FMEA Approach for Decreasing ERP Implementation Failure using Critical Failure Factors

George Wanas
Department of Information Systems and Technology
Institute of Statistical Studies and Research

Nagy Ramadan Darwish
Department of Information Systems and Technology
Institute of Statistical Studies and Research

ABSTRACT
The Enterprise Resource Planning (ERP) implementation projects have high failure rates. Any conflict done during the ERP implementation process leads to errors in business decision making, decrease productivity and profitability, and can affect the project success. The main purpose in this paper using Failure Modes Effects Analysis (FMEA) approach to deal with help in increasing the success rate of ERP implementation projects. This achieved through defining main failures and failure factors related to ERP implementations. The ERP projects are divided into three stages; Pre, during and post implementation. Each stage analyzed to define its main characteristics and its different failures and failure factors. Many risks can affect and lead to failure in ERP Implementation. The risk management techniques are very useful before, during and post ERP Implementation phases. The FMEA approach assesses and evaluates the defined failures and failure factors providing a quantitative measure for each risk of failure. Our study describes how to reduce ERP Failures by decreasing the risk value, so the researchers enhance the FMEA approach by a Proposed Enhanced FMEA approach to measure the risk. Based on the four organizational critical areas the researchers' uses four sub categorization aspects, Financial, Customer, Legal & Regulation, and Business Operation. The Enhanced FMEA approach leading to success of ERP implementation.

General Terms
Failure Modes Effects Analysis, Enterprise Resource Planning.

Keywords
Information and Communications Technology (ICT), Information Technology Transfer (ITT), Critical Failure Factors (CFF), User Requirements Specifications (URS).

1. INTRODUCTION
ERP system is a standard software package that integrates all business activities, business information across the firm, manages the available resources, and improves its business process [1-12] [13]. ERP system Control and manage complex business process and business information effectively [3] [14], the important benefits from ERP system allow better access to information [15]. There are many reasons which motivate the organizations for implementing ERP such as replacing old system and improving operational system performance [16].

Also, the elimination of data redundancy and the simplicity of business process are important strengths of ERP system, which has highly technical cross functional through the organization. ERP systems improve organizational performance and competitiveness [17] [18] [19].

ERP has many activities that managers use to manage the organizational activities such as purchasing, human Resources, accounting, production, and sales. There are many functions available in each ERP system, such as purchasing, inventory, supply chain planning, scheduling, quality control, and demand management. Financial that contains many modules as the following Accounts Payable, Accounts Receivable, Cash Management, and control. Projects that contain many modules at the following activity management, project billing, and project contracts. Human Resources contains many modules as the following time and attendance, training, payroll, and recruiting. Customer Relationship Management that contains many modules as the following services, calls center support, sales and marketing, and analytics.

The analysis for vendors market are very important issue when the company starts thinking about implementing the ERP system. After choosing proper vendor information about the capabilities of its system should be identified [20].

There are three stages in ERP implementation, ERP pre implementation stage contains the selection of ERP software, vendors, and defines URS. ERP Implementation phase contains activities related to software configuration, data conversion, integration, testing, and user training. ERP Post implementation stage contains the user training, and maintenance, management, and evolution.

The potential Risk is losing or gaining something. Risk can defined as uncertainty [21]. Failure is a state of not meeting a desirable objective and may be viewed as the opposite of success [22] [23].

Critical Success Factor (CSF) and Critical Failure Factors approaches used to in Information System evaluation. It has been applied to in information system area including project management, manufacturing system implementation, re engineering, and ERP system implementation [13] [24].

The ERP validation assures proper control the functional risk, Operational risk and also ensures user satisfaction and ensures that the ERP meets the user's requirements and expectations. The ERP system Validation includes software validation and Infrastructure Qualification for Hardware and equipment. The business process identification known as process mapping is a critical step in validation phase for ERP, a risk analysis are very important for correct system validation and development of system documentation which includes User Requirements Specification (URS), Functional Specification (FS), Configuration Specification (CS), Installation Qualification (IQ), and Operation Qualification (OQ).

There are different risk assessment tools which try to measure the Risk, each tool has its own characteristics, features, or criteria, these tools are differentiated from IS / ERP measurement approaches and models. These models did not

measure the risk specifically put measure IS or ERP. Risk Assessment tools used in industrial fields [25].

There are many tools can be used to perform risk assessment such as Preliminary Hazard Analysis (PHA), Functional Failure Analysis (FFA), HAZard and OPerability studies (HAZOP), Fault Tree Analysis (FTA), Hazards Analysis and Critical Control Point (HACCP), and Failure Mode and Effect Analysis (FMEA).

The study problem exists because ERP System are considered as a major investment, Around 75% of ERP implementation projects fail in achievement their goals, ERP System require efficient planning, and If ERP Apps fail to achieve Organizational goals [12] [13] [15] [26], for that, the management of ERP risk are very important for leading to ERP system success to ensure that ERP system success in achieving the business requirements. A different ERP system has different degrees in spending time on the implementation. The much of adjusting may be a step towards failure [24].

Many researchers have found that the weak of risk assessment the main reason that leads to the ERP implementation failure [27-29]. The organization must validate the ERP to assure that the ERP system meet the organizational requirements.

The paper consists 7 parts, part 1 is the Introduction, part 2 contains the Literature review, part 3 contains Main Failure Factors Assessment, part 4 includes the FMEA Approach, part 5 contains a paper conclusion and finally last part including the references.

2. LITERATURE REVIEW

There are many researchers interested in the areas of Risk and Failure, Risk control, Risk assessment, and Risk management as a general point of view. Also, there are many researchers interested in the areas of ERP risk and failure. The most important topic that received high focus from researchers was Risk evaluation and measurement, Critical Success Factors and Critical Failure Factors for ERP Implementations, Risk ranking and prioritization, Risk priority number (RPN), and Risk assessment and management Tools.

2.1 ERP Risks and Failure:

The ERP Implementations are risky projects. The Risk assessment is a very important solution for ERP Improvement and success that contains risk identification, analysis, and prioritization. Risk is categorized as functional risk and configuration risk.

The analysis for software failures is a difficult task since it is related to complex systematic business process with many variables compared to hardware failures which has limited variable. In addition to Identifying the strength and weakness of organizations can help in reducing the effect of failure.

2.2 ERP implementation difficulties:

The ERP implementation constraints that facing developing countries compared with developed countries.

2.2.1 The National Factors:

Are the great challenge for ERP Implementation, It includes Information & Communications Technology (ICT) infrastructure, an economical status of the country, manufacturing industrial strength, regional location, and governmental regulations [16] [30-31].

2.2.2 Organizational Factors:

Such as Computer culture, IT Maturity, Management Commitment, Business Size, ERP cost, and BPR experience. [13] [16] [32] [30] [33], all business units at different countries had different way of how business done because of different business process and local requirements [30]. Many of ERP failures in Egypt are caused by customization of ERP system to match the existing processes instead of restructuring them [13] [31].

2.2.3 Information Technology Transfer (ITT) problems:

Cultural issues facing the eastern developing countries when implementing and using western technologies, management procedures, and information systems and techniques. [13] [16] [32] [30] [33]

2.2.4 Business justifications

Most of the implementation failures in ERP were early ERP adoptions which did not have strong business justifications. [32].

2.3 Risk assessment tools:

There are many tools that are able to assess risk in general, such as Preliminary Hazard Analysis (PHA), Hazard & Operability Study (HAZOP), Fault Tree Analysis (FTA), Hazards Analysis & Critical Control Point (HACCP), and Failure Mode & Effect Analysis (FMEA), the PHA, FTA, and HAZOP tools are used in early stages in the requirement analysis and at the design process. They support qualitative not quantitative analysis [34] [35] that is why these tools are not preferred for ERP Implementation, the FTA does not consider the severity of failure [36] and in complex system such as ERP that includes large number of equipment and process variables the fault tree becomes lager and takes long time to be completed, and they become much more difficult to solve [34] [37-38], and also these make FTA not a preferred choice, and takes a long time to be completed, and they become much more difficult to solve [34] [37-38], and also these make FTA, not a preferred choice, HACCP is originated in the food industry [39][40], and hence it is more logic to used it in ERP system Implemented in food industry.

FMEA methodology gives a clear description of the failure modes [41], FMEA methodology is now used in a variety of industries such as Software [22] [40] [42-45], FMEA purpose is to examine possible failure modes and determine the impact of these failures on many stages by Design FMEA (DFMEA), Process FMEA (PFMEA), Machinery or Equipment FMEA (MFMEA) or Service FMEA (SFMEA) [22][41], FMEA is a strategic technique for creation of error free services operation [46]. And it is a methodology that focuses on prioritizing critical failures to safety improvement [47]. FMEA considers each mode of failure for every component of a system, [45].

Table 1. Risk assessment tools

Criteria	**Tools**				
	PHA	**FTA**	**HAZOP**	**HACCP**	**FMEA**
Used in Many stages for ERP implementation	X	X	X	X	✓
	[34] [25] [48]	[34]	[34]	[50]	[41] [22]

	[49]				
Quantitative Tools	X	X	X	✓	✓
	[34] [25] [49]	[34] [51]	[34] [52] [21] [53]	[54]	[55]
Consider Severity of the failures	✓	X	✓	✓	✓
	[52]	[36]	[53]	[50] [54]	[55]
Prioritizing critical failures	✓	X	✓	✓	✓
	[25]	[51]	[53]	[56]	[47] [25]
Give clear description of failure mode (Reason of Hazard)	✓	✓	✓	✓	✓
	[51]	[25] [51]	[51]	[54] [56]	[41] [55] [57]
Powerful in complex system such as ERP	✓	X	✓	X	✓
	[52]	[34] [38] [51]	[52]	[50]	[55]
Used in variety of industry over the world including Software	✓	✓	X	X	✓
	[48]	[58]	[59]	[39] [25] [50] [54]	[42] [43] [22] [57] [60]
Product error free	✓	✓	✓	✓	✓
	[25]	[25]	[25]	[50] [54]	[22]
Services operation error free	✓	✓	✓	X	✓
	[25]	[51]	[53]	[50]	[46]

According to table 1, the researchers conclude that FMEA is powerful Quantitative risk assessment tool for ERP Risk Assessment.

The researcher uses FMEA to assess the risk factors related to different implementation stages.

3. FAILURE FACTORS ASSESSMENT

CFF used to decrease the ERP implementation failure. Many researchers study CFFs that widely used in the information system area, it's lead to the ERP implementation success [4] [12-13], the following are the most common failure factors,

Organization Fit that described as the compatibility between ERP requirement and organizational characteristics, ERP Teamwork and Skill Mix factor contain Technical and business experts Cooperation as well as end users, lack of Project Management lead to Poor ERP implementation project management may cause failure in ERP Apps, Software System Design should be established before ERP deployment, ERP architecture should be established before implementation, Lack of user involvement and Training contain User commitment and a project champion in the early stages of the project lead to ERP implementation failure, Key users should be have system utilities satisfaction, Technology Planning configuring an appropriate infrastructure that Can lead to ERP implementation success, Communication expectations or goals at every level needed for success ERP implementation, Legacy System and Information Technology factor lead to Implementation success for that ERP system require people for working within the system and not around it, lack of Change Management lead to ERP implementation, Change Management contain Enterprise structure and culture change should be managed which includes people, organization, and culture change, Business Process Reengineer (BPR) is a very important factor In the process of ERP configuring, reengineering should occur frequently to gain the advantage of the system, Top Management Support needs to identify the project as a top priority, Lake of financial Support and costs analysis might impact the ERP adoption, cause the failure of system implementation projects [5] [6] [12] [42].

4. FMEA APPROACH

The FMEA approach is evaluated potential failure and their effects. The FMEA approach can reduce or control the potential failures [61-62]. FMEA is a useful tool for reducing the failure and factors causes [62-64].

The following are the advantages of using FMEA, failure Prevention planning, Cost reduction, Decreased waste, Decreased warranty costs, Reduced non value added operations, higher product reliability, less design modification, better quality planning, continuous improvement in process design and product, Accepts a high degree of complexity, and Results can be correlated directly with actual risks [41-42].

There are many Success factors for the FMEA approach as the following, Correct risk identification and classification, Correct control factors to adequately manage risk, Correct prioritization and allocation of resources based upon RPN, Process Knowledge, Information system reliability, Data accuracy, Data integrity [42].

4.1 Classical FMEA Approach:

FMEA is a technique which identifies potential system (process or product) weaknesses. The FMEA approach is accepted by many companies in variety of industries around the world for identifying, prioritizing, and addressing the main potential failure effects, causes of potential failure and control factors which influence the ERP implementation success.

4.1.1 Risk Management rating criteria using FMEA:

The FMEA approach contain three criteria for assessing the failure, the severity of the failure effect, how frequently the risk is likely to occur, and how easily the risk can be detected. Participants must set and agree on a degree between 1 and 5 for the severity, occurrence and detection level for each of the failure.

The Criteria for Severity, Occurrence, and Detection are defined depending on the types of problems in each ERP implementation stage (Pre, during, and post).

Severity "SEV": The severity is seriousness or impact of failure [41] [60]. The Severity criteria described as shown in Table 2.

Table 2. Severity

Severity (Effect)	Rating	Criteria
Insignificant	1	No effect on data security, integrity and/or accuracy Data can be retrieved and or stored in a normal operating environment, No hardware damage.
Minor	2	System Downtime of up to 15 minutes, but without affecting data security, integrity and/or accuracy. No hardware damage.
Moderate	3	Downtime of greater than 15 minutes and less than 1 hours and/or loss of data which has been previously backup. No hardware damage. No effect on product safety and/or quality.
Major	4	Downtime of greater than 1 hours and/or loss of data security, integrity and/or accuracy. Hardware damage that can be fixed or corrected with moderate maintenance. No effect on product safety and/or quality.
Catastrophic (very High)	5	Downtime of greater than 1 day and/or loss of data security, integrity and/or accuracy. Hardware damage that cannot be fixed and require replacement. Possible effect on product safety and/or quality.

Occurrence "OCC": Occurrence is a likelihood assessment that causes will happen and result in a failure [41]. The Occurrence criteria described as shown in Table 3. Occurrence describes how frequent is the cause likely to occur the risk?

Table 3. Occurrence

Occurrence	Rank	Criteria
Remote	1	Failure occurs every year or more (1 failure per 8760 hours of operation)
Rare	2	Failure occurs every 3 months(quarter) (1 failure per 2160 hours of operation)
Occasionally	3	Failure occurs every week (1 failure per 168 hours of operation)
Frequently	4	Failure occurs every day (1 failure per 24 hours of operation)
Continually	5	Failure occurs every shift (1 failure per 8 hours of operation)

Detection "DET": It is a likelihood assessment that the current controls will detect the cause of the failure [41]. The Detection criteria described as shown in Table 4. Detection describes how probable is a detection of failure cause?

Table 4. Detection

Detection	Rank	Criteria
Certain	1	Controls certainly detect any potential cause, and subsequent failure. Controls will prevent a potential failure and isolate the cause.
High	2	High chance that controls will detect a potential cause, and subsequent failure. Controls will prevent a potential failure and isolate the cause.
Medium likelihood	3	Medium chance that controls will detect a potential cause, and subsequent failure. Controls will provide on an indication of potential failure and may, or may not, prevents failure.
Low likelihood	4	Controls do not prevent failure from occurring. Controls will isolate the cause and failure mode after the failure has occurred.
Remote likelihood	5	Very remote chance that controls will detect a potential cause, and subsequent failure mode, or there are no controls.

4.1.2 Risk management Ranking criteria:

The development of risk ranking tables assists the decision making process. Risk ranking criteria use a 5*5 risk matrix as shown in [table 5] [65], the maximum score of 25 is obtained by multiplying the score of Severity times the Occurrence, and the least score is 1. Risk increases from the lower left hand corner to the upper right hand corner. Each color represents zones for equal amounts of Risk. The upper right hand red zone demands special attention, this hot red zone very carefully, Address these representation with the Pareto principle. The lower left hand zone contains the most issues that have lower risks. The second area gets second level attention, followed by the yellow area. Risk management ranking criteria calculated depending on Severity and Occurrence of risk.

Table 5. Ranking Criteria

Occurrence			Severity				
			Insignificant	Minor	Moderate	Major	Catastrophic
			1	2	3	4	5
	Continually	5	5	10	15	20	25
	Frequently	4	4	8	12	16	20
	Occasionally	3	3	6	9	12	15
	Rare	2	2	4	6	8	10
	Remote	1	1	2	3	4	5

4.1.3 Risk Evaluation:

Each Failure is scored using a predefined table based on a subject matter expert (SME) team's assessment of the element's contribution. The analysis begins with the SME team defining a scoring table for the three elements. Using the table, the SME team scores the three elements of each failure. A risk priority number (RPN) is calculated for each failure as the product of scores for each element Severity, Occurrence, and Detection as in Table 6.

RPN = Risk priority number, in order to rank concerns, Calculated as SEV x OCC x DET

Table 6. Risk Range

Risk Range	Criteria
001: 010	Insignificant
011: 050	Minor
051: 080	Moderate
081: 100	Major
100: 125	Catastrophic (Very High)

4.2 FMEA application Model for ERP Implementation:

To prioritize the CFF in ERP implementation using FMEA model, CFFs are considered as the potential failure causes in FMEA approach [42], there are five steps as the following,

Step1 Potential Failure Specification is the inability of ERP system implementation, Step2 Potential Failure Effects Specification is the result of a system failure mode is a potential effect of the Step3 Potential Failure Causes Specification that are the system design deficiencies that result in the failure mode in ERP implementation, Step4 Failure Modes Control includes the method that can be used for identifying and preventing the failure occurs in ERP implementation process, Step5 Risk Prioritizing of failure modes by using risk priority number (RPN) [60].

Table 7. FMEA Model [42]

Process step	Potential failure	SEV	Potential causes	OCC	RATE	DET	RPN	Actions recommended	Responsibility	New SEV	New OCC	New RATE	New DET	New RPN

4.3 Enhanced FMEA Approach:

Enhanced FMEA Approach [Figure 1] provides for Identifying, prioritizing, and addressing the main potential failure effect, potential failure causes and control factors which influence the successful implementation of ERP. A enhanced FMEA approach measure the risk based on four sub categorization aspects, Financial, Customer, Legal & Regulation, and Business Operation.

4.3.1 Risk evaluation rating criteria:

Using Enhanced FMEA Approach to calculate three Values Max Severity, Max Occurrence, and Max Detection.

Participants must set and agree on a degree between 1 and 5 for the severity, occurrence and detection level for each sub categorization aspects of the failure.

There are an extension in calculation method for the severity, occurrence, and detection criteria based on four sub categorization aspects, Financial, Customer, Legal & Regulation, and Business Operation. The calculation for severity or occurrence or detection for the risk will determine based on the four sub categorization aspects that illustrate the following table [Table 8].

Table 8. Ranking Criteria

		Aspect			
		Legal & Regulation	**Financial**	**Customer**	**Business Operation**
Criteria	**severity**	Risk Severity based on Legal	Risk Severity based on Financial	Risk Severity based on Customer	Risk Severity based on Business operation
	occurrence	Risk occurrence based on Legal	Risk occurrence based on Financial	Risk occurrence based on Customer	Risk occurrence based on Business operation
	detection	Risk detection based on Legal	Risk detection based on Financial	Risk detection based on Customer	Risk detection based on Business operation

Max Severity "MSEV":
Severity criteria are shown in [Table 2]. Determine the maximum severity by comparisons between the four aspects for Severity criteria, "Risk Severity based on Legal, Risk Severity based on Financial, Risk Severity based on Customer, and Risk Severity based on Business operation".

MSEV = Max (Risk Severity based on Legal, Risk Severity based on Financial, Risk Severity based on Customer, Risk Severity based on Business operation)

Max Occurrence "MOCC":
Occurrence criteria are shown in [Table 3]. Determine the maximum occurrence by comparisons between the four aspects for occurrence criteria, "Risk occurrence based on Legal, Risk occurrence based on Financial, Risk occurrence based on Customer, and Risk occurrence based on Business operation".

MOCC = Max (Risk occurrence based on Legal, Risk occurrence based on Financial, Risk occurrence based on Customer, Risk occurrence based on Business operation)

Max Detection "MDET":
Detection criteria are shown in [Table 6]. Determine the maximum detection by comparisons between the four aspects for detection criteria, "Risk detection based on Legal, Risk detection based on Financial, Risk detection based on Customer, and Risk detection based on Business operation".

MDET = Max (Risk detection based on Legal, Risk detection based on Financial, Risk detection based on Customer, Risk detection based on Business operation)

4.3.2 Risk Evaluation Max Ranking criteria:

The development of risk max ranking tables assists the decision making process. Risk max ranking criteria use a 5*5 risk matrix as shown in [Table 9], the maximum score of 25 is obtained by multiplying the score of Greater Severity times the Greater Occurrence, and the least score is 1. Risk increases from the lower left hand area to the upper right hand area. Each color represents zones of equal amounts of risk. The upper right hand red zone demands special consideration and special attention, this hot red zone very carefully, address these issues with the Pareto principle. The lower left hand area contains the most issues that have lower risks. The second area gets second level attention, followed by the yellow area. Risk management ranking criteria calculated depending on Max Severity and Max Occurrence of risk.

Table 9. Max Ranking Criteria

			Max Severity				
			Insignificant	**Minor**	**Moderate**	**Major**	**Catastrophic**
			1	**2**	**3**	**4**	**5**
Max Occurrence	**Continually**	**5**	5	10	15	20	25
	Frequently	**4**	4	8	12	16	20
	Occasionally	**3**	3	6	9	12	15
	Rare	**2**	2	4	6	8	10
	Remote	**1**	1	2	3	4	5

4.3.3 Risk Evaluation:

Each Failure is scored using a predefined table based on a subject matter expert (SME) team's assessment of the element's contribution. The analysis begins with the SME team defining a scoring table for the three elements. Using the table, the SME team scores the three elements of each failure. Based on four sub categorization aspects Financial (F), Customer (C), Legal & Regulation (L), Business Operation (B), a Max risk priority number (MRPN) is calculated for each failure as the product of scores for each element Max Severity, Max Occurrence and Max Detection as in [Table 10] [Figure 1].

MRPN = Max Risk priority number in order to rank concerns, Calculated as MSEV x MOCC x MDET.

Example describes the four sub categorization aspect on the risk, if a firm use illegal applications, based on Legal & Regulation aspects a firm will receive complains from the Application owner, and based on Financial aspects a firm will

pay a lot of money for the complains penalty, and based on Business Operation aspect may be the system crash and no have operation maintenance, and based on Customer aspect the illegal applications billing system may be unstable which exposes us to lose our customers.

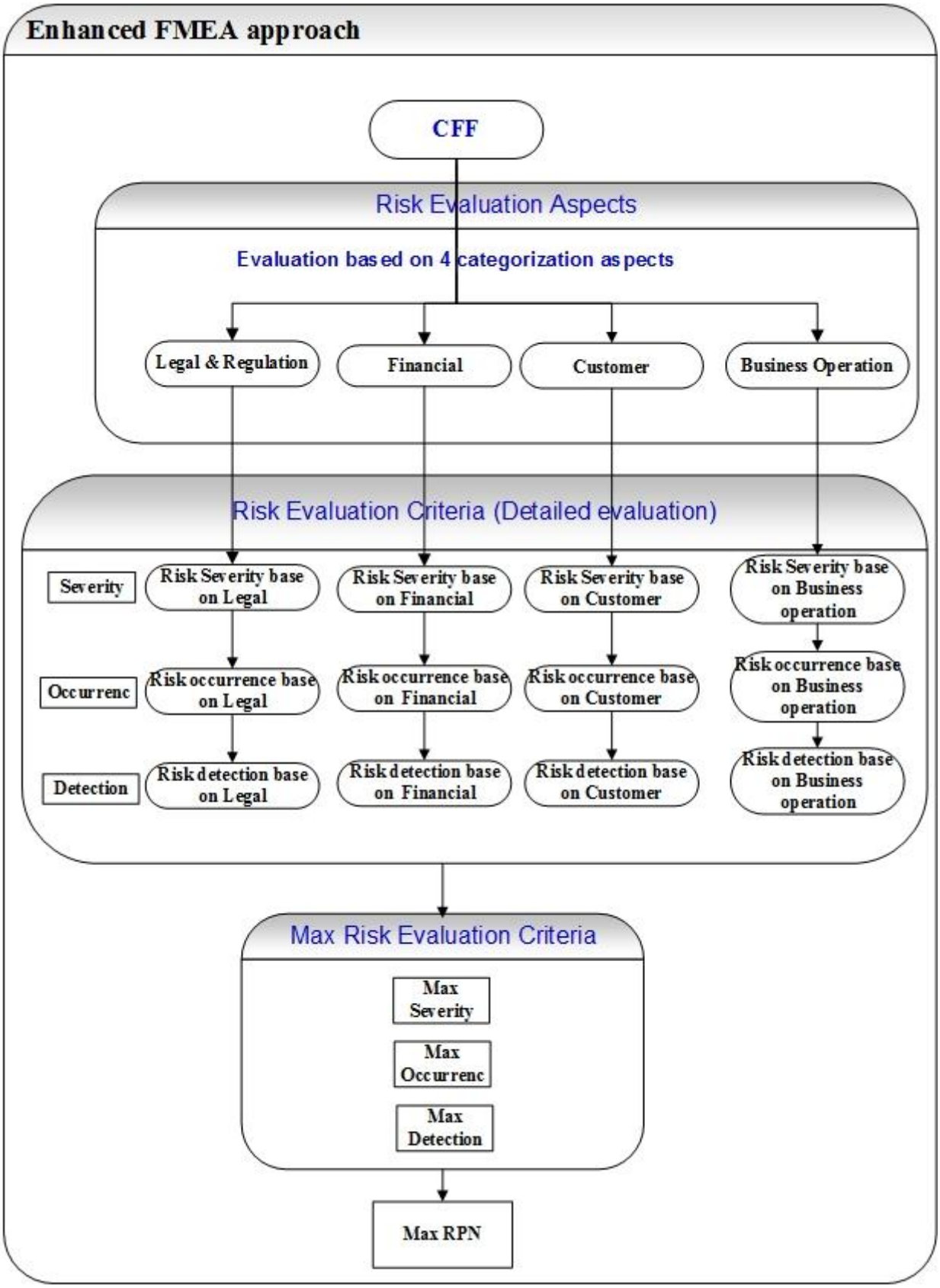

Fig 1: Enhanced FMEA Approach

Table 10. Enhanced FMEA Approach

Process step	Potential failure	FSEV	CSEV	LSEV	BSEV	MSEV	Potential causes	FOCC	COCC	LOCC	BOCC	MOCC	RATE	FDET	CDET	LDET	BDET	MDET	MRPN	Actions recommended	Responsibility	New MSEV	New MOCC	New RATE	New MDET	New MRPN

FSEV refers to Risk Severity based on the financial aspect.

CSEV refers to Risk Severity based on Customer aspect.

LSEV refers to Risk Severity based on Legal & Regulation aspect.

BSEV refers to Risk Severity based on Business operation aspect.

MSEV refers to Max Severity

FOCC refers to Risk Occurrence based on the financial aspect.

COCC refers to Risk Occurrence based on Customer aspect.

LOCC refers to Risk Occurrence based on Legal & Regulation aspect.

BOCC refers to Risk Occurrence based on Business operation aspect.

MOCC refers to Max Occurrence

FDET refers to Risk Detection based on the financial aspect.

CDET refers to Risk Detection based on Customer aspect.

LDET refers to Risk Detection based on Legal & Regulation aspect.

BDET refers to Risk Detection based on Business operation aspect.

MDET refers to Max Detection

MRPN refers to Max Risk priority number

New MSEV refers to New Max Severity

New MOCC refers to New Max Occurrence

New MDET refers to New Max Detection

New MRPN refers to NEW Max Risk priority number

5. CONCLUSION AND FUTURE WORK

It is concluded that ERP system are complex and cross functional systems control all organization activities. Successful ERP implementation projects are considered as one of the core competencies for any organization. Implementation of ERP systems includes multiple risks that need to be addressed and controlled on scientific bases. ERP systems have a high failure rate that needs to be known and decreases in every ERP implementation phases, pre implementation, during implementation and post implementation. Using a CFF approach useful to define main failures and failure factors related to ERP implementations, It's very useful to apply the Enhanced FMEA Approach in the three phases of ERP implementation, before, during and post ERP Implementation, there are three important criteria in FMEA, Severity, Occurrence, and Detection. The Enhanced FMEA Approach useful for helping in increasing the success rate of ERP implementation projects, the researchers contribute that design the Enhanced FMEA Approach based on four sub categorization aspects, Financial, Customer, Legal & Regulation, and Business Operation.

For future work in this area, Risk factors are highly dependent and the acceptance of risk values depends on the industry type. Therefore, Risk Acceptance level may need more enhancements to be automatically justified without human interference. The researchers will applying the proposed approach in many ERP projects.

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