M. L., Axline, S., Petrie, D., & Tanis, S. C. (2000). Learning from adopters' experiences with ERP: problems encountered and success achieved. *Journal of Information Technology (Routledge, Ltd.), 15*(4), 245-265. doi:10.1080/02683960010008944

Muscatello, J. R., & Chen, I. J. (2008). Enterprise Resource Planning (ERP) Implementations: Theory and Practice. *International Journal of Enterprise Information Systems, 4*(1), 63-77.

Ngai, E. W. T., Law, C. C. H., & Wat, F. K. T. (2008). Examining the critical success factors in the adoption of enterprise resource planning. *Computers in Industry, 59*(6), 548-564. doi:https://doi.org/10.1016/j.compind.2007.12.001

Olivier, F., Mario, B., & Robert, P. (2009). ERP implementation through critical success factors' management. *Business Process Management Journal, 15*(3), 371-394. doi:10.1108/14637150910960620

Panayiotou, N. A., Gayialis, S. P., Evangelopoulos, N. P., & Katimertzoglou, P. K. (2015). A business process modeling-enabled requirements engineering framework for ERP implementation. *Business Process Management Journal, 21*(3), 628-664.

Papageorgiou, E. I., & Stylios, C. D. (2008). Fuzzy Cognitive Maps. In W. Pedrycz, A. Skowron, & V. Kreinovich (Eds.), *Handbook of Granular Computing* (1st ed., pp. 755-774): Wiley-Interscience.

Princely, I. (2008). Impacts of business vision, top management support, and external expertise on ERP success. *Business Process Management Journal, 14*(4), 551-568. doi:http://dx.doi.org/10.1108/14637150810888073

Ram, J., Corkindale, D., & Wu, M.-L. (2013). Implementation critical success factors (CSFs) for ERP: Do they contribute to implementation success and post-implementation performance? *International Journal of Production Economics, 144*(1), 157-174. doi:https://doi.org/10.1016/j.ijpe.2013.01.032

Ramburn, A., Seymour, L., & Gopaul, A. (2013). Learning From a Failed ERP implementation: The Case of a Large South African Organization. *Proceedings of the European Conference on Information Management & Evaluation*, 215.

Rockart, J. F. (1979). Chief executives define their own data needs. *Harvard Business Review, 57*(2), 81-93.

Rothenberger, M. A., Srite, M., & Jones-Graham, K. (2010). The impact of project team attributes on ERP system implementations. *Information Technology & People, 23*(1), 80-109. doi:http://dx.doi.org/10.1108/09593841011022555

Shahin, D., & Sulaiman, A. (2011). Examining ERP implementation success from a project environment perspective. *Business Process Management Journal, 17*(6), 919-939. doi:doi:10.1108/14637151111182693

Shang, S., & Seddon, P. B. (2002). Assessing and managing the benefits of enterprise systems: the business manager's perspective. *Information Systems Journal, 12*(4), 271-299. doi:10.1046/j.1365-2575.2002.00132.x

Shanks, G. (2000). A model of ERP project implementation. *Journal of Information Technology (Routledge, Ltd.), 15*(4), 289-303. doi:10.1080/02683960010009051

Shivam, G., C., M. S., Akash, S., Vinod, K., & Uma, K. (2017). Identification of challenges and their ranking in the implementation of cloud ERP: A comparative study for SMEs and large organizations. *International Journal of Quality & Reliability Management, 34*(7), 1056-1072. doi:10.1108/IJQRM-09-2015-0133

Solutions, P. C. (2018, 2018). 2018 ERP Report. Retrieved from https://www.panorama-consulting.com/resource-center/erp-software-research-and-reports/

Somers, T., & Nelson, K. (2001). *The Impact of Critical Success Factors across the Stages of Enterprise Resource Planning Implementations*. Paper presented at the Proceedings of the 34th Hawaii International Conference on System Sciences, Hawaii.

Sondoss El, S., Assem Abd El Fattah, T., & Mohamed Hassan, R. (2008). A quantitative model to predict the Egyptian ERP implementation success index. *Business Process Management Journal, 14*(3), 288-306. doi:http://dx.doi.org/10.1108/14637150810876643

Stacey, A. (2016). *Semi-qualtitative Systems Analysis Using Fuzzy Cognitive Mapping*. Paper presented at the Proceedings of The 15th Eurpoean Conference on Research Methodoly for Business and Management Studies, London, United Kingdom.

Stapleton, G., & Rezak, C. J. (2004). CHANGE MANAGEMENT UNDERPINS A SUCCESSFUL ERP IMPLEMENTATION AT MARATHON OIL. *Journal of Organizational Excellence, 23*(4), 15-22. doi:10.1002/npr.20022

Sumner, M. (2000). Risk factors in enterprise-wide/ERP projects. *Journal of Information Technology (Routledge, Ltd.), 15*(4), 317-327. doi:10.1080/02683960010009079

Turbide, D. (1999). What is ERP? *Foundry Management & Technology, 127*(8), 94.

Turbit, N. (2003). ERP Implementation. *World Trade, 16*(7), 39.

Vergini, E. S., & Groumpos, P. P. (2016). A new conception on the Fuzzy Cognitive Maps method. *IFAC-PapersOnLine, 49*(29), 300-304. doi:https://doi.org/10.1016/j.ifacol.2016.11.083

Vilpola, I. H. (2008). A method for improving ERP implementation success by the principles and process of user-centred design. *Enterprise Information Systems, 2*(1), 47-76. doi:10.1080/17517570701793848

Wailgum, T., & Perkins, B. (2018, 12 February 2018). What is ERP? A guide to enterprise resource planning systems. *CIO.*

Willis, T. H., & Ann Hillary, W.-B. (2002). Extending the value of ERP. *Industrial Management & Data Systems, 102*(1/2), 35-38.

Xu, W., Ou, P., & Fan, W. (2017). Antecedents of ERP assimilation and its impact on ERP value: A TOE-based model and empirical test. *Inf Syst Front*

Information Systems Frontiers : A Journal of Research and Innovation, 19(1), 13-30.

Zhang, L., Lee, M., Zhang, Z., & Banerjee, P. (2003). *Critical Success Factors of Enterprise Resource Planning Systems Implementation Success in China*.

Zhu, Y., Li, Y., Wang, W., & Chen, J. (2010). What leads to post-implementation success of ERP? An empirical study of the Chinese retail industry. *International Journal of Information Management, 30*(3), 265-276. doi:https://doi.org/10.1016/j.ijinfomgt.2009.09.007