# ERP Health Assessment Model commensurate with ERP Success Factor Rate Metric

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## ABSTRACT

This paper proposes and initiates research on a top-down approach for ERP Implementation Success. Here the actual health assessment of on-going ERP Projects is Reverse Engineered keeping the expected ERP outcome as our base and evaluating it against ERP Projects' current developmental progress made vis-à-vis the Critical Success Factors. A three step methodology is proposed. The ultimate aim is to come up with ERP Health Assessment Model that will be used to evaluate the proposed metric - ERP Success Factor Rate, ERP SFR, at different stages of ERP Project Implementation. The proposed research will be used as a viable ERP Project Health Assessment Model commensurate with ERP Success Factor Rate Metric to increase the probability of ERP success.

## Keywords

Business Process Re-engineering (BPR), Critical Success Factors (CSF), Enterprise Resource Planning (ERP)

## Notations

CSF1……CSFn: ERP Project Implementation Critical Success Factors, where n is the total number of Critical Success Factors.

CSFi…….CSFj: Particular Critical Success Factor Value of the CSF being monitored.

CSFt: Critical Success Factor Threshold Value that ranges between CSFi …….CSFj, such that CSFi ≤ CSFt ≤ CSFj

MS1…….MSN: Project Milestones from 1 to N, where N is the total number of Project Milestones and MSk represents any Project Milestone in-between.

T: Time Period of ERP Project Implementation as measured from ERP Project Start-Up to its "Go-Live" Stage.

Qt1……..Qtx: ERP Project Implementation Quantitative objectives, where x is the total number of Quantitative Objectives.

Qu1,……Quy: ERP Project Implementation Qualitative objectives, where y is the total number of Qualitative Objectives.

S1,……Sz: ERP Project Implementation Strategic objectives, where z is the total number of Strategic Objectives.

## 1. INTRODUCTION

An Enterprise Resource Planning, ERP, system is an integrated suite of software applications that has its focus on the entire value chain, typically handling the processes of manufacturing, logistics, distribution, inventory, shipping, invoicing, financials, fixed assets, human resources, etc. in large businesses. ERP systems are all-inclusive software applications that support critical and strategic organizational functions. They provide a comprehensive framework and integrate both intra-organizational processes and inter-organizational processes with the organization's partners, suppliers and customers, with the help of web-enabled architectures. The Unique Selling Proposition of an ERP package is providing immediate, dynamic and strategic information, while it is still useful and effective; a fact that can give any organization a competitive advantage.

ERP system implementation is a complex organizational activity. Evaluation of ERP successes and failures is an important step towards improving our understanding of how ERP systems can be best deployed to bring down future ERP failures. A lot of research has gone into ascertaining the Critical Success Factors of ERP Projects as compiled by Zhenyu Huang[1]. This can be regarded as a bottom-up approach, wherein the success factors are analyzed for their contribution towards ERP success. Researchers have mainly concentrated on ascertaining the Critical Success Factors (CSF) of ERP Implementations. This paper focuses on how these previously researched CSF can actually determine the Success Factor of an on-going ERP Project. By constantly monitoring the proposed metric - ERP Success Factor Rate, ERP SFR, at important milestones of an on-going ERP Implementation Project, the implementers can modify their CSF as and when they foresee a dip in the ERP SFR, and hence increase the probability of ERP Success.

## 2. REVIEW OF LITERATURE

A lot many literatures talk about ERP Implementation successes and failures and the Critical Success Factors that contribute to the possibility of such a success. We start our proposed study by making the following paper as the base of our proposed research:

Zhenyu Huang, "A Compilation Research of ERP Implementation Critical Success Factors", Issues in Information Systems, Volume XI, No. 1, 2010. pp. 507-512. As per the compilation of research publications done on Critical Success Factors of ERP Implementation Projects done by Huang[1], when CSF publication reached its peak time in 1999; and 2006, ERP publication was in relatively low points. During 1999-2000, the number of CSF articles began to decrease while ERP articles increased dramatically. Contradictory to this, from 2004, ERP articles decreased gradually, whereas CSF articles increased again. This may

reveal the fact of increased attention on ERP implementation Critical Success Factor by academic world.

Second, the top 10 CSFs for 10 year period are: Top Manager Commitment; Teamwork and Composition; Education and Training; Project Management; Definition of Scope and Goals; Business Process Redesign; Change Management Program and Culture; Champion; Open and Honest Communication; and Choose the Right Vendor Right Package. However, Huang[1] also found that Open and Honest Communication and End User Involvement, plays a vital role in ERP implementation.

Third, that researchers paid more attention to human factor than technical factors in ERP implementation. More articles after 2003 put end-user's training or involvement as a CSF instead of technical skills or IT infrastructure. With the development of ERP software, it becomes more mature and needs less attention on technical parts. The success of ERP system implementation draws more on human and business issue than technical issue. Also, the communication among managers, end-users, ERP vendors and project team members becomes more important than before.

After a review of ERP critical success factor literatures, it reveals that many CSF articles are presented based on a review of already published CSF by other authors or limited case studies. As a result, the limitation of the article by Huang[1] is the occurrence of duplication in the frequency analysis of the success factors. Also because previous researchers normally focused only on a specific aspect of ERP implementation or a case study, there is little research that encompasses all significant CSF considerations. This also leads to the limited sample size of literature on ERP CSF topics.

T. R. Bhatti[8] conducted a survey of 53 organizations in Australia and based on the results defined new constructs associated with the ERP implementation and developed new multi-item measurement scales for measuring these constructs. He proposed that future ERP implementation empirical research could link these constructs in causal models in an ERP that will benefit significantly from the existence of relevant construct definitions and good measurement scales.

Bradley[5] examined Critical Success Factors for implementing Enterprise Resource Planning systems using the framework of classical management theory. The relationship between Ten critical success factors selected in ERP systems implementation that were proposed in past literature were selected and then corresponding project success was examined. Project success is defined as organizational impact and on time and on/under budget project completion. He concluded that considering the financial cost and risk associated with these projects; a better understanding of Critical Success Factors will enable practitioners and academics to improve the chance of success in the implementation projects. With this thought process in mind, we would like to come up with a definitive ERP Health Assessment Model.

Nah et al [9] categorized the various ERP Critical Success factors and these can be further explored to assuage the understanding of ERP stakeholders throughout the different phases of the ERP Projects.

Finney and Corbett [6] implied in their research that there is a need to focus future research efforts on the study of CSFs as they apply to the perspectives of key stakeholders and to ensure that this stakeholder approach is also comprehensive in its coverage of CSFs. We also reiterate the same thought process and would like to have an all-inclusive approach that takes care of all ERP stakeholders.

The all-important research question asked by Lind and Culler[11] : "Does a focus on each Critical Success Factor lead to higher information technology project performance?" can be further extrapolated to cover ERP Projects.

Chen et al [10] looked at the ERP Implementation Failures from the Project Management Perspective. Their Research explored and identified critical elements of project management that contributed to the success of the ERP implementation. They provided a roadmap to follow in order to avoid making critical, but often underestimated, project management mistakes.

In addition to the above prelude, a major thrust to undertake this research has been provided by Neemuchwala[4]' s White Paper "Evolving IT from "Running the Business" to "Changing the Business"", which identifies the business benefit of excellence in the delivery of software and services: moving IT from running the business to changing the business; from spending money on information to making money on information. By understanding customers' operations and business problems, analyzing options, and then applying a solid predictive model, unique analytical and knowledge-management tools, and unusually canny business insight, puts firmly into customers' hands the means to evolve its IT operations from merely running the business to transforming and changing the business to drive maximum business value. Keeping this principle in our mind, we endeavour to build the ERP Health Assessment Model, in order to give all the ERP stakeholders the key to ERP projects' success.

Velcu[3] studied the "Impact of the Quality of ERP Implementations on Business Value". They investigated if the quality of ERP implementations is correlated with how the business performance of the company develops after implementation. In order to reach this objective, they performed a comparative analysis of the change in financial performance after implementation between 17 less successful ERP adopters and 32 successful ERP adopters. It was expected that the successful ERP adopters would have a higher financial performance than the less successful ERP adopters because the less successful adoption would hinder the efficiency of assets utilization and business processes. The findings revealed no significant difference in the financial performance change after implementation between the two groups of ERP adopters in terms of ROA and ROI. However, the further decomposition of ROA and ROI indicated that the successful ERP adopters do have significantly better efficiency benefits than the less successful ERP adopters, in terms of Assets Turn-over and Capital Turnover, in the first two years after implementation. This result further motivates us to find a way in which the ERP Project Health can be monitored from the very beginning till the end, so as to achieve more successful ERP implementations and hence achieve a greater Business Value.

Sun et al [7]'s study connected the schedule, cost, and achievement of ERP Implementation with CSF priorities that can be utilized in a manner which can drastically improve successful ERP implementations in accordance with the user satisfaction. This study can form our base in deciding how the CSFs need to be prioritized and monitored to achieve the best possible ERP implementation.

Lind and Culler[11] delved into an important research question: Does a focus on each Critical Success Factor lead to higher information technology project performance? The research question was addressed with the critical success factors and information technology project performance. The correlations for both project performance and project success were significant. Factors significant in predicting project success using a scaled measure were size of project and the critical success factors of project mission, availability of technology, and client acceptance. Factors predicting the dichotomous measure of project success were the critical success factors of client acceptance, communications, and troubleshooting. Also the performance score was higher for smaller sized projects. Taking a cue from this Research work, similar Research work can be carried out albeit with few modifications as illustrated in the next section, as ERP Projects though are Information Technology projects, but differ considerably in their Implementation methodologies.

## 3. PROPOSED MODEL

Over the years, ERP has proved itself as a practical answer to linking all Enterprise-wide operations. Despite robust ERP software packages available in the market with heavy investments in their respective R&D budgets, many ERP implementations fail, thus burning a big hole in corporate budgets. Past and current research delves into Critical Success Factors but fails to link these factors to ERP Implementation Success. The ultimate aim is to reduce the ERP Project failure rate by developing an ERP Health Assessment Model that could be used to determine the proposed metric - ERP Success Factor Rate, ERP SFR, at different stages of ERP Project Implementation. This would help the ERP Project implementers to monitor ERP SFR at various stages of ERP Implementation and make changes during ERP Implementation Stage itself to increase the ERP SFR.

The aim of the research is to arrive at the proposed metric - ERP Success Factor Rate, ERP SFR. The three-step methodology adopted is as enumerated below:

1. Determine CSF that are important for the current ERP Implementation.
2. Determine the ultimate Quantitative, Qualitative and Strategic objectives of ERP Implementation.
3. Determine the current scale of CSF (of all the CSF short-listed as in point 1.) for the objectives enumerated in point 2.) at the current ERP Implementation milestone.

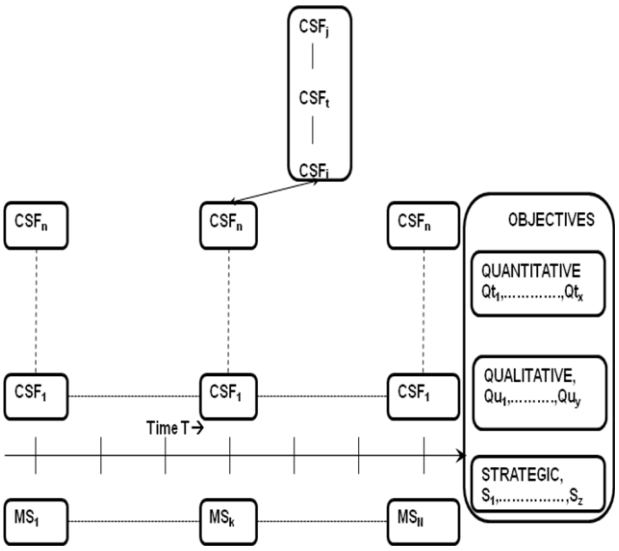


**Fig. 1 Proposed ERP Health Assessment Model**

The methodology proposed is a top-down approach wherein the final goals of ERP Implementation with respect to Quantitative, Qualitative and Strategic objectives are kept in sight throughout the entire process of evaluation, as depicted in Fig.1, with respect to the Critical Success Factors that are most relevant for a particular ERP Implementation. P. Soffer et. al. [2] proposed a comprehensive approach towards ERP Modeling in which Reverse Engineering was applied, but this model does not provide a link between the Critical Success Factors and the ERP Implementation objectives.

In order to initiate research, as depicted in the Fig.1, as part of the three-step methodology, firstly, in an on-going ERP implementation, the Critical Success Factors, CSF1, CSF2,……., CSFn, need to be short-listed that are likely to impact the ERP Success if not paid enough attention. Zhenyu Huang[1] has identified 37 different CSF through his comprehensive research spanning related articles over a period of 10 years and has also short-listed the top ten Critical Success Factors. There is an indication of a shift in the CSF from Technical Skills towards Education and Training for clients. ERP systems vary in the domains or verticals in which they are implemented, viz., Manufacturing, Academic, Pharmaceutical, Hospitality, etc. It is often observed that CSF that are considered critical in one domain may fall down in the criticality ladder in some other domain. A thorough study and impact analysis of all CSF on final ERP Implementation should be undertaken and then this paper recommends that at least ten CSF should be short-listed by the implementers for future study. Ten CSF for a particular ERP implementation is recommended in order to bring down further computational complexity. On the side, in order to make this study more exhaustive, a parallel study can be undertaken with the next ten short-listed CSF. CSF1, CSF2,……., CSFn represent the Critical Success Factors short-listed for a particular ongoing ERP Project implementation to be monitored across ERP Project Implementation milestones, MS1, MS2,……..,
MSN, where N represents the number of milestones of the ERP Implementation Project, along the time period , T, which is the total time taken for the completion of the Project.

Sometimes it is cumbersome to define the completion date of the project. We can assume that time period, T, is the time period between the Project Start-Up and the Project "Go-Live" dates.

Secondly, the final Quantitative, Qualitative and Strategic objectives of ERP Implementation need to be enumerated. As depicted in Fig. 1, let the Quantitative objectives be denoted by Qt1,……..,Qtx; Qualitative objectives be denoted by Qu1,……..,Quy; and Strategic objectives be denoted by S1,……,Sz. These parameters reflect the final goal of ERP implementation, in order to measure the progress towards all intended benefits of the ERP system. By taking the terms Quantitative, Qualitative and Strategic, this paper intends to focus on three-fold benefit of an ERP system that encompass the entire gamut of why ERP System is being designed in the first place. This paper now elaborates on the understandability of Quantitative, Qualitative and Strategic objectives of ERP Implementation.

As the term goes, Quantitative objectives are those that are quantifiable and measurable. They are the stated objectives at the start of ERP Implementation for which the ERP Project was undertaken by the organization. They reflect the lacunae in the current system that is wished to be filled by the proposed new system. Examples can be shortened life cycles, quicker response times, increased visibility, etc. This paper recommends that broad objectives are more preferred to be enumerated for the purpose of proposed ERP Health Assessment rather than narrow or detailed objectives.

Qualitative objectives of ERP implementation though not outright measurable have far greater impact and are major differentiators between ERP Project successes and failures. These parameters can be any factors that disturb the zero-tolerance acceptance level of final ERP Implementation. Delivering on promises with industry optimized Best Practices incorporated with no deviations is the highest quality expectation from any successful ERP Implementation. Keeping this as our final target and measuring the proposed ERP Success Factor Rate, vis-à-vis the CSF, can effectively foretell the relative success expected from an on-going ERP Implementation.

Implementation of ERP in an organization rather than having stand-alone custom applications performing their respective departmental tasks is a strategic decision taken by the top-level executives that involves heavy investments and impacts each and every aspect of the organization. Hence, it is apparent that when the proposed metric - ERP Success Factor Rate, ERP SFR, is being deduced, it is compared with the long-term strategic objectives of ERP Implementation. It is well-understood that Business Process Reengineering, BPR, is a necessary pre-cursor for ERP Implementation. As per this paper's understanding, BPR is not only a necessary pre-cursor; it is an inevitable part of ERP implementation, even if it is not initially included in the ERP Implementation Project Plan. This is because if the new ERP system brings about any change in the Business Process, however small that maybe, it is in effect reengineering the Business Processes. This change, however insignificant it may seem, has a long-term implication on the organization. These intended process changes that will bring about strategic business transformations and contribute towards the Strategic objectives of ERP Implementations should be clearly segregated from business transformations to be done only for routine purposes. These subtle changes are those that bring out the difference in the organization from just "Running the Business" to actually "Transforming the Business" [4] to the next level. These strategic business transformations will be indicators towards a more viable metric - ERP Success Factor Rate, ERP SFR.

Once all the above parameters have been collated, a statistical analysis would be pursued for further inference at different milestones of the ERP Implementation Project. The values of CSF, pertaining to a particular ERP Implementation would be flexible. This would be compared with threshold level of each CSF, say, CSFt as depicted in Fig 1. Each CSF, viz., CSF1, CSF2,……..,CSFn, will have their own unique pre-determined threshold values. ERP SFR may be deduced as the summation of CSFt. If any CSF falls below its' threshold value, it would result in dipping of ERP Success Factor Rate, ERP SFR, thus giving an indication that the particular CSF is not at satisfactory level and necessary inputs are required to bring the particular CSF equal to or above its' threshold value. On the contrary, if ERP SFR is satisfactory then no such external inputs would be required. The end-term Quantitative, Qualitative and Strategic Objectives of ERP implementation would ideally remain constant for each milestone of ERP Project Implementation. This paper restricts itself on outlining the strategy for outlining a proposed ERP Health Assessment Model commensurate with ERP Success Factor Rate, ERP SFR, as illustrated above.

## 4. CONCLUSION

This paper proposes a new ERP Health Assessment Model, in order to come up with a new proposed metric - ERP Success Factor Rate, ERP SFR. ERP SFR with respect to CSF will be computed based on the threshold values of the CSF in order to predict the Success Factor Rate of an on-going ERP Project Implementation. This metric will provide a one-point easy access view to current state analysis and probability of future ERP Implementation Success. The model is neither static in nature nor is it constant for all ERP Implementations. The Critical Success Factors are ERP Implementation and domain specific, which are not same for all implementations, and hence the proposed model is not static in nature. Since the ultimate aim of undertaking this research is of increasing the proposed metric - ERP SFR, this metric can be monitored not only at various project milestones but constantly during the entire ERP Implementation, the proposed model is also not constant, but dynamic in nature.

The next paper on the proposed research methodology will carry computational techniques with live examples and data collated to plot and determine the proposed metric – ERP Success Factor Rate, ERP SFR and the benefits that accrue from potential visibility of proposed metric - ERP SFR throughout during an on-going ERP Implementation. The constant visibility of proposed metric - ERP SFR, will help project managers to perform better risk management and change management. This will go a long way in making ERP Implementations more successful and cutting down on ERP Implementation failures.

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