

A Structural Equation Model for Identifying Critical Success Factors of Implementing ERP in Iranian, Kalleh Food Products Company

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Abstract

Enterprise Resource Planning (ERP) is solution based on information technology that provides for various managers, organization information quickly and accurately. ERP systems have benefits both tangible and non-tangible, there is evidence of the failure of these projects, project managers often focus on technical and financial aspects but people and organizational issues are not considered so organizations are need studied critical success factors (CSFs) in ERP implementation. The aim of this study was to identify critical success factors and their influence on the implementation of ERP in Iranian Food Industry (case study is in Kalleh food Products Company with 12,000 employees and 300 products). The findings are based on a questionnaire, of which 105 managers and professionals using ERP were distributed and collected. Based on the research literature, 25 criteria were identified that were divided into three factors, technological, people and organizational, a model was developed to show the effect of the variables was tested using structural equation modeling (SEM) and the software LISREL8.8, the final model research presented and factors approved was ranking by the Friedman test and the software SPSS18. Based on the results, it was found that the technological factors, organizational and people influence on ERP implementation.

Keywords

Enterprise Resource Planning (ERP), Critical Success Factors (CSFs), Structural Equation Modeling (SEM)

1. Introduction

Become a necessity in today's organizations need to use of Information System (IS) and Management Information Systems (MIS) that are the achievements of Information Technology (IT), these improve organizational processes, increase productivity and efficiency and also to accelerate decision-making at all organizational units (Papaioannou et al, 2011). According to Dezdar and Ainin (2011), Enterprise Resource Planning (ERP) is an integrated system that is used to manage the enterprise resource, establish effective communication between different units and by integrating all the functions, provide required resources through a single computer system. Al-Dammas and Al-Mudimigh (2011) described ERP system is composed of a centralized database and four parts that (1) finance and accounting part including the cash and hand, accounts receivable, customer credit and revenue, (2) sale and marketing part including the orders, sales forecasts, return requests and price changes, (3) manufacturing and production part including the materials, production schedules, shipment dates, production capacity and purchases and (4) human resources part including the hours worked, labor cost and job skills. Sarker and Lee (2003) stated

that a lot of organizations tried to make implementation ERP but did not achieve the desired results that main reasons for failures of implementing ERP were lack of leadership commitment, lack of clear strategy and plan for implementing ERP, problems in system customization, software testing, lack of trained technical staff and finally, lack of exact plan for budget allocation and economic justification. Based on research, Zhang et al (2005), on average, ERP implementation projects took 2.5 times longer than projected, were 178% over budget.

2. A Review literature of ERP key Elements for Successful Implementation

According to Jutras and Castellina (2010), economic research shows that average mean investment for ERP implementation in Small and Medium Enterprises (SME) is 50 thousand dollars to several million dollars. Umble et al (2003) found that More than 90% of ERP implementation would breach the budget and appointed time. Research Study by several researchers in the past decade, Suganthalakshimi and Mothuvelayuthan (2012), Tarafdar and Gordon (2007), Nah and Delgado (2006), Nelson and Cheney (2005), Motwani et al (2005), Somers and Nelson(2004), Huang et al (2003), Jarvenpaa and Ives (2003), Umble et al (2003), Ziari (2003), Al-mashari et al (2003), Lois (2003), Wall et al (2003), Lian (2001), Esteves and Pastor (2001), Nah et al (2001) and Wee (2000) Indicates that there are eight key factors for successful implementation of ERP.

2.1 Appropriate business and IT legacy system

According to Nah et al (2001), appropriate business and IT legacy system illustrates how organizations need to change business processes and implementation an ERP. Al-mashari et al (2003) understood that the lack of benefit of modern business management systems and old systems will intensify the need to change the organization in different tissues. Wall et al (2003) described, all efforts ERP implementation because of to reduce the complexity of organizational processes also Inter-organizational systems involve existing information technology infrastructure (hardware and software), business processes, organizational culture and organizational structure.

2.2 Project team composition

Based on research by Suganthalakshimi and Mothuvelayuthan (2012), the structure of the project team has a strong impact in the implementation process and two important factors are the integration of third-party consultants within the team and the retention within the organization of the relevant ERP knowledge. Boon et al (2003) said, the project implementation team is composed of people who have previous success, fame, flexibility and it is the responsibility of those critical decisions.

2.3 Good project scope management

According to Nah et al (2001), ERP implementation of project management is essential because assessment of project success is base on to achieve goals at determined time and defined budget. Sumers and Nelson (2004) argued, extent and complexity of the ERP project is because of extensive combined hardware and software and lots of subjects of people, organizational and process. Based on research by Suganthalakshimi and Mothuvelayuthan (2012), this factor is related with concerns of project goals, function and their congruence with the organizational mission and strategic goals and some components of this factor are: scope of business processes and business units involved, ERP functionality implemented, technology to be replaced/upgraded/integrated, and exchange of data.

2.4 Top management commitment

Based on research Nah et al (2001), the project must be approved by top management and he should be supported, top management must clearly learned from the project as an important priority for the organization and declare their commitment through participation in the project and allocate valuable resources to its. According to Somers and Nelson (2004), management support is important for accomplishing project goals and objectives and aligning these with strategic business goals. Top management organization can appoint an Executive Director that is a lot of information about organization operational processes as Project Champion to monitor the implementation of ERP.

2.5 software development, testing and troubleshooting

According to Wee (2000), in the initial phase of the project, software development, testing and troubleshooting is very essential, before the establishment of the structure ERP should be considered most important operational requirements and the process. Nah et al (2001) argued that Organizations must continuously develop and expand various aspects of the software to be able to take advantage of all the benefits and capabilities of software and to solve problems must have a close relationship with consultants and software vendors. Based on research Al-mashari et al (2003), because of multi-part of ERP software, one of deployment problems is Integration Modules that to

solve this problem use of middle ware but these technologies are not available in most of the times so organizations need to develop interfaces for business applications.

2.6 Change management strategy and programs

Based on research Motwani et al (2005), organizations for the successful implementation ERP requires a close cross-functional cooperation, the information entered by one division will be used by other divisions, even in real time. Thus, employees may be expected by their peers to use the ERP in order to make the ERP more useful, Since ERP is a major investment of a firm and the implementation may involve substantial organizational changes. Umble et al (2003) defined, at establishment of ERP will be re-engineering of organizational processes and will provide the best performance by the system that organizations must recognize these changes and adapt their business processes with those.

2.7 business plan and vision

Based on research Nah et al (2001), given the breadth and complexity of implementing ERP, in order to give organizational efforts is necessary to be clear that the objectives, business plan and vision. Business plan should show a clear strategic interest and to consider resources, costs, risks and time lines so can be said that Mission will be successful if it becomes measurable goals and objectives. According to Lian (2003), lead to the failure of ERP implementation if the directions are not clear and not accurate strategic planning, Identify strategic goals causes the project team is moving in the right direction throughout the implementation process.

2.8 management and evaluation of performance

Based on research Nah et al (2001), monitoring and evaluation come into play at the shakedown phase, milestones and targets are important to keep track of progress. Achievements should be measured against project goals. The progress of the project should be monitored actively through set milestones and targets. Based on research Al-mashari et al (2003), in ERP implementation in addition to technical performance such as reliability, are examining other aspects such as flexibility, speed, time lines and costs, many researchers suggest that used to Balanced Score Card (BSC) to assess the four dimensions of financial, customer, internal process and learning and innovation.

3. Critical Success Factors (CSFs) of ERP Implementation

Bullen and Rockart (1986) defined critical success factor (CSFs) for ERP as “the limited number of areas in which satisfactory results will ensure successful competitive performance for individual, department, or organization”. Ngai et al. (2008) defined that by identifying the most relevant CSFs an organization can take effective measures to eliminate or minimize the causes that are negatively affecting the ERP systems implementation. However we collected 25 the CSFs found in the ERP literature and are illustrated in Table 1.

Table 1: Summary of literature reviews on CSFs for ERP implementation

No.	Critical Success Factors (CSFs)	Citations
1	Organizational Fit	Bernroider and Stix (2006), Kumar et al (2002), Kumar et al (2003), Lall and Teyarachakul (2006), Liao et al (2007), Nah and Delgado (2006), Umble et al (2003)
2	Modularity	Bueno and Salmeron (2008), Kumar et al (2002), Kumar et al (2003)
3	Ease of use	Ayağ and Özdemir (2007), Bueno and Salmeron (2008), Keil and Tiwana (2006), Verville and Haltingen (2003), Wei et al (2005), Yang et al (2007)
4	Flexibility	Ayağ and Özdemir (2007), Umble et al (2003), Wei et al (2005)
5	Vendor support	Ayağ and Özdemir (2007), Fisher et al (2004), Kumar et al (2002), Kumar et al (2003), Liao et al (2007), Rao (2000), Umble et al (2003), Verville and Haltingen (2003), Wei et al (2005), Yang et al (2007)
6	Functionality	Ayağ and Özdemir (2007), Keil and Tiwana (2006), Kumar et al (2002), Kumar et al (2003), Liao et al (2007), Wei et al (2005)
7	Customization/ parameterization	Berchet and Habchi (2005), Bueno and Salmeron (2008), Keil and Tiwana (2006), Kumar et al (2002), Kumar et al (2003), Verville and Haltingen (2003), Yang et al (2007)

8	Latest technology	Ayağ and Özdemir (2007), Kumar et al (2002), Kumar et al (2003), Rao (2000)
9	Good performance	Schmidt et al (2001), Taylor (2006), Baccarini et al (2004)
10	Configuration management	Schmidt et al (2001), Taylor (2006), Kappelman et al (2006), Baccarini et al (2004), BCS (2004), Oz and Sosik (2000); Sauer and Cuthbertson (2003)
11	Skilled and sufficient vendor	Schmidt et al (2001), Sauer and Cuthbertson (2003), Kappelman et al (2006), Baccarini et al (2004), Standish Group (2009)
12	End-user training provision	Beynon and Davies (1999), Jiang et al (1999)
13	Top management commitment	Umble et al (2003), Chang et al (2008), Chen et al (2009), Hui et al (2010), Sun and Bhattacharjee (2011), Garg (2010), Huang (2010)
14	User involvement	Almahdi et al (2008), Francoise et al (2009), Al-mashari et al (2003), Kothari (2003), Kappelman et al (2006), Standing et al (2006)
15	Good project scope management	Huang (2010), Garg (2010), Boyer et al (2008), Arain (2007)
16	on-time communication between foreign vendors and local users	Ge and Vob (2009), Allen and Havenhand (2002), Bhatti (2005), Arain (2007)
17	Organization Maturity Level	Dantes and Hasibuan (2010), Belassi and Tukei (1996)
18	Business Process Reengineering	Somer and Nelson (2005), Al-Mashari et al (2003), Kumar et al (2003)
19	Appropriate development processes	Schmidt et al (2001), OGC (2005), Mahaney and Lederer (2003), Standish Group (2009), Sauer and Cuthbertson (2003)
20	Effective monitoring and control	Schmidt et al (2001), OGC (2005), Humphrey (2005), Mahaney and Lederer (2003), BCS (2004), Sauer and Cuthbertson (2003)
21	ERP Implementation Strategy	Allen et al (2002), Holland and Light (1999)
22	Culture Readiness	Motwani et al (2005), Gargeya and Brady (2005)
23	Frozen requirement	Schmidt et al (2001), Taylor (2006), Kappelman et al (2006), Baccarini et al (2004), Sauer and Cuthbertson (2003)
24	Effective communication and feedback	Schmidt et al (2001), Kappelman et al (2006), OGC (2005), Humphrey (2005), Sauer and Cuthbertson (2003)
25	Committed and motivated team	Standish Group (2009), Mahaney and Lederer (2003), Standing et al (2006)

4. Hypotheses and Conceptual Model

ERP system implementation is a long-term project, not a short-term program.

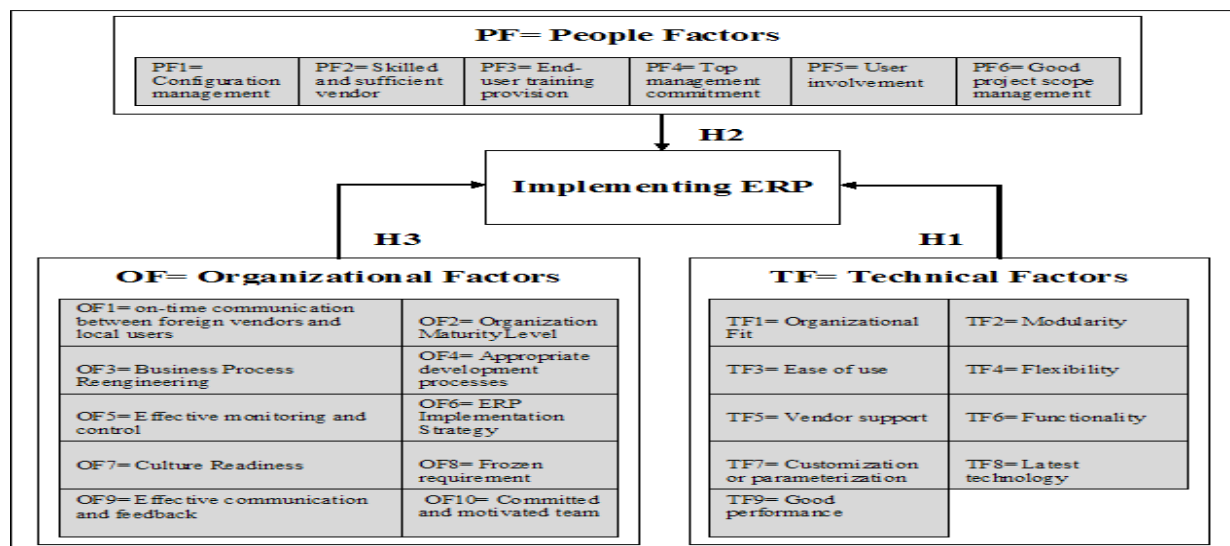


Figure 1: Conceptual research model of ERP implementation

Based on the ERP literature and critical success factors identified, the researchers classified the hypothesized factors into three categories with: (1) technical factors including nine criteria, organizational fit (TF1), modularity (TF2), ease of use (TF3), flexibility (TF4), vendor support (TF5), functionality (TF6), customization or parameterization (TF7), latest technology (TF8), good performance (TF9), (2) people factors including six criteria, configuration management (PF1), skilled and sufficient vendor (PF2), end-user training provision (PF3), top management commitment (PF4), user involvement (PF5), good project scope management (PF6), (3) organizational factors including ten criteria, on-time communication between foreign vendors and local users (OF1), organization maturity level (OF2), Business Process Reengineering (OF3), appropriate development processes (OF4), effective monitoring and control (OF5), ERP implementation strategy (OF6), culture readiness (OF7), frozen requirement (OF8), effective communication and feedback (OF9), committed and motivated team (OF10). The hypothesized research framework refers to Figure 1.

We get the following hypothesis:

- H1: Technological factors have a significant relationship with ERP implementation
- H2: People Factors have a significant relationship with ERP implementation
- H3: Organizational Factors have a significant relationship with ERP implementation

5. Method

According to purpose this research is applied and according to methods for data collection is descriptive – survey. The study population included all levels of management and professionals in the kalleh. Sampling method was census type that total 105 questionnaires distributed and collected in the Statistical population, the result indicated that 87.5% of the respondents were male and type of education degree 63.8% bachelor and 27.6% were masters. The measured scales of each construct were generated based on related studies, with modifications to the wording as appropriate for practices of this statistical population. The Cronbach alpha value is 0.799 for the three constructs, according to Gherbal, Shibni, Sidani and Sagoo (2012) the value 0.70 or more is significant and reliable, then this value indicating a high internal consistency. Various reliability test results are shown in Table 2.

Table 2: Summary of the measurement model

Construct Name	Construct identifier	Indicator	Mean	Std. Dev.	Item-to total correlation	Cronbach alpha
Technological factors on Implementing ERP	TF	TF1	2.33	.824	.351	.799
		TF2	2.92	1.111	.191	
		TF3	3.65	.827	.318	
		TF4	2.82	1.011	.308	
		TF5	2.81	.831	.330	
		TF6	3.19	.949	.447	
		TF7	2.69	1.116	.446	
		TF8	3.01	1.007	.288	
		TF9	2.83	1.171	.519	
People factors on Implementing ERP	PF	PF1	2.80	1.017	.427	
		PF2	2.70	1.035	.541	
		PF3	2.39	1.067	.473	
		PF4	2.72	1.094	.537	
		PF5	3.01	1.262	.057	
		PF6	2.55	1.101	.446	
Organizational factors on Implementing ERP	OF	OF1	3.14	.910	.221	
		OF2	2.98	.892	.504	
		OF3	3.10	.984	.358	
		OF4	3.01	.751	.336	
		OF5	3.24	.739	.012	
		OF6	3.15	.904	.481	
		OF7	3.29	.857	.131	
		OF8	2.65	.887	.282	
		OF9	2.85	.943	.277	
		OF10	3.76	.936	-.013	

To test the research model, path and Hypotheses of Lisrel 8.80 was used, Output-based software model shown in Figure 2. The relationships between variables and coefficients are specified for each of them.

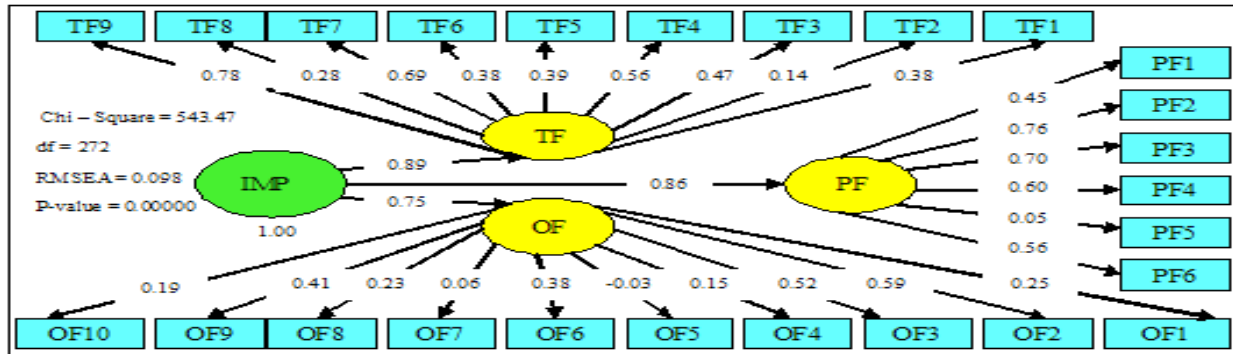


Figure 2: Standard Estimate of model

The basic question raised is whether this model is appropriate? To answer this question, must fit criteria model are examined. The most popular index is perhaps the chi-square statistic, Chau (1997) mentioned, for evaluate the goodness of fit the research model, there are several criteria, McDonald and Ho (2002) recommended, fit indices determines that the Suggested model can be a good predictor of sample data, four indexes suggested by Hartwick and Barki (1994) which include: chi-square per degree of freedom, Non-Normed Fit Index (NNFI), Comparative Fit Index (CFI), and Average Absolute Standardized Residual (AASR). In another research, Segars and Grover (1993) used to Goodness-of-fit Index (GFI), adjusted Goodness-of-fit Index (AGFI), Pit Criterion, and Root Mean Square Residual. In Table 3, Fit indices model is examined.

Table 3: Fit indices of structural model

Index	Standard value index	Measured value index	Result	Source determines the size of the standard index
Chi-Square/df	Below of 2.0	1.998	Model fitting is Ok	Tabachnick & Fidell (2007)
GFI	Above of 0.90	0.93	Model fitting is Ok	Hooper & Coughlan (2008)
AGFI	Above of 0.90	0.91	Model fitting is Ok	Hooper & Coughlan (2008)
RMSEA	Below of 0.10	0.098	Model fitting is Ok	MacCallum et al (1996)
CFI	Above of 0.90	0.93	Model fitting is Ok	Brwone & Cudeck (1992)
NFI	Above of 0.95	0.98	Model fitting is Ok	Hu and Bentler (1999)

The results showed that all of these fit indices are acceptable, suggesting that the overall structural model provides a good fit with the data.

To demonstrate the significance of each of the parameters used to t-test, that based on the proposed Selim (2007) should abs (t) >= 2, Figure 3 include T-value of model.

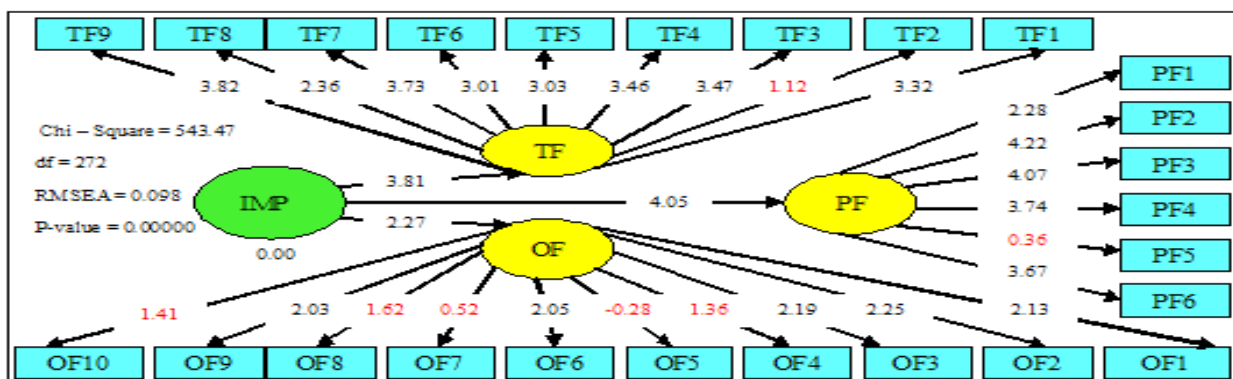


Figure 3: T-value of model

Table 4 shows a summary of which of the variables and the relationship was significant and which of the relationships in the model are not significant.

Table 4: Standardized coefficients and significant numbers of model results

Relationship	Standardized coefficients	Significant numbers	Result(approve or reject the hypothesis)
TF1 & TF	0.38	3.32	Approve
TF2 & TF	0.14	1.12	Reject
TF3 & TF	0.47	3.47	Approve
TF4 & TF	0.56	3.46	Approve
TF5 & TF	0.39	3.03	Approve
TF6 & TF	0.38	3.01	Approve
TF7 & TF	0.69	3.73	Approve
TF8 & TF	0.28	2.36	Approve
TF9 & TF	0.78	3.82	Approve
TF & IMP	0.89	3.81	Approve
PF1 & PF	0.45	2.28	Approve
PF2 & PF	0.76	4.22	Approve
PF3 & PF	0.70	4.07	Approve
PF4 & PF	0.60	3.74	Approve
PF5 & PF	0.05	0.36	Reject
PF6 & PF	0.56	3.67	Approve
PF & IMP	0.86	4.05	Approve
OF1 & OF	0.25	2.13	Approve
OF2 & OF	0.59	2.25	Approve
OF3 & OF	0.52	2.19	Approve
OF4 & OF	0.15	1.36	Reject
OF5 & OF	-0.03	-0.28	Reject
OF6 & OF	0.38	2.05	Approve
OF7 & OF	0.06	0.52	Reject
OF8 & OF	0.23	1.62	Reject
OF9 & OF	0.41	2.03	Approve
OF10 & OF	0.19	1.41	Reject
OF & IMP	0.75	2.27	Approve

6. Conclusions and Final Model Research

The main objective of this research is to investigate the relationship between critical success factors and implementing ERP. According to Table 4 and Figure 3 can be given to the research hypotheses and detailed examined:

- Hypothesis 1: Technological factors have a significant relationship with ERP implementation. As seen in Table 4, modularity (TF2) was not a significant criterion of technological factors but the relationship between technological factors and the ERP implementation is significant Because of approved criteria, organizational fit (TF1), ease of use (TF3), flexibility (TF4), vendor support (TF5), functionality (TF6), customization or parameterization (TF7), latest technology (TF8) and good performance (TF9).
- Hypothesis 2: People factors have a significant relationship with ERP implementation. As seen in Table 4, user involvement (PF5) was not a significant criterion of people factors but the relationship between people factors and the ERP implementation is significant Because of approved criteria, configuration management (PF1), skilled and sufficient vendor (PF2), end-user training provision (PF3), top management commitment (PF4), good project scope management (PF6).
- Hypothesis 3: Organizational factors have a significant relationship with ERP implementation. As seen in Table 4, appropriate development processes (OF4), effective monitoring and control (OF5), culture readiness (OF7), frozen requirement (OF8) and committed and motivated team (OF10) were not a significant criteria of organizational factors but the relationship between organizational factors and the ERP implementation is significant Because of approved criteria, on-time communication between foreign

vendors and local users (OF1), organization maturity level (OF2), Business Process Reengineering (OF3), ERP implementation strategy (OF6), effective communication and feedback (OF9).

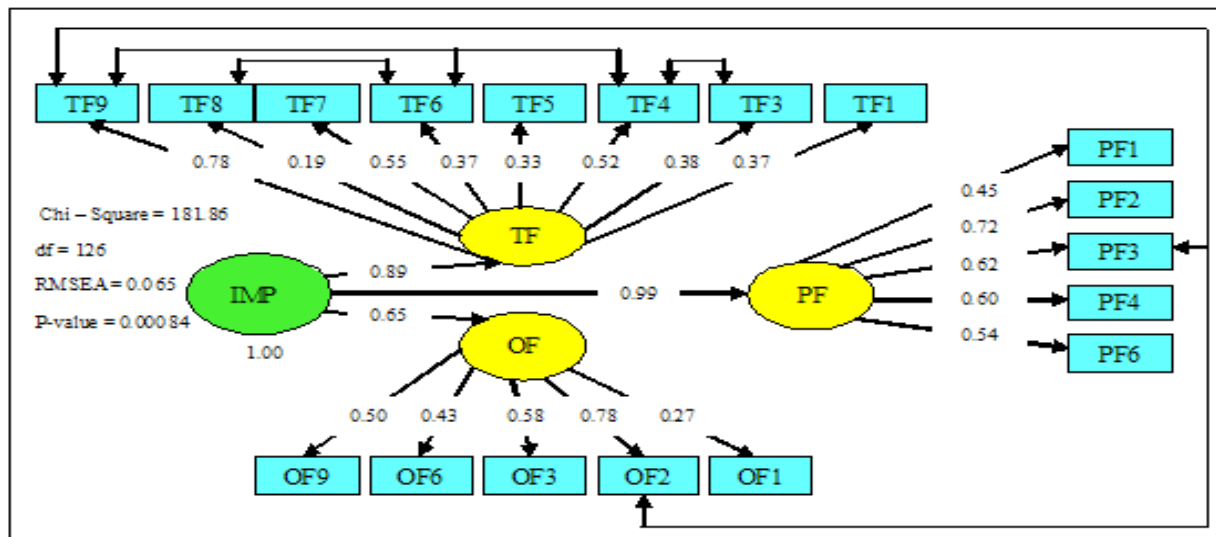


Figure 4: Final model research

According to the results, final model research shown in Figure 4, as it turns out RMSEA has been reduced from 0.098 to 0.065 and other model fitting criteria are also improved. To determine the degree of influence of each of the accepted criteria and ranking them used the Friedman test and software spss18 that shows in Table 5, high to low.

Table 5: Ranking accepted criteria

Technological Factors		People Factors		Organizational Factors	
Criterion Name	Mean Rank	Criterion Name	Mean Rank	Criterion Name	Mean Rank
Ease of use	6.13	Skilled and sufficient vendor	3.32	ERP implementation strategy	3.26
Functionality	4.99	Configuration management	3.23	On-time communication between foreign vendors and local users	3.15
Latest technology	4.63	Top management commitment	3.03	Business Process Reengineering	3.05
Flexibility	4.41	Good project scope management	2.77	Organization maturity level	2.84
Good performance	4.33	End-user training provision	2.66	Effective communication and feedback	2.70
Customization or Parameterization	4.21				
Vendor support	4.11				
Organizational fit	3.18				

Based on the identified factors can be suggestions presented for successful implementation of ERP system that technological factors, adequate education and counseling to users, Select appropriate software package compatible with organizational needs, for people factors, increasing acceptance of criticism by directors and employees, managers to embrace the challenges and changes in the organization, corporate leaders to support the changes in employee attitudes and for organizational factors, being specialists in the discipline of their actual position, recognizing the importance of learning for all employees, performance-based incentive system created good and the fairly, open institutional environment for the people declaration.

In this paper, our purpose was to identifying and ranking important factors that lead to failure or success in implementing ERP system. In research method section to evaluate the significant variables and relationships, we could use of classical and fuzzy logic methods that we applied classical methods and the Structural Equation Modeling (SEM) and in future research for measuring variables we intend to apply of Fuzzy logic to weight the Critical Success Factors (CSFs), to be able to compare a variety of research methods.

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