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Aditya Agrawal
Bond University, Queensland

Gavin Finnie
Bond University, Queensland, gfinnie@staff.bond.edu.au

Padmanabhan Krishnan
Bond University, Queensland, pkrishna@staff.bond.edu.au

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Aditya Agrawal, Gavin Finnie, Padmanabhan Krishnan
School of Information Technology
Bond University
Queensland, Australia
Email: {gfinnie, pkrishna}@staff.bond.edu.au

Abstract

Enterprise Resource Planning systems evolution initiatives often represent the single largest investment (and therefore risk) for distribution corporations yet there exist few management frameworks in the literature to help decision makers measure risk during this organization-wide change process. We have customized our original ORE framework as a multi-criteria, relative risk, condition consequence management decision framework enabling executive decision makers in distribution businesses to calculate and compare risk evolution at fixed points of the ERP change cycle. The framework emphasizes the political and process dimensions of evolution and utilizes the Analytic Hierarchy Process to enable management to make structured and balanced risk mitigation decisions. This paper describes the development of ORE into ERP-ORE and illustrates the application of the framework through a case study description of a medical supplies distributor implementing an ERP system.

Keywords

Managing IS Evolution Risk, Organizational Risk Management, Quantitative Decision Making, Enterprise Resource Planning, Distribution Businesses.

Introduction

Distribution businesses are redefining themselves in the context of their new role in the supply chain. This involves a change from a make or break bulk aggregator to the supply chain information manager. In order to better manage internal customer and operational information, and ready themselves for their new role in the supply chain several distributors are implementing Enterprise Resource Planning (ERP) systems. ERP systems signify integrated business application packages (Rosemann, Klaus & Gable 2000). However the essence of ERP is the process of connecting all information flows within the firm and using that connectivity together with analysis to advise decision makers and make routine decisions. This leads to better internal and external communication resulting in decreased costs, better decisions and greater customer satisfaction (Lawrence, Jennings & Reynolds 2005).

An ERP implementation initiative is critical for distribution firms and there are few projects in a corporation's history which have a greater financial and organizational impact (Sumner 2000). ERP systems represent a new business operating system (Chang 2004) and are a significant investment of time and resources (2% to 5% of revenues (Austin, Cotteleer & Escalle 1999). Inadequate and poorly planned implementation is one of the most frequently cited reasons for ERP disasters (Hong & Kim October 2002). ERP standard processes often conflict with the non-standard distribution processes (Lawrence, Jennings & Reynolds 2005) and can cause disruptive change (Soh, Kien & Tay-Yap 2000). Its success can lead to key competitive advantage (Cisco, Tektronix) or bankruptcy (Fox Meyer) (Skok & Legge 2001). Risk assessment and mitigation is therefore critical to managing and ensuring the success of the ERP evolution. There are no formal frameworks in the literature which support distributors in implementing ERP systems.

The Analytic Hierarchy Process (AHP) is a widely used management science framework (Saaty 1980). Developed by Thomas Saaty, it is a mathematical decision making technique that allows consideration of both qualitative and quantitative aspects of decisions. It reduces complex decisions to a series of one-on-one comparisons and then synthesizes the results. The within-criterion matrices are mathematically merged with the between-criteria matrix to yield an overall prioritization of the decision alternatives in light of the decision maker's elicited preferences. This is done by the right eigenvector method which Saaty showed to be the most correct approach. AHP provides support for all major phases of the decision making process; intelligence, design, and choice. It can be used with an individual (unitary) decision maker or with groups thus drawing all stakeholders together and providing a means of conceptualizing and communicating the problem permitting shared vision. Most importantly it provides a means to manage the cognitive complexity which is so often

attendant to problems with multiple decision criteria for which multiple decision alternatives must be considered (Karsten & Garvin 1996), such as understanding and managing risk during ERP evolution.

The original Organizational Risk Evaluation (ORE) (Agrawal, Finnie & Krishnan 2007) framework was developed as a multi-criteria, relative risk, condition consequence, management decision framework enabling executive decision makers to calculate and compare risk evolution at fixed points of the information systems evolution change cycle and make structured and balanced risk mitigation decisions. One of the key characteristics of the original ORE framework was its generality of application to various business domains and information system paradigms with the flexibility to customize it for particular domains and paradigms (Agrawal, Finnie & Krishnan 2007).

The ERP-ORE framework is a customization of the original ORE framework for measuring risk during the evolution of the ERP information system paradigm in the distribution business domain. AHP is utilized at several stages within the framework as a formal management science methodology to discuss and assign weights to different customizable elements within the framework.

The rest of the paper is organized as follows. The relevant aspects of the original ORE framework are reviewed to facilitate understanding of customization. Next the architecture of ERP-ORE is described and its elements are detailed. Finally ERP-ORE framework application is demonstrated using the hypothetical case study of a medical supplies distributor replacing their legacy technical infrastructure with an ERP based infrastructure to meet the new demands of the supply chain.

Background

The purpose of this section is to review the relevant literature concerning the original ORE framework that is relevant to defining and understanding the key terms and concepts in ERP-ORE.

ORE Framework

The ORE framework (Agrawal, Finnie & Krishnan 2007) is built based on a multi-level architectural design based on a set of core principles including operations, tactics and strategy, divide and conquer and separation of concerns. It assumes a hierarchical organizational decision making model that enables effective use in management decision making. ORE factors and metrics are chosen to represent all dimensions of the Leavitt diamond for balanced decision making (Leavitt 1965). Methodologically it uses an estimation process of measurement, self-referential scale development and assessing risk evolution based on historical measurements to make decisions (Nair 2006). It enables fixed time sampling in a cyclic evolutionary process and allows multiple applications during the same evolutionary phase. ORE is formally defined as per the representational theory of measurement to facilitate real world comprehension of the measures produced. ORE sub-project factors include Technical Change, Size Change, Requirements Change, Personnel Change, Parallelism and ranked factors including Development Platform, Manpower Outsourcing and Project Team. Each factor is operationalized using a set of relevant and measurable metrics. Priority and Dependency models allow the prioritization and linking of different sub-projects making up an information systems evolution and associated risk propagation. Default weights were assigned to all factors and metrics based on the empirical findings of the Carnegie Mellon University Software Risk Program (Higuera & Haimes 1996). The overall ORE risk function may be mathematically represented as,

$$\rho(organizational) = \sum_{i=1}^{n} (\rho_i * \sigma_i + \delta_i) \quad (1.1)$$

where ρ_i stands for sub-project risk of project *i*, σ_i stands for priority for sub-project i, δ_i stands for $\sum_{j \in \{\rho_{i_1} \ldots \rho_{i_n}\}}^{n} \rho_j * \sigma_j$. Where ρ_{i_x} represents the xth project on which ρ_i depends and σ_j represents the priority of ρ_j. There are *n* sub-projects in the organizational information systems evolution.

ERP-ORE Framework

Overview

ERP-ORE customizes the original ORE design and thinking for the ERP in Distribution problem. ERP systems represent a buy rather than build approach to information systems design (Skok & Legge 2001). Therefore the major work during the implementation process is structured process mapping of the current business processes in comparison to the ERP processes. Once this is completed decisions have to be taken regarding which processes to change or what software modifications are necessary. Next a strategy needs to be devised to manage the organizational implications including education of the corporate staff in adjusting to the new paradigm, alleviating their fears regarding their jobs, and earning support and consensus (Lawrence, Jennings & Reynolds 2005).

Hence the two major dimensions of risk are *process* and *politics*. The operationalization of these dimensions into factors and metrics is illustrated in Figure 1 (on the next page).

Key Architectural Customizations

Several ORE architectural concepts are re-defined in ERP-ORE. Technical sub-projects are now defined as the specific ERP modules including sales order processing, distribution systems planning, warehouse management, financials and executive information systems. The Project Level Controller (PLC) becomes the formal ERP management team (Delta team) (Lawrence, Jennings & Reynolds 2005) which is usually composed of power users within the different business units who manage the organizational politics and have executive management support. They are primarily concerned with the day to day operational and tactical management of the implementation. The Organizational Level Controller (OLC) is defined as the steering committee who represent executive management and whose main role is one of guidance, mentoring and directing. They understand the strategic objectives and can make important resource allocation and political decisions.

ERP project management has to support ongoing tasks as the customization of the system for new business objectives and incorrectly understood current requirements continues (Chang 2004). Hence the framework is expected to support continued decision making through continuous refinement of the company specific risk scale.

Additional Factors

Most distribution and supply chain metrics such as lead time, fill rate, on time performance etc. are internal focussed metrics aimed at measuring operational concerns. However for measuring the organization and supply chain wide impact of ERP systems deployment require broader metrics. There are no such widely accepted metrics (Lambert & Pohlen 2001). ORE lacked any general organizational level metrics due to their dependence on the contextual business and work model. ERP-ORE provides organizational level factors specific to the ERP in distribution domain.

The organizational level factors serve as a formal mechanism to consider and think about important organizational risk dimensions and incorporate them into risk measurement. Due to the lack of maturity in scale and metrics it includes them as highly unstructured factors to allow flexibility for choice of metrics, weightings of metrics within the factor, and of the factor weight itself in comparison to other factors based on the domain specifics. Weights can be decided using AHP. It is expected that as the framework is used and customized further to the organizational specifics, metrics can be plugged into the unstructured factors provided. This is in accordance with the representational theory of measurement according to which ORE measurements were defined (Fenton 1998). By default these factors are assigned the same weight as the priority and dependency adjusted project risks of the ORE model. There is no empirical evidence to support a different weighting.

Based on Porters Five Forces model (Porter 1980) that provide a strategic check for corporate strategy both within the outside the company, two organizational level factors have been developed.

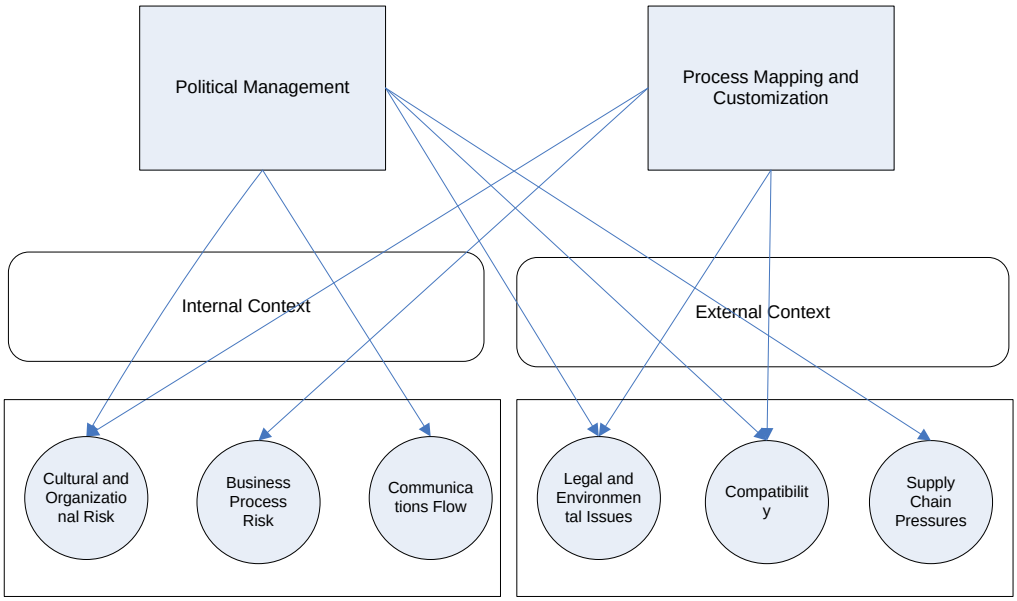

Figure 1: Operationalization of Dimensions into Factors and Metrics

Internal Context

The purpose of this factor is to formally consider several internal corporate risk causing issues. The factor has the following unstructured metrics,

- *Cultural and Organizational issues*: ERP solutions are developed using best practice business and work models. It is necessary to consider the suitability of these implicit models for the organization. Misfits between an organization and a ERP solution can be classified into the categories of source (company specific, industry specific or country specific) and type (data, function or output) (Soh, Kien & Tay-Yap 2000). These misfits and their resolution is the major source of customization efforts and mitigating and managing their risk is a key activity.

- *Business Process Risk*: Distributors due to the nature of their business have developed highly non-standard processes suited to providing their customers whatever they need as and when they need them. The sales oriented distribution culture demands such customizations and changing them without understanding can mean loss of key competitive advantage. Legacy systems at most firms had evolved over many years and were specifically designed to meet the firm's needs. There have been several cases of distributors going live with the new system and immediately experiencing customer service failures. The ERP systems had likely not been completely programmed to capture those processes that were critical to important customer service needs and so the firm's employees were forced to go offline to meet customer needs. ERP-ORE incorporates this important measure through the Business Process Risk metric (Lawrence, Jennings & Reynolds 2005; Mashari & Zairi 2000)

- *Communications Flow*: Communication flows are an important indicator of the success of the system evolution and corporate education process. While primarily being a matter of judgment it can be measured through artefacts such as number of emails and chat messages in a given period of time exchanged between business user groups, technical teams etc. The balance between communication flows can be visualized as a Kiviat graph and ratio of balance can be scaled, interpreted and included into the organizational risk calculation (Bruegge & Dutoit August 1998).

  The political complexity of the social situation cannot be over-emphasized. At any given moment each political constituency is constantly evaluating the usefulness of the new system to their political power and influence and playing games to maintain their position (Keene 1981; Skok & Legge 2001). Success of the Delta team in selling the ERP idea to the corporate staff is an important consideration in this process. Political considerations therefore need to be considered in determining an appropriate risk value for this metric.

External Context

The purpose of this factor is to formally consider several environmental corporate risk causing issues. The factor has the following unstructured metrics,

- *Legal and Environmental issues*: An aspect of ERP packages often missed is that they also contain implicit models of regulatory, legal and environmental contextuality that can seriously affect the useful operation of the system if the organizational environmental context is different. An example in the context of a hospital ERP system is the difference between the medical models of Asia and Europe. While the Europe healthcare model is usually privately delivered and the government or insurance pays the bill, in the Asian model often the individual is responsible for healthcare costs and the government subsidizes healthcare costs through economies of scale and community control. (Holland & Light 1999; Soh, Kien & Tay-Yap 2000). These aspects can be formally considered within this metric.

- *Compatibility*: The compatibility of the new system with the infrastructure of partners within the supply chain is a key risk criterion. Since a major purpose of the initiative is allowing integration with the supply chain proper customization to ensure the systems are technically compatible with partners is necessary. Common misalignments include plug and play e-process misalignments, information co-ordination misalignments, and knowledge sharing misalignments (Sawy 2001). Compatibility issues are therefore a significant cause for risk in supply chain systems evolution has to be considered.

- *Supply chain pressures*: A distributor is defined by its role in the supply chain and supply chain pressures drive the distributor's initiatives. Issues such as channel partner pressure (e.g. Wal-Mart) for quicker implementation (Phillips & Caldwell 2005) can quickly destroy all structure as the company scrambles to cope under the pressure applied. Hence this metric has been left unstructured to be used based on management judgment as a changing barometer of these pressures and their risk impact.

Re-Definition of ORE Factors

Some of the default ORE factors need to be re-understood or clarified in the context of ERP. Size change is interpreted as the total size of the system that needs to be *customized* and its evolution is understood to be the portion that remains to be mapped and customized. The Development Platform metric is retained in ERP-ORE due to the possibility of some modules being customized through coding or custom development to meet business needs. Manpower outsourcing is no longer relevant to the framework unless actual project management and customization of a module is being outsourced. Finally project team is re-interpreted as the risk due to inner-team cohesion and communication between the ERP, consultant, management and module teams. The original general ORE interpretations can be used for a particular sub-project if more appropriate.

Adding AHP to the Methodology

The Analytic Hierarchy decision methodology is incorporated into the ERP-ORE framework at several key steps in the estimation and decision making process. During sub-project risk assessment AHP can be used to decide the weightings of metrics within the factors and the weightings of factors within the overall sub-project risk assessment. Once the sub-project risk assessments are completed, AHP is next used to decide the priorities of the different sub-project metrics relative to one another and to agree upon the dependencies between the different sub-projects. Finally AHP is used to decide the weightings of the different organizational level risk factors (and their metrics) relative to each other. The discipline of the AHP is hoped to permeate the ERP-ORE estimation process and assist in the management of a very complex situation.

Overall ERP-ORE Organizational Risk Equation

The ERP-ORE framework retains the original sub-project risk factors, metrics and weights of the ORE framework. Priority and dependency models too retain their original definitions, though through the use of AHP the weighting and prioritization process now becomes more formal and systematic. ERP-ORE however re-interprets several sub-project factors, and adds two important ERP in Distribution specific organizational level risk factors to the original ORE organizational risk equation as stated in Equation (1.1). The revised overall organizational risk equation may be represented as,

$$\rho(organizational) = (\omega_{SP} * \sum_{i=1}^{n} (\rho_i * \sigma_i + \delta_i)) + (\omega_{IC} * IC) + (\omega_{\mathrm{EC}} * EC) \qquad (1.2)$$

Where ρ_i, δ_i have their usual meanings, and there are *n* sub-projects in the ERP systems evolution. AHP can be used to decide the weights σ_i of the sub-projects. AHP can also be used to agree upon the dependencies δ_i, and weights of factors constituting sub-project risk ρ_i, and the metrics constituting each factor.

Organizational level weights $\omega_{SP}, \omega_{IC}, \omega_{EC}$ are by default assigned equal (unary) weights as there is no empirical evidence to support any other weighting. Management judgment assisted by the AHP decision making process can be used to assign a priority suited to the domain and circumstances.

- IC stands for Risk due to Internal Context, and may be represented as

$$IC = \sum_{f \in F_{IC}} f * w_{IC}(f) \tag{1.3}$$

where F_{IC} = {Culture and Organization, Business Process, Communications Flow} and the function $w_{IC}()$ (weight of) can be decided using AHP.

- EC stands for Risk due to External Context, and may be represented as

$$EC = \sum_{f \in F_{EC}} f * w_{EC}(f) \tag{1.4}$$

where F_{EC} = {Legal and Environment, Compatibility, Supply Chain Pressures} and the function $w_{EC}()$ (weight of) is decided using AHP.

Case Study

Overview

ERP-ORE application is described through a hypothetical case study at the first two major milestones in the implementation lifecycle of an ERP system. The environment of supply chain management is highlighted. Distribution businesses are primarily sales and marketing businesses. This culture has its particular strengths and weaknesses which serve as a background for this case. ORE methodology based on the scientific estimation process is further formalized in ERP-ORE through the use of AHP. The dimensions of process customization and organizational political management are emphasized. Finally measurement of the organizational factors internal and external context is also illustrated.

Case Scenario

Medinc (adapted from (Mcafee 2001)) is a US based national distributor of brand name medical supplies to medical practitioners. The company seeks to be a one-stop shop providing a broad range of medical supplies, drugs and equipment, and filling orders quickly, accurately and reliably. The orders are small and the customers are unsophisticated (compared to drugstores) and require a lot of help. Hence the marketing and sales function is highly emphasized within the organization.

The company has several major competitors who have a greater product mix and a larger sales force. In order to meet its ambition to be a one stop shop and make up for its size weaknesses the company must utilize internal and supply chain information flows, improve marketing, better forecast needs and better maintain warehouse inventory. The supply chain also requires them to expand their role and carry out complex forecasting activities to smooth supply and demand curves and soften the Bullwhip Effect in the supply chain (Lee, Padmanabhan & Whang 1997). There is considerable pressure by suppliers to implement solutions to achieve these goals. Hence the company has decided to replace its legacy multiple systems based infrastructure with a brand name ERP solution. The main selection criteria were single brand name vendor, size and financial strength of vendor, analytic functionality, upgradeability and customization, and cost and support for all major business functions. Needs analysis, high level process flow model comparisons and product demonstrations were conducted. Technical support track record and test database and orders were studied. Channel specific consultants were consulted. Vendors also arranged for user site visits (Lawrence, Jennings & Reynolds 2005). After considerable discussion a world class European ERP vendor was selected.

Modules being implemented are A) Distribution Requirements Planning: forecasting, value added processing and semi-automated procurement support, B) Warehouse Management: pick slip generation and management, tracking orders through the warehouse, cross dock, receiving and putaway, and warehouse information automation, C) Sales and Order Processing: automation of activities and information flows relating to request for quotation, request for information, entering the sale and tracking the transactions, D) Financials: tracking, managing and reporting on financial information, and E) Executive Information Systems: metrics development, mapping along strategic, tactical and operational dimensions and developing analytical reports for decision makers. Each module implementation is considered a sub-project.

Executive management is aware of the business criticality of the project. They decide to use ERP-ORE to assist in managing risk during the project evolution. A consulting firm specializing in ERP implementations are also brought in to bring project specific expertise. A Delta team composed of power users and managers of all business units is formed and management publicly informs the staff of its unconditional support to the Delta team. A War room is established for the Delta team to work from. The Delta team acts as Project Level Managers (PLC). A steering committee of all chief executive officers and several members of the executive management team is setup to act as Organizational Level Controllers (OLC). The Delta team meets weekly with major users, consultants and ERP vendor officers and the OLC team meets fortnightly with the Delta team and major representatives from consultant and ERP vendor teams.

The major project phases are decided as process mapping and data scrubbing, modifications testing and approvals, pre-testing of system, activating ERP processes, and system cutover and go-live. Standard project management scheduling allocates three months for the implementation of each phase.

Process Mapping and Data Scrubbing Phase

The purpose of the process mapping and data scrubbing phase is to study process differences between the ERP system and the company and begin the process of data standardization and migration.

Organizational Parameters

The OLC team uses the AHP to decide organizational parameters. The three single node decision trees are shown in Figure 2. Pairwise preferences are elicited from decision makers for each tree. For priorities and organizational factor weight trees the alternatives are ranked relative to each other. Saaty's 9 point scale is used. The scale ranges from 9 (extremely preferred) to 1 (equally preferred). For dependencies binary values 1 (is related) and 0 (is not related) are used. Priorities are assigned based on the business importance of better forecasting and analysis, followed by operational efficiencies. The comparison matrices are depicted in Figure 3.

Since there is no prior scale or empirical results the OLC assigns all organizational parameters equal value 3.3. The priority matrix is simplified using eigenvector computations to the following alternative priorities (rounded x10) A: 5.13 B: 0.63 C: 0.33 D: 1.29 E: 2.61. Executive information systems (E) analytics is dependent on all other modules. Financials (D) depend on the operational information (A, B and C) from other operational modules to develop financial analytics. Default full dependent risk propagation is maintained. The AHP synthesis phase is not required for these single node decision trees (dependencies do not even need the eigenvector computation) however the pairwise comparison procedure decreases the complexity of the decision process.

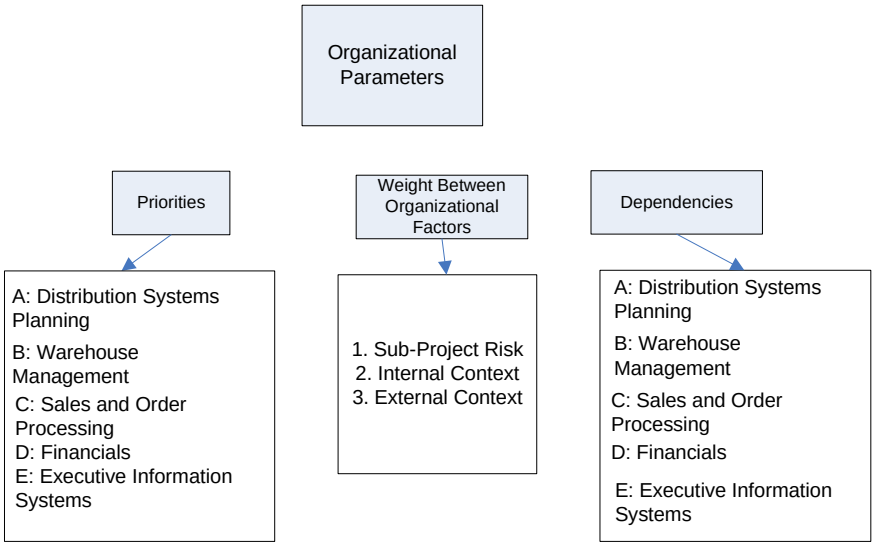

Figure 2: AHP Trees for Organizational Parameters

	A	B	C	D	E
A	1/1	7/1	9/1	5/1	3/1
B	1/7	1/1	3/1	1/3	1/5
C	1/9	1/3	1/1	1/5	1/7
D	1/5	3/1	5/1	1/1	1/3
E	1/3	5/1	7/1	3/1	1/1

	1)	2)	3)
1)	1/1	1/1	1/1
2)	1/1	1/1	1/1
3)	1/1	1/1	1/1

	A	B	C	D	E
A	0	0	0	0	0
B	0	0	0	0	0
C	0	0	0	0	0
D	1	1	1	0	0
E	1	1	1	1	0

Figure 3: AHP Based Comparison Matrices

Sub-Project Factors Risk Assessments

The module implementation managers assess different risk factors of the sub-projects. Since there is no reference scale the PLC advises the managers to use the default framework weightings for metrics within factors, and the weighting of factors. PLC also advises the managers to maintain the default Equation 1.2.

PLC Decision Making

Based on the risk assessments the list of sub-project risk values are derived as summarized in Table 1 (second column. Third column contains updated values discussed later). The dependent projects naturally have a higher risk due to dependency risk propagation. The main risk sub-projects that PLC discovers are module A (Distribution Systems Planning) for complexity and importance, and C (Sales Order and Processing) where employee resistance is very high. Medinc has a powerful sales and marketing department that is highly change resistant. The department has a highly customized quoting system designed for the non-standard medical supplies business and it does not want to relinquish the system and the informational control it signifies. Salesmen are particularly reluctant to allow technical personnel to "tell them what to do". Poor politics by the ERP team has increased their paranoia.

Table 1: Sub-Project Risk Values

Sub-Project	Initial Risk Value	Updated Risk Value
A	77	150
B	56	40
C	90	100
D	248	348
E	300	400

Table 2: Internal Context Risk Values

Internal Context	Initial Risk Value	Updated Risk Value
Cultural & Organizational Issues	60	90
Business Process Risk	75	80
Communications Flow	50	90

Table 3: External Context Risk Values

External Context	Initial Risk Value	Updated Risk Value
Legal & Environmental Issues	50	40
Compatibility	79	90
Supply Chain Pressures	80	100

Organizational Factors Risk Assessment and Decision Making

The OLC listen to the feedback of the PLC teams and reprimand the ERP teams for their poor tact. As a team they use the AHP to assign weights to organizational factors internal and external context, and weights to the metrics within each factor. Since there is no reference scale they assign equal weights to all elements. They discuss and assign a risk value out of 100 to each of the metrics within each factor as summarized in the second columns of Table 2 and 3 (third column contains updated values discussed later). Despite strong advice from consultants and the ERP team the OLC believes communication flows and the legal issue are not important and assigns them a low weight. The company prides itself on its considerate and flexible culture and the team assigns it a low value. Compatibility, business process risk and supply chain pressures are the key reasons for implementation and are therefore assigned highest risk. The OLC feeds the values into the model and framework outputs risk at this time (denoted by t_{phase1}) to be $risk_{phase1}$. Since there is no scale the OLC does not feel justified in acting further at this stage and adopts a wait and watch policy.

Modifications Testing and Approval Phase

The purpose of this phase is to conclude the process mapping phase and make important customization decisions regarding whether to redesign the business process, modify the software, or adding bolt-ons. OLC decides to carry out the process using informal meetings between PLC and the stakeholder groups.

Organizational Parameters

The OLC meet to discuss the organizational parameters. On the advice of the consulting team the dependencies and weightings are retained. There is heated discussion on the priorities as the sales executive director insists that the sales module should be given highest priority as his salesmen are not happy with the ERP team and "want to do things their way". The CEO has to intervene and decides to retain original priorities. On vote the motion is passed in favour of supporting the CEO. Political and "me too" issues dominate the discussion.

Sub-Project Factors Risk Assessments and PLC Decision Making

The project managers work with their teams to re-assess progress since the last phase. The PLC moderates the discussions to try to reach consensus. Major problems are encountered. All teams fail to reach any consensus on which customizations to carry out and how. Power users reluctant to lose control threaten to derail the normal running of the corporation. The problem is especially acute with Warehouse Management. The low skill workers in the warehouse are afraid for their jobs and are being incited by the unions. The CEO on advice of the PLC hires a labour speciality law firm and sack several influential labour leaders. The PLC increases the risk to all projects, except B: Warehouse Management where the action seems to have had a disciplining effect. The new assessments are summarized in Table 1 (third column).

Organizational Factors Risk Assessment and Decisions

The OLC are shocked by the dissension and political issues faced in the first three months. There is great unrest and lack of staff support. The salesmen are refusing to share information. All three internal context metrics are increased in risk as detailed in Table 2 (third column). The importance of cultural and communication issues is realized. External pressures also increase. Some of the customers and suppliers have rival ERP platforms and put pressure on the firm to change vendors. Unknown technical compatibility concerns arise with a major supplier using a rival ERP solution. The hiring of the legal firm decreases several legal issues however puts additional financial pressure on the ERP budget. Changes to the external context metrics are detailed in Table 3 (third column). The OLC feed the risk values and the framework outputs $risk_{phase2}$ at time t_{phase2}. They discover that $risk_{phase2} - risk_{phase1}$ is highly positive. The OLC realizes that a major internal and external education program needs to be developed to manage staff and supply chain partner fears and demonstrate how the project benefits them. At the same time more discipline needs to be instilled into the customization decision process.

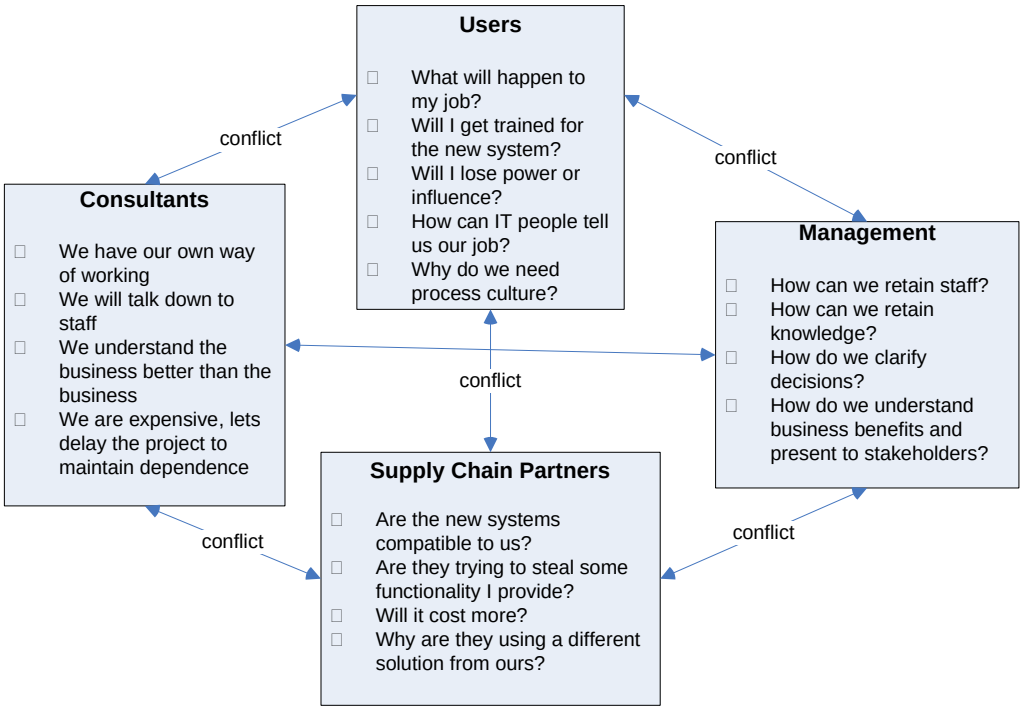

Figure 4: ERP Rich Picture for Medinc (Adapted from (Skok & Legge 2001))

OLC instructs the PLC to use a formal change management methodology and asks the consulting team to research and propose one. Key business requirements are re-iterated with the PLC to allow them to make choices between nice to have changes and key changes. They are advised to speak to the OLC in case of doubt.

The OLC also develops in conjunction with HR a fortnightly ERP newsletter that will answer questions for different departments and educate staff about the ERP initiative, its motives and purposes. This newsletter is based on the rich picture devised by the OLC detailing common questions, concerns and issues (Figure 4). Common delaying games such as *diverting resources*, *deflecting goals* (sales team especially), *dissipating energies* are studied and strategies are devised to manage them (Keene 1981). The CEO and COO schedule meetings with all major partners on supply and demand sides to manage expectations and the PLC are instructed to repeat the approval phase again and ensure definite decisions are taken. HR is also instructed to develop a recruitment plan for all business functions to manage staff turnover.

Conclusion and Directions for Further Work

ERP-ORE customizes the risk measurement for distribution businesses during ERP systems evolution. It focuses on the dimensions of politics and process which are identified as the most important issues. ORE concepts are re-defined for this domain. Two organizational risk factors internal and external criteria are added to the framework. Internal and External context factors assess the risk impact of political and process issues internal and external to the company. Due to lack of widely accepted metrics these factors are semi-structured to allow management to plug in metrics and weights as necessary. Each sub-project becomes a module implementation and AHP allows a formal consensus building and decision making methodology to decide weights and priorities at several steps of the ERP-ORE methodology. The AHP discipline is expected to permeate the entire decision making process. Hence the work develops the ORE framework for specific domains and paradigms and further formalizes it towards a management science framework.

Several avenues of work are possible. ERP-ORE risk outputs can be structured into back office and front office components to support important resource allocation decisions where front office risk must be politically managed (Evangelidis 2003). More formal mathematical structures such as matrices can be introduced to capture risk values and make possible additional types of analysis and operations on framework output. Most importantly through application of the framework in corporate projects, weights, factors, metrics, functional configurations (linear, additive etc.) are expected to be refined. We plan to document the growing maturity of the framework through experience papers that can be eventually collated into a guide book for practitioners, consultants and management in the use of ERP-ORE.

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