Analyzing the Effects of Information Technology Flexibility on Business Process Agility and Business Process Outcomes

Case Study: Azaran industrial company

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Abstract: Change is a quality of many organizations in today's competitive and unstable environment. They need to change in order to survive and compete. Organizations need to be agile if they want to seize the opportunities they have. In this research we analyze the effects of information technology flexibility on business process agility and business process outcomes in Azaran industrial company. This research is a correlational one. The statistical population for this research includes managers and employees at Azaran industrial company. The company has a total of 250 employees from which 141 were chosen at random to answer survey questions. A survey was designed to be both valid and reliable. To determine the reliability of the survey, 50 questionnaires were distributed among the participants and Cronbach'salpha was calculated for the variables. The results suggest that information technology flexibility has a significant positive effect on business process agility but there is no meaningful relationship between business process agility and business process outcomes. Information technology flexibility has a correlation coefficient of 0.42, thus showing a meaningful relationship with process agility. Process agility has a correlation coefficient of 0.06 with the quality of process outcomes and 0.13 with efficiency.
[Sayyed Mohsen Allameh, Mohammad Mahdi Abrishamkar, Rayehe Bahrami, Sajad Jafari. **Analyzing the Effects of Information Technology Flexibility on Business Process Agility and Business Process Outcomes.** *J Am Sci* 2012;8(8):786-793]. (ISSN: 1545-1003). http://www.jofamericanscience.org. 119

Keywords: Information Technology, Agility, Process, Flexibility

1.Introduction

Production environments have undergone different stages so far: from manual production to mass production to the latest one called agile production. The term agility was first used by researchers at Lehigh University, and has since been defined in many different ways. Brian Maskell (2001) defines agility as the ability to thrive and prosper in an environment of constant and unpredictable change.

Recently, researchers have shown that "value is particularly created at the business process level and can grow in a chain of causes"(Davern and Wilikn, 2010). This means that organizations need to focus their efforts on creating capabilities in which IT can be used as a tool in gaining competitive advantage.The relationship between IT and company performance is investigated in many papers while often overlooking the business process. (Dehning and Richardson, 2002).While in information systems' literature agility is recognized as a dynamic capability, and IT is consideredto be a foundation of agility, its value at the process level is not discussed. Furthermore, the strategy of management literature shows that the business process isat the core of creating competitive advantage and is a better level for analysis. (Rey et al, 2004). Infrastructure for flexible IT is defined as: " The ability to easily distribute and support hardware, software, communication technology, data, skills and competencies, commitments and values based on the physical, technical, and human aspects of the existing IT infrastructure."(Byrd and Turner, 2000).Organizations exist in ever-changing environments and a flexible IT infrastructure allows them to respond to market needs while preparing for future integration (Byrd and Turner, 2000).

In this research we investigate and analyze the effects of IT flexibility on business process agility and subsequently its effect on business process efficiency in Azaran industrial company. The remainder of this paper is organized as follows.We begin by presenting a review of literature on IT flexibility, business process agility, and business process efficiency. This is followed by a discussion of the relationship between these conceptsand presenting the conceptual model of this study. After that, we discuss our research methodology and we focus on the case study and survey results. In the final section we present a discussion and our concluding remarks.

2.Theoretical background

2.1.Agility

Following the broad economic and political changes that took place from the late 1980s to mid-1990s, many attempts were made to identify the factors that influence the new global business systems. The United States became the leader of this movement after seeing significant increase inits share of the global market especially in the production area where there was competition from Asian and European countries. In 1991 a group of industry experts realized that the environment was changing at a rate higher than what traditional organizations could respond and adapt to. These organizations were unable to take advantage of theopportunities created for them which run may have led to their bankruptcy in the long (Hormozi, 2001). This situation led to the introduction of organizational agility and process agility.

The term agile literally means quick and well-coordinated in movement, and marked by ability to think quickly (dictionary.com). Agility comes from agile production which has recently become a popular concept.It has been accepted as an effective strategy by producers that prepare for considerable performance gains. In such an environment an organization must be able to produce different products with short lifetimes simultaneously, redesign products, adapt production methods, and effectively respond to change. Any organization with these capabilities is considered an agile organization.
Many non-contradicting definitions have been suggested for agility. They generally point to idea of quickness and change in the business environment. Because agility is a relatively new topic, consensus on a precise definition has not been reached. Such an organization must recognize changes in the environment and see them as opportunities for growth. They define agility as the ability to overcome the unpredictable challenges of unprecedented changes in the business environment, and gain advantage and profit from those changes. Brian Maskell (2001) considers agility as the ability to thrive and prosper in an environment of constant and unpredictable change.Goode (1997) believes that agility is giving up the old methods of doing things.
Agility is not a goal; it's a tool for keeping competitiveness in an uncertain and changing market.

2.2. Process (operational) agility

The dynamic capabilities point of view considers agility a dynamic capability (Sambamurthy et. al, 2003). Agility in information systems literature is creating strategic value for companies where IT provides a platform for agility (Sambamurthy et. al, 2003). Assuming IT and agility are related, there is a significant need to understand how agility is defined and measured in the subject literature.

We can find different types of agility in the literature: operational agility, cooperative agility, and customer agility (Sambamurthy et. al, 2003). Operational agility is the ability of business processes in creating quickness, accuracy, and cost economics in taking advantage of opportunities for innovative competitive performance (Sambamurthy et. al, 2003). This means management can create or redesign processes such that they create competitive advantage or take advantage of opportunities. An example of business process agility is using RFID to track orders more easily and reduce errors (Bustillo, 2010). Cooperative agility uses the relations with the suppliers. For example Ford provides its suppliers with customer support information so that they can improve future products (Terseko, 1999). Similarly, customer agility uses customer relationships to create innovative products and opportunities, and provide better service. To create operational agility, the management of an organization has to recognize the business processes which are the foundation of the organization's strategy and move towards streamlining them (Stalk et. al, 1992). To achieve process agility, the management must be able to redesign business process components separately and blend individual capabilities and tasks in response environment changes (Frates and Sharp, 2005). Tallon et al (2008) improved this concept by defining business process agility as a response to changes in demand, development of new products, changes in the product mix, product pricing, market expansion, distributer selection, and IT development. The difficulty in using such a definition is finding a specific process in which the changes and their expected results can be considered results of agility.
In fact the expected results are considered crucial in the success of agility (MacKenzie, 2003).Without such measurements it's difficult to compare agility levels and estimate the results which allow a meaningful evaluation of the value of the business. In this paper we define operational agility as the ability to redesign a business process by quickly adding new capabilities to the set of capabilities in the business process.

2.3. Flexibility in IT infrastructure

IT infrastructure in an organization is a collection of technological resources accumulated over time (Ray et al, 2005) and might not be imitable (Ravichandran et al, 2005). Flexible IT infrastructure is defined as: The ability to easily distribute and support a variety of hardware, software, communication technologies, data, skills and competencies, commitments, and values in the

physical, technical and human aspects of the current IT infrastructure (Byrd and Turner, 2000).

Flexible IT infrastructure can simplify expanding and adjusting the set of capabilities in the business process. Therefore, allowing the organization to respond quickly to opportunities and threats (Ray et al, 2005). This is because flexible IT infrastructure leads to the improved ability in finding effective solutions quickly (Ravichandran et al, 2005). Thus it is clear that inflexible IT infrastructure can only expand or improve the capabilities to some extent, and with great difficulty. Organizations exist in ever-changing environments and flexible IT infrastructure allows them to continue to respond to the requirements of the market while preparing for future integration (Byrd and Turner, 2000).Working in changing environments means business processes need to adapt to their environments.

2.4. The relationship between IT infrastructure flexibility and business process agility and process outcomes

Tallon (2008) found out that technical capabilities of IT compatible with flexible components have a positive relationship with the ability of a company to initiate or respond properly to change. Thus, differences in IT infrastructure flexibility are expected to affect business process agility in companies. As mentioned by Sambamurthy (2003) IT is a platform for agility. Therefore analyzing the differences in business process agility explain the changes in process outcomes.

Previous research suggests a relationship between business process and an organization's performance (Elbashira, 2008 and Mukhopadhyay 1995, 1997). Flexible IT infrastructure is a crucial resource for a company which, with a process-based view, can create value for business (Barua, 1995 and Karimi, 2007). Karimi et al. (2007) found that IT infrastructure resources enhance ERP capabilities on an operational level which has positive effects on process outcomes. This shows that ERP capabilities have positive and useful effects on process outcomes. Processes are the means for achieving a company's general goals and thus process outcomes are measured as performance mean (Dehning, 2002 and Mahil, 2004). In the literature process outcomes are described as processes with quality and effectiveness. Quality can be measured based on process outcomes leading to determining the how a process can satisfy the customers' needs (Schneiderman, 1996).

The hypotheses of this research with regard to the literature are as follows:

1. IT infrastructure flexibility has a positive relationship with business process agility.
2. Business process agility has a positive relationship with process outcomes.

And the alternative hypotheses are:

1. Business process agility has a positive relationship with the efficiency of process outcomes.
2. Business process agility has a positive relationship with the quality of process outcomes.

The conceptual model for this research which draws upon the literature and the hypotheses mentioned above is presented in figure 1.

This conceptual was taken from Sambamurthy et al. (2003) and considers IT to be an enabler for agility. This model was conceptualized using the dynamic capabilities theory. Future researchers are encouraged to explore, analyze, and extend this model.

This study revises the components of the conceptual model in the paper by Sambamurthy et al (2003) and uses the following measurable structures to test the conceptual model.

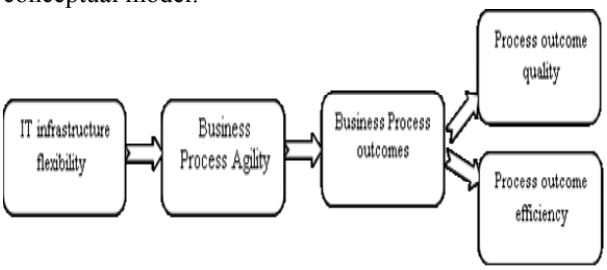

Figure .1Conceptual model

2.5. Identifying business processes for the study

It was mentioned that agility needs to be measured for a specific process. Choosing specific processes to measure business process agility is very important since IT might not affect all processes equally. Thus, studying the classifications of business processes provides insight into the matter of choosing processes. Chosen processes validate the agility of the business process and thus are tested in the model.

To better clarify business process agility Day (1994) divides business processes into different groups and presents frameworks such as supply chain and process capability. In a recent paper on Supply Chain Management Tracy et al (2005) focused on the capabilities of the chain. Using the framework in Day (1994), they showed that spanning processes are in the form of effective influences on SCM (Tracy et al, 2005). Spanning processes integrate the inside-out and outside-in processes in an organization. Outside-in processes are activated by the requirements of the market and existing competition, while inside-out processes link the organization to its environment (such as warehousing raw material).

Spanning processes include customer order management, procurement, customer service, and product development. One point of view suggests that there are 5 critical business processes in every supply chain: customer order management, procurement, manufacturing, new-product development, and logistics (Gardner, 2005). Customer order management and procurement are used in this study to validate the structure of agile business processes. These two critical processes are well-defined across the industry. Customer order management is the core process of every business, since this is how customer satisfaction is achieved (Jin-Hai et al, 2003). The success or failure of order management (delivering on time) directly affects customer satisfaction (Kumar and Sharman, 1992). Failure leads to decrease in revenue and loss of customers. Procurement, which is related the organization's ability to find raw material for production, is important in customer order management. Furthermore, procurement affects customer satisfaction (Spekman, 1994).

3. Research methodology

3.1.Population and samples

Considering the objectives, this research is an applied one and considering data collection it is a descriptive one. It analyzes the business process of the organization. To collect data, a field research in Azaran industrial company and a secondary research were conducted. The statistical population included employees in different levels of the organization, a total of 250 employees. Business process outcomes, business process agility, and IT infrastructure flexibility were the dependent, mediating, and independent variables respectively. The data were collected between late February and late March of 2012. Standardized questionnaires were used as the means of data collection. A total of 150 questionnaires were distributed among the employees, 141 of which were valid. The questionnaire had two parts: the first part included questions about demographic features such as gender, age, education, and position, while the second part included questions about variables of the research. A five-level scaling method was used for questions in part two ranging from strongly agree to strongly disagree. Table 1 shows demographic information for the study and Table 2 shows descriptive statistics of the variables.

Table 1. Demographic information

	Variable	*Frequency*	*Frequency Percent*		*Variable*	*Frequency*	*Frequency Percent*
Gender	Male	110	0.779		diploma or lower	31	0.221
	Female	31	0.221		Associate's degree	16	0.115
Marital Status	Single	36	0.257	**Education**	Bachelor's degree	74	0.522
	Married	105	0.743		Master's degree	19	0.133
	<< 25	4	0.027		PhD	1	0.009
					Senior manager	2	0.018
Age	26-30	48	0.345	**Position**	Executive manager	7	0.044
	31-35	31	0.221		Supervisor	12	0.088
	36-40	25	0.177		Employee	39	0.274
	41 >>	33	0.230		Other	81	0.575
	Total	141	100%				

Table2. Mean and standard deviation

Variables	Min	Max	Mean	Std. Deviation	N
Process Agility	2	5	3.72	0.624	141
IT infrastructure flexibility	3.33	5	4.25	0.466	141
Effectiveness	1	4.25	3.23	0.606	141
Quality	3	4.80	3.99	0.444	141
Efficiency	2.20	4.40	3.61	0.428	141

3.2.Evaluating research variables

The questions in the questionnaire were validated by industry experts and professors in Isfahan University. To determine the reliability of the survey, 50 questionnaires were distributed among the participants and Cronbach'salpha was calculated for the variables. The alpha was 0.83 for all the questions related to the variables in the analytical model of the research including IT infrastructure flexibility,

business process agility, and process outcomes, which is acceptable.

3.2.1. Evaluating business process outcomes

Process outcomes are described as processes with efficiency and quality in the literature. Quality can be measured based on process outcomes this way it can be determined how much efficiency in a process can satisfy the customer's needs (Schneiderman, 1996). The quality of a process can be determined by customer satisfaction. For example fewer errors in billing, transportation, and on-time delivery lead to returning and more sales (Lambert and Pohlen, 2001). "How outcomes are achieved" determines the efficiency (Schneiderman, 1996). A principal theory suggests that information systems decrease the costs of coordination (Clemons, 1993). Thus, the consequences of an efficient process are reflected in the costs of coordination, advanced inventory management, etc. (Saeed, 2005).

A total of 9 questions were designed using a five-level Likert scaling(1= strongly disagree and 5= strongly agree) to evaluate the aforementioned variables. The results of confirmatory factor analysis can be seen in Table 3.

3.2.2. Evaluating process agility

In this paper we used previous works to evaluate process agility. The study by Raschke(2010) was used as a reference for evaluating the dimensions of these concepts. In total 3 questions were designed to evaluate business process agility and 16 to evaluate components of agility in processes using a five-level Likert scaling (1= strongly disagree and 5= strongly agree). The results of confirmatory factor analysis can be seen in Table 3.

3.2.3. Evaluating IT infrastructure flexibility

Flexible IT infrastructure can simplify expanding and adjusting the set of capabilities in the business process. Therefore, allowing the organization to respond quickly to opportunities and threats (Ray et al, 2005).This variable was also evaluated using the questionnaire by Raschke (2010) which contained 3 questions about IT infrastructure flexibility. The results ofconfirmatoryfactor analysiscan be seen in Table 3.

Table 3.the results ofconfirmatoryfactor analysis

	CMIN/DF	*RMR*	*GFI*	*AGFI*	*CFI*	*NFI*	*RMSEA*
Process agility	-	0.000	1.000	1.000	1.000	1.000	0.06
IT flexibility	0	0.000	1.000	1.000	1.000	1.000	0.04
Efficiency	1.52	0.008	0.99	0.94	0.99	0.99	0.06
Quality	1.44	0.023	0.99	0.95	0.99	0.97	0.05

The coefficient for S29 was eliminated because it was negative.

4. Case study

The statistical population for this study included the CEO, supervisors, specialists, and other employees from R&D, production, marketing and sales, human resources, accounting, etc. Azaran industrial company was founded in the historical and industrial city of Isfahan in 1987. Before that, it was a factory which manufactured industrial gears. After a period of research and development and due to the country's need, the company restructured and started manufacturing brass valves under the commercial name Azar. Azaran Company now operates in an area of 25000 square meters with a staff of 250 employees. This company has been able to become the largest valve manufacturer in the country without using any foreign technologies. The company cans also manufacture the most advanced and up-to-date machines needed in valve-manufacturing lines. The various high quality machines have been able to meet most of the crucial demand for such machines in the country. This research focuses on the processes.

5.Findings of analyzing the conceptual model

After validating the methods for measuring the variables of the research, the conceptual model of the research was analyzed using structural equation model. This method was chosen due to its ability to analyze the relationships between all the variables instead of analyzing them in pairs. The SEM approach is a comprehensive method for testing the relationships between the observer variables and the latent variables. Since the conceptual model tries to analyze the causal relationships between four latent variables, the SEM approach as it provides the ability to analyze those relationships simultaneously. A well-known program named AMOS was used in running the structural equations.

5.1. Results of path analysis the causal relationships between the main variables

To check the appropriateness of the model CMIN statistical path analysis and other criteria for the appropriateness of the fitness were calculated. Table 3 shows the results.

Table 3 Fitness criteria of path analysis model

CMIN	*df*	*CMIN/df*	*RMSEA*	*GFI*	*AGFI*	*IFI*	*CFI*	*RMR*
91.62	96	1.99	0.08	0.92	0.81	0.96	0.96	**0.05**

The output from AMOS in the standard estimation segment of the model proves that the path analysis model is an appropriate model. The value of RMSEA is 0.08 which is appropriate. Furthermore, GFI and AGFI are respectively above 90 percent and 0.81 percent. IFI and CFI are also both above 90 percent. Finally, RMR is equal to 0.05. To compare the observer variables of the four latent variables in the path analysis model, standard model estimation was performed.

Furthermore significant numbers of calculations shows that the causal relationship between IT flexibility process agility is meaningful (significant numbers in the model should be more than 2 and less than -2). This research attempts to determine the effects that the variables have on each other. The results of calculating the direct and indirect effects the variables have on each other were obtained using causal coefficients and are shown in Table 4.

Table 4 the direct and indirect effects and the total effect of variables on the final variable

path of effect of variable i on variable j	**direct effect**	**indirect effect**	**total effect = direct effect + indirect effect**
IT flexibility on process agility	0.110	-	0.110
Process agility on quality of process outcomes	0.038	-	0.038
Process agility on efficiency of process outcomes	0.132	-	0.132
IT flexibility on quality of process outcomes	-	0.004	0.004
IT flexibility on efficiency of process outcomes	-	0.015	0.015

Table 5 testing research hypotheses

Hypotheses	**Sample size**	**P-Value**	**Regression weight**	**Test result**
IT flexibility on process agility	141	0.02	0.41	Valid
Process agility on quality of process outcomes	141	0.54	0.05	Invalid
Process agility on efficiency of process outcomes	141	0.15	0.13	Invalid

6. Discussion and conclusion

The aim of this paper was to show the effect of IT flexibility on process agilityand the outcomes of customer order management and procurement processes in Azaran industrial company. In order to produce reliable results the conceptual model for this study was checked using structural equation model. The results showed that IT flexibility and process agility have a positive relationship in this company and increasing IT flexibility increases agility in both processes. The results are similar to the results of the study by Tallon (2008) where he emphasized that flexibility in IT infrastructure has a positive relationship with a company's ability to initiate or respond to change. Thus it is expected that differences in IT infrastructure flexibility affect the agility of business processes in organizations.

Process agility has no positive relationship with the quality and efficiency of procurement and customer order management processes. This is in contrast to the findings of Sambamurthy (2003), Karimi (2007), and Barua (1995).

In today's modern world organizations need to predict changes in order to perform better than their competition and achieve success. The need to predict changes has increased the need for agility and has led to more investigations in this area. Therefore organizations need to measure the agility of their processes and determine their strengths and weaknesses so that they can eliminate these

weaknesses over time and according to their needs and improve their performance.

7.Suggestions

The following suggestions are offered for future research in improving organizational performance, processes and determining the relationship between IT infrastructure flexibility, process agility and process outcomes:

We suggest conducting this survey in different companies and different industries using the same model. A variable can also be considered for organizational performance and the effects of process performance on it can be analyzed. Another suggestion is analyzing other the subject matter for other business processes. Researchers can help management find the processes and components to invest in so that they can get achieve the desired results, this way return of investment, agility, and risk evaluation are possible. Consequently, researchers can analyze the effects of themanagers' behavior in making decisions for investment on agility components especially in risk analysis. By determining the causal relationships, possible weaknesses in agility, quality, and efficiency can be traced to their roots and eliminated. Due to increased variety of products and increased ability to respond to the customer's needs by competitors, factors such as cost, waste, and quality have been accepted as influential factors in the market and agility in the organization can keep the competitive advantage. Therefore the organization can increase efficiency and improve performance by controlling costs, waste and other overhead, increasing product quality and reducing response time.

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7 25 2012