A RE-STRUCTURING OF THE ENTERPRISE RESOURCE PLANNING IMPLEMENTATION PROCESS

MICHAEL F. FRIMPON
Ghana Institute of Management and Public Administration (GIMPA)
P. O. Box AH 50, Achimota
Accra, Ghana.

Abstract

The low success rates of implementation of the very complex Enterprise Resource Planning (ERP) process are well documented. This paper has 2 objectives: (I) to compile the critical success factors (CSFs) from current literature, (ii) group CSFs that approximately attain the same objective into roles where the roles together accomplish the main goal of a Best ERP implementation. 28 critical success factors (CSFs) were obtained through an exhaustive search, and were partitioned into 5 newly created specialty roles of Top Management, Technology Management, Process Management, Change Management and Project Management. The confinement of the CSF interactions to within roles resulted in a dramatic reduction of pair wise comparisons from 378 to 79. Pair wise comparisons are a measure of interactions and concomitantly of complexity. Key words: Enterprise Resource Planning (ERP), Critical Success Factors (CSFs), Roles, Pair-wise Comparisons.

1. Introduction

Enterprise Resource Planning (ERP) is defined as an Integrated Computer based planning technique used in organizations for management and resource planning (Maheshwari et al, 2011). Basically it is an integrated software package consisting of a set of standard functional modules (production, sales, human resources, finance, etc.) developed or integrated by the vendor that can be adapted to the specific needs of each customer (Esteves-Sousa et al, 2000). ERP is a very new concept in business programming having been introduced by research and analysis firm Gaertner only in 1990. ERP systems provide management a better overview to deeply analyze an organizations managing and functional activities by improved process flow, better data analysis, higher quality information for decision making, less inventories, decreased information flow timing, improved coordination for the overall supply chain, and better consumer service and have been adopted as the best technological solutions for the effective and efficient information management (Francoise et al, 2009).

A complex technological initiative like an ERP process is an undertaking involving a multiplicity of factors that impact the implementation to varying degrees. A factor that is critical to the success of the project is intuitively referred to as a Critical Success factor (CSF). Therefore, critical success factors (CSFs) are variables that are fundamental to the success of the implementation, and an organization must handle these CSFs well in order to have a successful implementation. The CSFs approach has been used by managers as a framework for strategic planning to direct them in determining those elements that must go right to succeed in achieving goals and objectives (Jafari et al, 2006).

1.1 Principle

ERP attempts to integrate all departments and functions across the organization onto a single computer system that can serve all those different departments' particular needs. Each department typically has its own computer system configured for the particular ways that the department does its work. But ERP combines them into an integrated software program so that the various departments can more easily share information and communicate with each other. Swartz ET. Al, 2001 echoes it beautifully that, "an ERP system creates a single version of the truth" because everyone uses the same system. At the core of this enterprise software system is a central database (See **Figure 1 in appendix)**. This database draws data from and feeds data into modular applications that operate on a common computing platform. This helps to standardize business processes and data definitions into a unified environment with a single unified software program divided into software modules that *roughly approximate* the old standalone systems. The ERP project yields a software solution integrating information and business processes to enable sharing throughout an organization of information entered once in a database (Swartz et. al, 2001).

1.2 Reasons Universities adopt ERP

From a university perspective ERP refers to the use of commercial solutions for both administrative and academic purposes. Typical administrative functions may include human resources, accounting, payroll, and billing. Academic functions include recruitment, admissions, registration, and all aspects of student records. Among the top reasons why universities adopt ERP solutions are "improved student service, transformed enterprise processes, modernized computer systems, improved administration, maintaining competitiveness and increased operating efficiency" (Maheshwari et al, 2011).

1.3 Challenges

Modern universities have challenges of similar magnitude as corporate organizations. Some commonly identified ones are: Difficulty in accessing information from paper files, improper means of exchanging information between various departments, lack of interconnection between departments, difficulty in keeping the records of students and staff error free and up-to-date, wastage of hundreds of hours by staff each month manually entering information or performing administrative tasks that could be handled automatically such as evaluations and generating results, lack of accuracy in maintaining the financial records such as fees, salary and expenses, lack of automation in calculating fee balances or finding fee defaulters, lack of automation for computing the staff's salary, lack of easy means or quick way to access old records, administrators spending too much time in creating time-tables and in assigning adjuncts, lack of means to provide employers and sponsors fast access to student records (Maheshwari et al, 2011).

Additionally, management of the university may not even know that these new IT systems can bring multiple synergies or benefits to their institution. Some universities may also not have resources like access, skills, capabilities or dynamic capabilities to generate any tangible output from these systems (Al Fawaz et al, 2010).

1.4 Risks and Failure Possibilities

ERP process implementation can be a lengthy process. By the time the new Campus Management system at Central Michigan University went live in the summer of 2006, seven years had passed since the initial discussion took place with upper management regarding vendor selection (Davis et al., 2007).

"With such complexity in mind and considering that well over half of all ERP implementation efforts end in failure, excellent planning, incorporating employee involvement, good communication should be at the top of any organization's list when considering an ERP implementation effort" [Davis et al, 2007, Barker et al, 2003].
Its complexity presupposes that it has a high probability of failure as captured in the enumerated information below culled from Maheshwari et al, 2011.

- Failure rates for ERP implementations are estimated to range between 50-90%, depending upon the research used.
- Over half of all ERP implementation efforts end in failure.
- The Meta Group reports that as many as 70% or 7 out of 10 ERP projects end in failure, which is two and half times the industry average.
- A Computer Associates survey of 886 managers reports 44% of ERP projects lose $1 million per year, 35% lose $5 million per year, and 21% lose $11 million per year.
- Unisource experienced a $168 million loss, FoxMeyer Drug and Dow Chemical each experienced $500 million losses, Dell Computer experienced a $115 million loss, and Nestle struggled with a $280 million ERP project, along with Boeing, Apple Computer, and Allied Waste.

1.5 Benefits

The risks of successfully executing an ERP system are daunting but the benefits can be very rewarding. Some of the benefits that prompt organizations to start an ERP project include "improved access to accurate and timely information, enhanced workflow, increased efficiency, reduced reliance on paper, tightened controls and automated e-mail alerts, user-friendly web-based interfaces, streamlined processes and ease of adoption of best business practices, and an established foundation for new systems integrated with existing systems (Swartz et.al, 2001)".

Table 1 in appendix shows some substantive benefits of an ERP process rollout.

Simply put, ERP obliterates the old standalone computer systems in payroll, admission, library, HR and a whole lot more.

1.6 Implementation Costs

The stupendous benefits some of which were enumerated above however come with a serious price tag. International Data Group (IDG) investigated and disclosed that global expenditure on ERP systems climbed up with yearly increasing rate of 13.5% between 2001 and 2006, and hit at $187 billion in 2006 (Singhal et al, 2011). Expenditures are estimated to range between approximately 6% of the annual revenue for a large organization to up to 50% for small firms. In addition, as implementation costs rise, so does the chance of an implementation failure. In the United States alone, it is expected that higher education's collective investment in vendor-supplied enterprise administrative systems, modified versions of the standard ERP systems, may exceed $5 billion to date, placing it among the most significant information technology (IT) investments of any kind (EDUCAUSE Center for Applied Research (ECAR), 2002). American Universities often spend in excess of $20 million each to implement modern enterprise resource planning (ERP) projects that can take two, three, or more years to implement (Swartz et al, 2001). For example, Georgetown University (30,000) spent nearly $60 million on a campus wide ERP initiative using PeopleSoft (Singhal et al., 2011).

1.7 Complexity

A process that has the many positive attributes of "transforming enterprise services, increasing operating efficiency, and improving administration" but carries with it the risks of cost and schedule overruns as well as dreadfully low-success rate figures is necessarily a complex one. Satirically, ERP is a mission that comes with a monkey wrench embedded in the implementation process.

1.8 Compilation of CSFs

Researchers have unearthed different numbers of CSFs in the quest to tame the ERP animal. But there is a large gap in the numbers of the factors labeled critical by various authors (Table 2 in appendix). A possible reason is that some of these factors have other factors embedded in them.
As seen below:

- User "Education and Training" and "Commitment" are sub factors under "Change management" in Nah[16].
- Singhal[20] and Finney[8] cite "Commitment" as a full CSF
- Yingjie[26] and Shanks[19] cite "Training" as a full CSF.

This paper tries to avoid the issue of embedded CSFs by treating all of them as of approximate equal importance until a next iteration when there will be a deliberate quantification of weights. To understand and manage the ERP process it is necessary to study the critical success factors that impact the implementation. Table 5 in the appendix is a listing of the 28 CSFs with their descriptions and sources compiled by this paper. It must be noted that "28" is the largest or among the largest number of CSFs to be used in a research by a paper.

2. Structuring the Process

2.1 CSF Interactions

The major reason for the complexity of an ERP implementation process is the overwhelming multiplicity of variables encountered in the planning, execution and monitoring process. The complexity of the process is further magnified by the overwhelming number of interactions and relationships between the variables. An analytical re-structuring that clearly shows the interplay and relationships of the CSFs and the possible elimination of unnecessary interactions can result in a reduction in the complexity. Reducing the complexity will result in better management of the CSFs and a reduction in the failure rates.

2.2 Grouping CSFs

Generally for every ERP initiative, the main objective or goal is to have a successful implementation. In order to reduce the complexity, it is helpful to put the CSFs into groups where they together help achieve a sub-objective of the main ERP objective of a successful implementation. This is particularly helpful if the emerging structure contains a relatively large number of CSFs. The project team can then decompose the complex ERP selection problem into simpler and more logical judgments of the attributes or CSFs (Wei et al, 2004). In this paper, a role is defined as a group of CSFs identified and put together for the purpose of achieving a sub-objective of the main objective. Roles are the sets created to hold specific CSFs that help the attainment of the main goal. The sub-objectives or the roles are diagrammatically captured in Figure 2 in the appendix.

Implementing the objectives of the roles should successfully end up with the desired result which is also captured in Figure 3. In this structuring exercise, all the CSFs are not considered in one fell swoop, but are placed in roles according to the following criteria: (Bullen et al., 1995)

1. Function: Identify the CSFs necessary to achieve the goals and objectives.
2. Best measure: Many other CSFs can be measures of the role but this CSF is the best or among the best.

In addition, we make the simplifying assumption that the CSFs in different roles have no interactions. Using simple set theory notation; for any pair of CSFs,

$$\left(CSF_i \cap CSF_j\right) = \emptyset;\ i \in role\ I, and\ j \in role\ J, I \neq J \qquad (A)$$

As a corollary, for any pair of CSFs, a condition for selection into a particular role is governed by the simple probability formula

$$P\left(CSF_i \cap CSF_j\right) > 0; \quad i \in role\ I, and\ j \in role\ J, I \neq J \qquad (B)$$

2.3 Pairwise Comparisons

Using the COMBIN function in Excel (COMBIN(X, Y=2) allows us to deal with the Combinatorics problem of comparing CSFs two at a time. Pairwise comparisons are a measure of the number of interactions, and number of interactions is a measure of complexity. As can be inferred from Table 4 in appendix,

- Total pairwise comparisons in the structured process is (10+69) = 79;
  - Number of pairwise comparisons between the CSFs in the roles = 69.
  - Number of pairwise comparisons between the 5 roles = 10.
- Total pairwise comparisons between the 28 CSFs in an unstructured process = 378.

The dramatic reduction of 299 pairwise comparisons is due to the fact that there are no interactions between CSFs in different roles as outlined in (A) above.

3. Aggregation of CSFs under Roles

3.1 Assigning the CSFs

The assignment of the CSFs into their respective roles can be sequential, but not necessarily so. However, the structuring is as much art as science and different researchers may choose different structuring strategies. Simple restructurings that result in a *non-focusing* on relationships such that

$$P\left(CSF_i \cap CSF_j\right) = 0; i \in role\ I, and\ j \in role\ J, I \neq J \qquad (B)$$

can bring a systemization and clarity to a very complex operation like an ERP implementation. Below are *approximate* algorithms for the sequential placement of the CSFs into their respective roles.

3.11 : Algorithm for Top Management Role

1. Articulate the goals of the project and explain how it ties in with the vision of the school,
2. Approve the version of the ERP package that will include industry "best" processes and practices and result in the least customization.
3. Outline the implementation strategy of "phased or big bang".
4. Support the implementation in cash or kind
5. Delegate the local decisions to the project management team
6. Champion or appoint an advocate for the implementation.

3.12: Algorithm for Technology Management Role

1. Select the best hardware and software combination that can withstand the rigors of a tasking system such as an ERP.
2. Ensure that the data to be migrated and/or imputed into the new systems are cleaned and not compromised.
3. Configure the systems so that they are at their optimal best.
4. Continuously monitor system and process performance so there are no downtimes
5. Test system to ensure it is running as should, and troubleshoot for system integrity

3.13: Algorithm for Process Management Role

1. Work with consultants to oversee the complex exercise of mapping organizational strengths, weaknesses, practices and processes to that of the new tool aka re-engineering

2. Involve the vendors in the re-engineering since they "wrote" the code.
3. Determine how much extra tinkering should be done to the ERP package in order to meet institutional needs
4. Ably manage the tradeoff contest between customization and standardization
5. Work with consultants to oversee the complex exercise of mapping organizational strengths, weaknesses, practices and processes to that of the new tool aka re-engineering

3.14: Algorithm for Change Management Role

1. Involve the user in pertinent decision making so he does not develop a psychological resistance to the new system.
2. Change the dynamics of the organization to ensure the new system succeeds by ensuring there is readiness to the demands of a very hard taskmaster.
3. Educate users in current industry best practices and vigorously train them in the technical uses of the system.
4. Preach strongly against cultural practices such as a lack of adherence to time, schedules, "lateness to meetings", "use of cell phones during meetings", and other non-value adding behaviors that can militate against implementation success.
5. An ERP implementation project is a long and arduous endeavor. Sporadic and unfocused commitment to the project can doom it.

3.15: Algorithm for Project Management Role

1. Conduct a needs assessment of the organization to determine the version of ERP needed and implementation type.
2. Select the best technical and managerial minds to compose the implementation team.
3. Ensure the composition of the group is heterogeneous with representations from all the involved entities.
4. Formalize the implementation process to ensure focus on one plan.
5. Coordinate across this disparate group which definitely includes entities with possible conflicting interests by opening and maintaining strong communication channels.
6. Need for the various competing interests such as vendors, consultants and users to see themselves as partners with the same objective.
7. Manage the boundaries of the implementation so the process does not careen out of control.
8. Exhibit the required leadership by taking on the great tasks enumerated above and beyond.

4. A Structured ERP Implementation

The roles are the pillars that shoulder the burden of the implementation of the ERP process. **Figure 4** in the appendix depicts the configuration of the ERP process. A weakness in *any* of the pillars can result in a failure. On the other hand, *all* the pillars have to be managed well to result in a successful implementation. That is why there should be focused treatment of the roles to ensure each CSF receives consideration until it drops out if it has to. Taking out a CSF without analytic diligence can weaken the pillars and result in the crumbling of the edifice as witnessed in the many failures that dot the ERP landscape.

5. Conclusion

ERP is still in its nascent stages having been around only since 1990. There is some literature on ERP implementations in the West but that of the third world in the ERP-knowledge space is not the best. Therefore, it is not a huge surprise that Africa is still virgin territory when it comes to its presence, and there are no blueprints that interested organizations such as colleges and universities can use to map their path towards an assured success. This study defines a re-structured CSFs "role" model for ERP implementations. The model was developed through a multidisciplinary approach of Combinatorics, Decision theory and Project management in a set of previous CSFs lists. The compiled number of CSFs is large and could even be larger but their partition into the five groups of Top Management, Technical Management, Process Management, Change Management and Project Management roles makes the model computationally less intensive and thus more easily manageable.

Limitations

The study is limited to only one university. The sample size although very small is good enough for this early part (Hubbard, 2009).

Future Research

The model developed here constitutes the basis for further work. Metrics should be developed to measure the Roles and their associated CSFs in order to be better able to quantify the implementation process. A good methodology like Analytic Hierarchy Process (AHP) by Saaty can be used to determine the weights of the attributes instead of number of citations as used by certain authors.

If there are dependencies between the Critical Success Factors, as is most likely, then a modeling approach like Analytical Network Process (ANP) also by Saaty should be used to determine and calibrate the weights to further enhance the accuracy of the model. ERP in the Cloud is a new initiative that can be explored because it should have great utility for universities. The Cloud works on the principle of economies of scale at application, software and hardware level. It results in many benefits like service provisioning, reduced costs, optimum resource utilization (Goel et al, 2011). This tool can be leveraged to help resource-starved institutions like those in Africa. A focus on structured ERP implementations in Ghana and other African institutions would also be beneficial to the ERP vendors who could learn lessons for future implementation efforts in different cultures and organizations.

REFERENCE

[1] Al-Fawaz, K., Eldabi, T., Naseer, A., (2010). *Challenges and Influential Factors in ERP Adoption and Implementation*. European, Mediterranean and Middle Eastern Conference on Information Systems 2010.

[2] Al-Mudimigh, A.,Zairi,A., Al-Mashari, M.(2001). *ERP software implementation: an integrative framework.* European Journal of Information Systems (2001) 10, 216–226.

[3] Barker, T., & Frolick, M. N. (2003). *ERP implementation failure: A case study.* Information Systems Management, 20(4), 43-49.

[4] Bologa, A., Muntean, M., Sabau, G., Scorta, J. (2009). *Higher Education ERPs: Implementation Factors and Their Interdependencies.* WSEAS TRANSACTIONS on COMPUTERS. Issue 4, Volume 8.

[5] Bullen, C. V. (1995). *Productivity CSFs for Knowledge Workers.* Information Strategy: The Executive's Journal, 12(1): 14.

[6] Davis, M.J., & Huang, Z. (2007). *ERP in Higher Education: A Case Study of SAP and Campus Management.* Volume VIII, No. 1, Issues in Information Systems.

[7] Esteves-Sousa, J., & Pastor-Collado, J. (2000). *Towards The Unification Of Critical Success Factors For ERP Implementations*. 10th Annual Business Information Technology (BIT) 2000 Conference, Manchester.

[8] Finney, S., Corbett, M. (2007). *ERP implementation: a compilation and analysis of critical success factors.* Business Process Management Journal Vol. 13 No. 3, pp. 329-347. www.emeraldinsight.1463-7154.htm

[9] Francoise, O., M. Bourgault and R. Pellerin, 2009. *ERP Implementation Through Critical Success Factors' Management.* Business Process Management Journal, 15(3): 371-394.

[10] Goel, S., Kiran, R., Garg, D., (2011). *Impact of Cloud Computing on ERP implementations in Higher Education*. International Journal of Advanced Computer Science and Applications, Vol. 2, No. 6, 2011

[11] Hubbard, D. (2009). *How to Measure Anything.* Kindle ebook (location 2388)

[12] Hubbard, D., Samuelson, D. (2009). *Modeling Without Measurements. How the decision analysis culture's lack of empiricism reduces its effectiveness.* OR/MS Today - October 2009

[13] Jafari, S.M., Osman, M.R., Yusuff, R.M., Tang, S.H. (2006). *ERP Systems Implementation In Malaysia: The Importance of Critical Success Factors*. International Journal of Engineering and Technology, Vol. 3, No.1, 2006, pp. 125-131

[14] Lee, C., Lee, H. (2001). *Factors affecting ERP Implementation systems in a Higher Education Institution*. IACIS.

[15] Maheshwari, S.P., Singh, P., & Tripathi, L.K. (2011). *ERP Implementation in Educational Institutions: Challenges and Opportunities.* Eighth AIMS International Conference on Management January 1-4, 2011

[16] Nah, F.F., Zuckweiler, K. M., Lau, J.L.(2003). *ERP Implementation: Chief Information Officers' Perceptions of Critical Success Factors.* INTERNATIONAL JOURNAL OF HUMAN–COMPUTER INTERACTION, 16(1), 5–22.

[17] Paula, K., Robert B. K., (2002). *ERP Systems in Higher Education.* ECAR (EDUCAUSE Center for Applied Research). Volume 2002, Issue 22.

[18] Saaty, T. (2008). *Relative Measurement and Its Generalization in Decision Making. Why Pairwise Comparisons are Central in Mathematics for the Measurement of Intangible Factors.* The Analytic Hierarchy/Network Process. RACSAM (Rev. R. Acad. Cien. Serie A. Mat.) VOL. 102 (2), 2008, pp. 251–318

[19] Shanks, G., Parr, G.A., Hu, B., Corbitt, B., Thanasankit, T., Seddon, P. (2000). *Differences in Critical Success Factors in ERP Systems Implementation in Australia and China: A cultural analysis.*

[20] Singhal, S., Tandon, P., Sharma, S.K. (2011). *Critical Success Factors in Implementation of ERP in Education*. International Journal of Contemporary Practices - Vol. 1, Issue. 1

[21] Siriginidi, S. R., (2000). *Enterprise resource planning: business needs and technologies.* Industrial Management & Data Systems 100/2 [2000] 81±88.

[22] Swartz, D., & Orgill, K. (2001).*Higher Education ERP: Lessons Learned.* Number 2 2001 • EDUCAUSE QUARTERLY. 24(2), 20-27.

[23] Tsai, W., Chen, S., Hwang, E.T.Y., Hsu, J. (2010). *A Study of the Impact of Business Process on the ERP System Effectiveness.* International Journal of Business and Management Vol. 5, No. 9

[24] Wei, C., Chien, C., Wang, M.J. (2003). *An AHP-based approach to ERP system selection*. Int. J. Production Economics 96 (2005) 47–62.

[25] West, R., Diagle, S.L. (2004). *Total Cost of Ownership (TCO): A Strategic Tool for ERP Planning and Implementation.* Volume 2004, Issue 1.

[26] Yingjie, J. (2005). *Critical Success Factors in ERP Implementation in Finland.* Swedish School of Economics and Business Administration. M.Sc. Thesis (Feb. 2005)

[27] Zhang, L., Lee, M.K.O., Zhang, Z., Banerjee, P. *Critical Success Factors of Enterprise Resource Planning Systems Implementation Success in China.* 36th Hawaii International Conference on System Sciences – 2003.

Table 1: EDUCAUSE QUARTERLY #2, 2001

Description	**Before**	**After**
Reduction in paper forms	N.A.	15,200 fewer forms processed
Duration of monthly closing	10 days	4 days
Duration of semiannual closing	4.5 months	2 months
Availability of budget reports	Hardcopy monthly	Available online daily
Online access	315 users	1,645 users
Creation of account codes	Manual	Automatic
Alerts	0	16
Approval process	Manual	Automatic
Online requisitions	775	11,400
Paper requisitions	12,973	4,323
Online receipts	0	6054
Supply chain forms	N.A.	Eliminated 21 paper forms
Performance metrics	N.A.	Weekly
Policies and procedures	Inconsistent and undocumented	Desktop manuals and online
Days between letter-of-credit draw downs	30	7

Table 2: Table showing CSFs compiled from different authors. The first row is the totals of the numbers of the papers.
As can be seen, it ranges between 6 and 26.

# of CSFs =	6	20	10	10	6	11	11	26
Paper =	**Maheshwari et al**	**Esteves-Sousa et al**	**Singhal et al.**	**Sumner et al.**	**Yingjie**	**Shanks et al.**	**NAH et al.**	**FINNEY et al.**
1	Mgmt.:	Sustained mgmt. support	Top Mgmt. Support	Mgmt. support,	Top mgmt. support,	Top mgmt. support	Appropriate business and information technology legacy systems	Top mgmt. commitment and support
2	Cultural	Effective organizational change mgmt.	Re-engineering of Business Process	re-design of business processes,	Effective project mgmt.,	External expertise	Business plan and vision	Change mgmt.
3	Scope	Good project scope mgmt.	Effective Project Mgmt.	Training and re-skilling,	Business process reengineering,	Balanced project team	Business process reengineering (BPR)	BPR and software configuration
4	Technical	Adequate project team composition	Company-wide Commitment	Re-design of business processes,	Suitability of software and hardware,	Data accuracy	Change mgmt. culture and program	Training and job redesign
5	Money	Comprehensive business process reengineering	Education and Training	External consultants,	Education and training, and	Clear goals	Communication.	Project team: the best and brightest
6	Manpower	Adequate project champion role	User Involvement	Mgmt. structure,	User involvement.	Project mgmt.	ERP teamwork and composition	Implementation strategy and timeframe
7		User involvement and participation	Suitability of Software and Hardware	Discipline and standardization,		Change mgmt.	Monitoring and evaluation of performance	Consultant selection and relationship
8		Trust between partners	Data Accuracy	Effective communication,		Education and training	Project champion	Visioning and planning
9		Adequate ERP implementation strategy	Vendor Support	Maintaining excellent staffing		Best people full-time	Project mgmt.	Balanced team
10		Avoid customization	Organizational Culture	Avoiding attempts at software modification.		Minimal customization	Software development, testing, and troubleshooting	Project champion
11		Adequate ERP version				Presence of a champion	Top mgmt. support	Communication. plan
12		Dedicated staff and consultants						IT infrastructure
13		Strong comm. inwards and outwards						Managing cultural change
14		Formalized project plan/schedule						Post-implementation evaluation
15		Adequate training program						Selection of ERP
16		Preventive trouble shooting						Team morale and motivation
17		Appropriate usage of consultants						Vanilla ERP
18		Empowered decision-makers						Project mgmt.
19		Adequate software configuration						Troubleshooting/crises mgmt.
20		Legacy systems knowledge						Legacy system consideration
21								Data conversion and integrity
22								System testing
23								Client consultation
24								Project cost planning and mgmt.
25								Build a business case
26								Empowered decision makers

	TABLE 3: Compilation of Critical Success Factors (CSFs)	
#	**CSF**	**QUOTED DESCRIPTION**
1	Vision and Goals	Attaining stated goals or benefits is important to sustaining organizational commitment to ERP implementation (NAH et l, 2003).
2	ERP Version	The choice of the correct ERP version has to be decided upon. An older version may result in frequent updating (Esteves-Sousa et al, 2000).
3	ERP Strategy	While 'phased' implementations provide usable functionality incrementally, 'big-bang' ones offer full functionality all at once at implementation end (Esteves-Sousa et al, 2000).
4	Management Support	It has been empirically proven that strong and committed leadership at the top management level is essential to the success of an ERP implementation (Finney et al, 2007).
5	Decision Delegation	Project team members must be empowered to make quick decisions to reduce delays in implementation related with slow decision- making (Parr et. al, 1999).
6	Project Champion	The individual should possess strong leadership skills, as well as business, technical and personal managerial competencies (Finney et al, 2007).
7	Hardware and Software	The suitability of software and hardware refers to the fit between the selected ERP system and the hardware. Lack of data software quality and reliability and the hardware, software difficulties lead to ERP failure (Maheshwari et al, 2011).
8	Data Accuracy	Data loaded from existing legacy systems must be of high quality (Shanks et al, 2011).
9	Configuration	The system should not be under configured. It can become a nightmare to spend many months designing and building a system, just to have it perform slowly out of the gate (Swartz et. al, 2001).
10	Performance Monitoring and Evaluation	According to Majed Al-Mashari et al, the measuring and evaluation of performance are very critical factors in ensuring the success of any organization (Yingjie, 2005).
11	Testing and Troubleshooting	Development and testing perspectives unique to ERP projects must be well-thought-out and managed (Nah et al, 2003).
12	Customization	Even the most robust out-of-the-box ERP functionality might need to be customized to fit the business.
13	Consultant Support	Although universities have usually restricted budgets, external consultants cannot be replaced and play an essential role in the implementation process (Bologa et al. 2009).
14	Vendor Support	It is hypothesized that if a firm finds out more about a software vendor, it can make a better decision regarding the selection of ERP systems (Lee et al., 2001).
15	Standardization	Wherever and as far as possible, the ERP-hosting organization should try to adopt the processes and options built into the ERP, rather than seek to modify the ERP to fit the particular business practices (Parr et al, 1999).
16	User Involvement	A major cause of ERP failure is lack of employee involvement (Barker & Frolick, 2003).
17	Organizational Culture	Many difficulties have been faced when implementing and using western technologies, management processes, information systems methods, and information systems techniques in developing countries (Shanks et al, 2000).
18	Education and Training	The most measured subset of costs is the initial software development efforts while the most uncertain (and often the largest) cost is long-term maintenance and training (Hubbard et al. 2009).
19	Discipline	Wilson et al (1994) claims that ERP packages, lack of top management support, changes in personnel, lack of discipline, resistance, and lack of broad-based company commitment are the major factors that slow down the process of implementation (Zhang et al, 2003).
20	Commitment	Sustained management commitment, both at top and middle levels during the implementation, in terms of their own involvement and the willingness to allocate valuable organizational resources (Holland et al. 1999).
21	Needs assessment	One of the first steps involves evaluating the needs and requirements that will drive the implementation of an ERP system (Swartz et. al, 2001).
22	Staffing	Sumner (1999) examined the relationship between critical success factors (CSFs) and ERP system performance, and among the CSFs identified was, maintaining excellent staffing (Tsai et al., 2010)

23	Team Composition	ERP projects typically require some combination of business, information technology, vendor, and consulting support. The structure of the project team has a strong impact in the implementation process (Esteves-Sousa et al, 2000)
24	Formalized Plan	This means to have a well-defined plan/schedule for all the activities involved in the ERP implementation, with an appropriate allocation of budget and resources for these activities (Esteves-Sousa et al, 2000).
25	Coordination	Good coordination and communication between implementation partners are essential (NAH et al., 2003).
26	Partnership	During the implementation phase there are different partners involved such as consultants and software and hardware vendors. An adequate partnership between them will ease achievement of the goals defined (Esteves-Sousa et al, 2000).
27	Scope Management	Avoid Scope creep, which is clearly delineating and effectively limiting the scope of the project. (Swartz et. al, 2001).
28	Leadership	The project lead can be considered to be the team leader or project champion for the Campus Management project at this university. This is an additional recommended CSF for a successful ERP implementation (Swartz et al, 2001).

Table 4

ROLES (MGMT)	**NUMBER OF CSFs**	**PAIRWISE COMPARISONS**
TOP	6	15
TECHNOLOGY	5	10
PROCESS	4	6
CHANGE	5	10
PROJECT	8	28
	SUM	69
	PAIRWISE COMPARISONS BETWEEN THE 5 ROLES =	10
	TOTAL COMPARISONS	**79**
	NUMBER OF CSFs	
ALL CSFs	28	**378**

Fig1

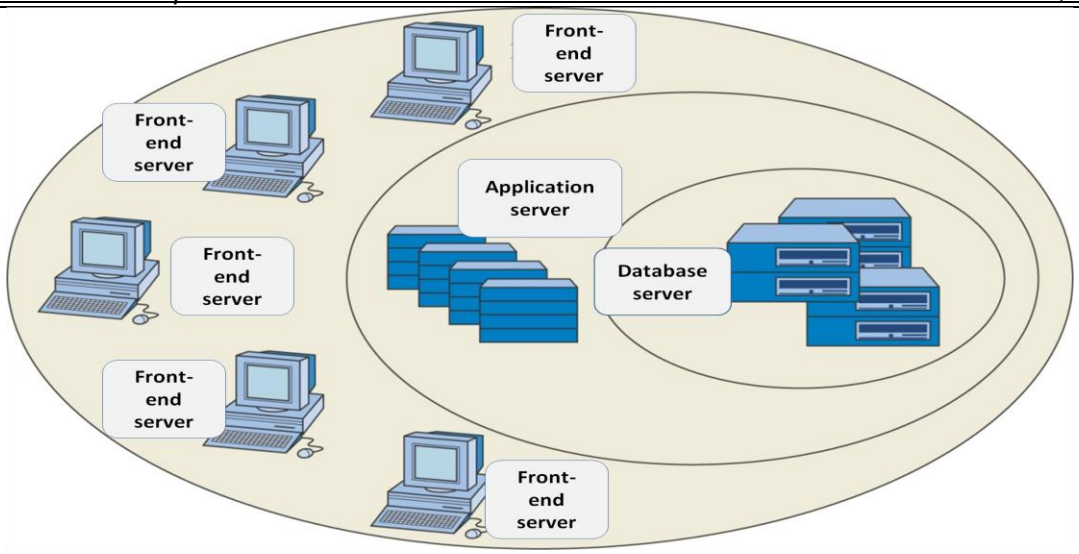


Figure 1 above is a *modified* SAP technologies diagram. It shows how the system integrates the application programs and other functions in the organization. In particular, it shows how the integration is accomplished through the sole database shared by all the application programs

Fig 2

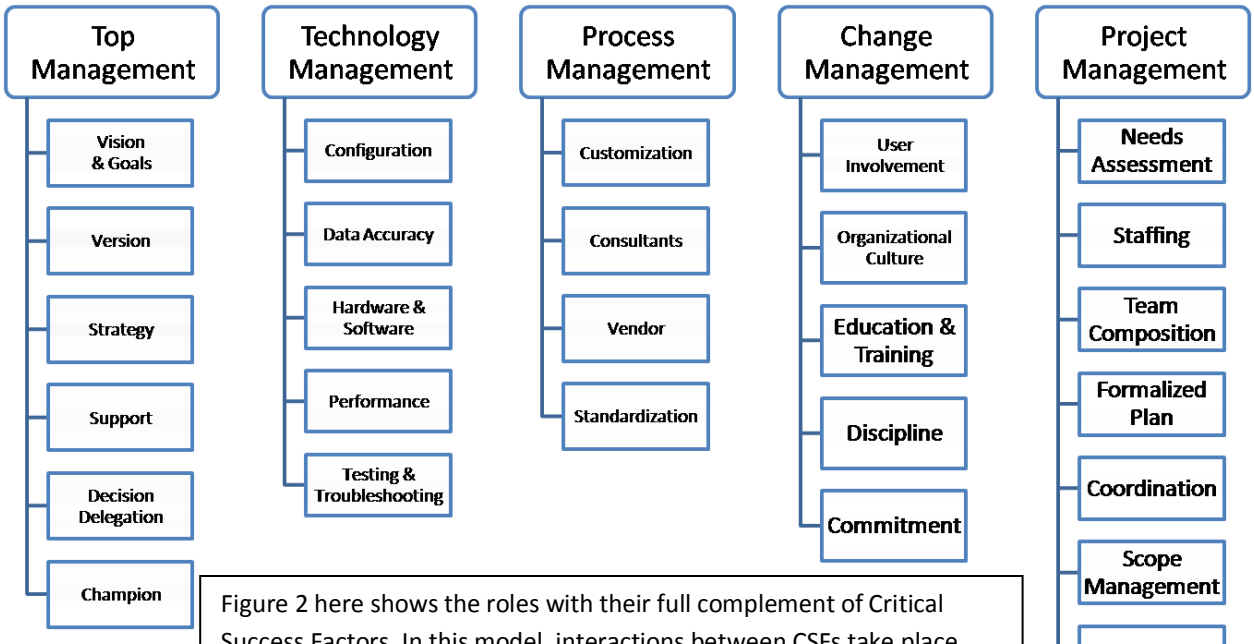
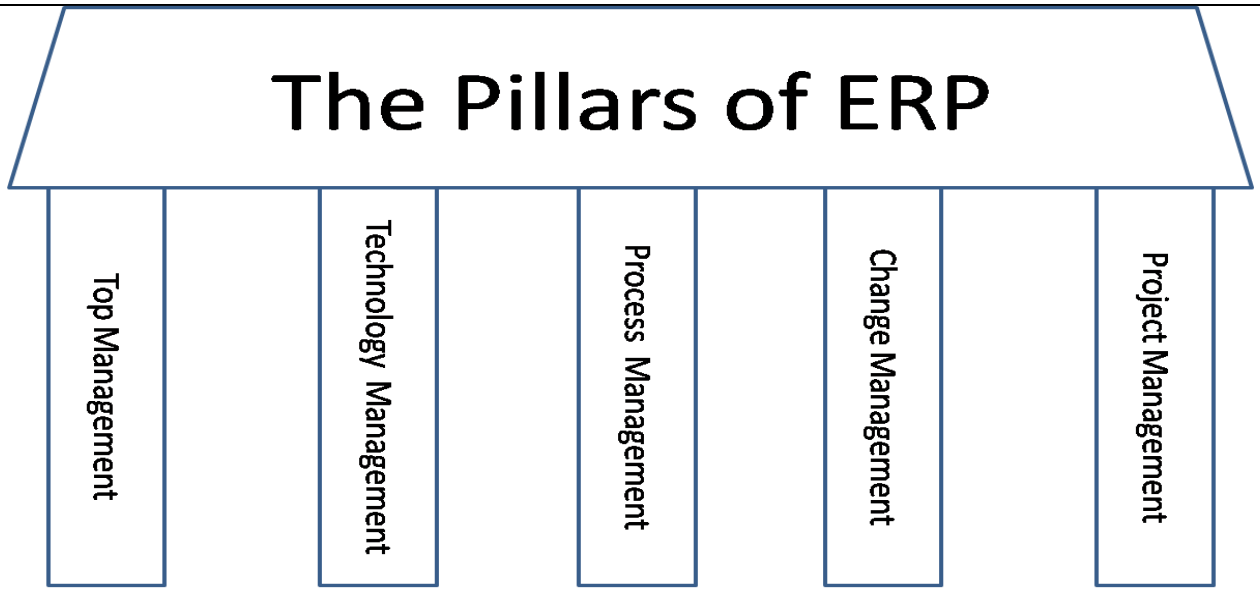


Figure 2 here shows the roles with their full complement of Critical Success Factors. In this model, interactions between CSFs take place only in the roles. In subsequent iterations, it is plausible to come up with inter-role interactions such that the CSFs in a role can influence the others in a different role.

Fig 3

This graphic tells us that the objective of the roles (sub-objectives) is to achieve the principal objective of a "Best ERP Implementation".

Fig 4



This graphic captures the holistic idea of an ERP implementation process. A sub-optimization in any of the pillars will result in a failure as has been chronicled in many papers. When the pillars are sturdy, then a successful implementation is assured.

This is an exploded version of Figure 3 showing all CSFs and all Roles. This Logical Decisions for Windows (LDW) hierarchal graphic is useful for depicting large "Goals, sub-goals and attributes" diagrams. It will be of immense use in the next iterations of the model when using AHP or ANP to determine weights of the CSFs (criteria) and roles (sub- goals). LDW is a good tool for modeling Multiattribute Criteria Decision Analysis (MCDA) problems such as ERPs.

Fig 5