

Investigating the relationship between team-working and production agility in manufacturing organizations

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Abstract

From the beginning of the twenty-first century, manufacturing organizations have some challenges of new problems, in particular rapid changes in productions and customers' needs. These changes in almost production organizations may be increasingly known as treatment factors, so, they have developed new approaches to agile manufacturing in order to response the above challenges. One of the most effective ways for overcoming rapid changes is to apply team working procedures in which companies are facing with many problems and try to solve them with together. Therefore, the formation of effective teams is an undeniable necessity while team works are closely related to production planning. In the present paper, the concept of team works are discussed and show the relationship between them and their capabilities which cause to improve production agility in production companies. A conceptual model in which agility tools have been considered in the middle of the other concepts (team works and agility skills) has been developed. The conceptual model which defines the relationship between team work and agile production has been developed and analyzed using questionnaire. The proposed model has been validated using T-test method and Likert linguistic domain of experts' opinions by analyzing the filled out questionnaires. Results revealed that there is a significant relation between team working and production agility in production organizations.

Keywords: Production agility systems, Teamwork, Manufacturing organizations, Conceptual modeling

1. Introduction

Modern manufacturing organizations are facing to some major challenges. On the one hand, new technologies are emerging and traditional and old ways will cause obsolescence. On the other hand customer requests and demands for new products and services are being changed during short times (Ho, Lau, Lee & Ip, 2005). In accordance with the new environment, the above mentioned adoption of urgent measures is inevitable for many organizations. Therefore, in the recent years modern production systems as agile manufacturing operations management have been emerged rapidly (Crocitto & Youssef, 2003). In this situation, for many organizations, team working is a key tool for organizational change and can be also used for changing programs and procedures. Teamwork which is increasing the ability of learning and continuous improvement in organization is now known as a very important method for production and renewing changes over the production companies. If the core competencies organization coupled with teamwork inherent capabilities, they are capable to improve their abilities in particular on innovation, flexibility and responsiveness. Teamwork capabilities help production organizations to overcome the demands under uncertainty and different situation of environmental aspects. While the above capabilities help production organizations to improve core competencies and support competitive performance organizations and developing future capabilities through, team building in organizations is known as the best way to re-engineer old structures in order to develop competencies (Parry I. J. et al, 1998).

1.1 Teamwork

By definition, a team is a collection of people with complementary skills who are committed to achieve a common goal that all respondents consider their works (Katzenbach and Smith, 1998). Teams can be categorized in terms of many operations and applications. Griffin evaluated organizational responsibilities and expertise according to the below measures (Debra et al., 2014)

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- Quality circles: Small teams of staff the in a field, regular, argue about problem-solving in the workplace and provide recommended solutions.
- Team work: Includes all those who work in a field and constantly linked together regardless of what you are doing, take joint decisions.
- Problem-solving teams: Temporary teams that are created to solve specific problems in the workplace.
- Management team: Managers of different areas that together make up the team.
- Product development teams: The combination of team work and problem-solving teams are the new designs for the product or service to create customer satisfaction.
- Virtual Teams: Virtual team is a working team whose members are from places far apart are connected electronically and contact facing its members at least.

1.2 Agile manufacturing

Agile manufacturing which is known as an appropriate strategy for enable manufacturing organizations in order to maintain their competitive edge is a new approach to production in the new era suggests (Rigby, Day, Forrester & Burnett,2000; Hormozi,2001). Extract strategies, agility, empowering organizations are mainly applied to respond to changes in demand quickly (Christopher,2000). Agile organization is one that surrounded changes and respond quickly to market requirements (Ramesh & Devadasan, 2007). With the aim of explaining various aspects of agility, many researchers have attempted to develop their conceptual models. In 2000, Sharifi and Zhang studied the establishing relationships between stimuli, abilities and agility in the UK industry which have achieved successes in several industries. This model of agile manufacturing is one of comprehensive models includes three main components as follows:

1. The first part of the driving agility is the fact that the changes that occur in the business environment institute and the company may be new opportunities and gain competitive advantages in order to guide.
2. The second part is the agile ability skills which provides the power needed to respond to changes and generally divided into four categories as shown in table 1.
3. The third part is agility tools provide agility. Tools which help us to achieve agility abilities are categorized in this part (Sharifi & Zhang, 2000). Table 2 shows the classification agility tools (Gunasekaran,1999).

Table 1: Production agility skills

Agility skills	Components
Responsiveness: the skill used to identify and respond quickly to changes.	Feeling and understanding and predicting changes, rapid response to changes in the system by implementing it, recover from changes.
Competency: This means a wide range of capabilities such productivity, efficiency and effectiveness in order to provide corporate goals.	Strategic vision, technology, quality products and services, cost effectiveness, introduce new products at an increasing rate, change management, people capable and competent, efficient and proper operation, cooperation, integrity
Flexibility: Ability to achieve the objectives of processing and manufacturing of diverse products and is different with the same equipment.	Flexibility in production volume, flexibility in product shape and product model, flexibility in the organization and organizational matters, flexibility in human resources
Quickness: Is the ability to get things done and operations in the shortest time	Fast delivery and timely products and services, introduce new products to market fast, quick operation in a very short time

Table 2: Classification of agility tools

Agility Tools	Subset
Strategies	Virtual firms, supply chain, concurrent engineering
Technology	Hardware, tools and equipment, information technology
Systems	Systems design, systems planning and production control, system management and data integration
Human resources	Knowledge workers, empowering staff and senior management support, theoretical and practical training

2. Teamwork and agile manufacturing

Some organizational factors move organizations' productions abilities toward the agility and changes that occur in the business environment institutions. They can participate in new opportunities and gain competitive advantage following their specific guidance. One of these factors used for changing in competitive factors, market demand, technology, consumer needs, social factors, programs and current plans, programs and strategic objectives and business strategy of the company can be categorized as organizational factors. In this context, one of the problems that arises the relationship between teamwork and agility is the management of any organization. It is not able to plan and execute to achieve organizational goals, but also solution that can be made in this area. A recommended way for achieving desired success is to use all skills and experiences of staff in order to share knowledge on intellectual abilities. In this regard, the formation of effective teams in the business environment is an undeniable necessity and organization should move towards teamwork.

In a conceptual framework, a team work participate the organization and management to improve the production quality, increase productivity and customer satisfaction. Teams which are categorized as task teams, virtual teams, quality teams, product development teams, team work, and problem solving and team management teams have the same activities but the different types of expertise within the organization so they play different roles on organization. Following the above concept, each team may affect on the specific agility tools such strategy, technology, system and human resources. On the other hand, each agility tool can participate to different agile skills such responsiveness, competency, flexibility and quickness. The conceptual framework is depicted in figure 1 which shows the relationship between team works and agility tools on the one side, and agility tools and agility skills on the other side. Therefore, the above framework which is known as a conceptual model is a double sided pattern shows the relationships between team works and agility tools on one side and agility tools and agility skills on the other side. In short and brief consideration, a model developed using agility tools as a middle concept between team works and agility tools.

Each team has some specific roles for moving organizations toward agility. Teams need the specific tools including Strategies, technologies, systems and human resources on moving organizations toward agility. Using the above tools help organizations to improve agility abilities consisting of accountability, competence, flexibility and speed. They also help organization to respond the required changes which cause to improve organizational abilities on customer satisfaction, increase productivity, improve performance, enhance the quality and guarantee the organization to remain a competitive environment.

3. Validation of the proposed conceptual model

In order to validate the proposed conceptual model depicted in figure 1, a questionnaire has been designed and experts filled out them based on their opinions. The pre-designed questionnaire, shown in appendixes 1 and 2, has been distributed over the experts who have enough experiences on team works and agility in Sobhan Pharmacy Company which had been selected as case study. At the first stage, they have been asked to understand the relationship between team works and agility tools and agility tools and agility skills at the second stage Filled out questionnaires have been analyzed utilizing the concept of Likert assumptions in which 1 defines the lowest relation and 5 defines the highest one. Since the number of filled out questionnaires is not exceeded of 30, the well-known statistical function of T test is used for checking the relationships (Walpole et al., 2011). In this case, calculating the mean and standard deviation outlines the value of t and the possibility of acceptance or rejection of hypothesis H_0 will be checked.

Following the above consideration and also likert domain, the research hypotheses are defined as follow:

The null hypothesis is considered that the average numbers with Likert scale is equal to 3, or $H_0: \mu=3$.

The hypothesis one which is considered to be one-sided for average is defined as $H_0: \mu >3$

Using the statistical analysis, the amount of t distribution, obtained from the formula for calculating t, ($t = \frac{x-\mu}{\delta/\sqrt{n}}$),

should be compared to the one set in T distribution table, at 95% ($\alpha = 0.05$). In one-sided test such as the present work, the null hypothesis will be rejected if the real value of t obtained is greater than one in table and it is approved that there is a significant relations between two parameters. In this research work in which there is seven filled out questionnaires, if obtained t is greater than $t_{\alpha, n-1} = t_{0.05, 6} = 1.943$ the null hypothesis will be rejected. All calculated amounts of t have been tabulated in table 3 in which every two direct and indirect parameters have been compared. For example, the calculated t for existence of the relationship between virtual team and technology is 3.872. Because it is greater than 1.943, it can be concluded that there is a significant relation between virtual team working and technology. Virtual team working is a kind of team work and technology is a production agility tool.

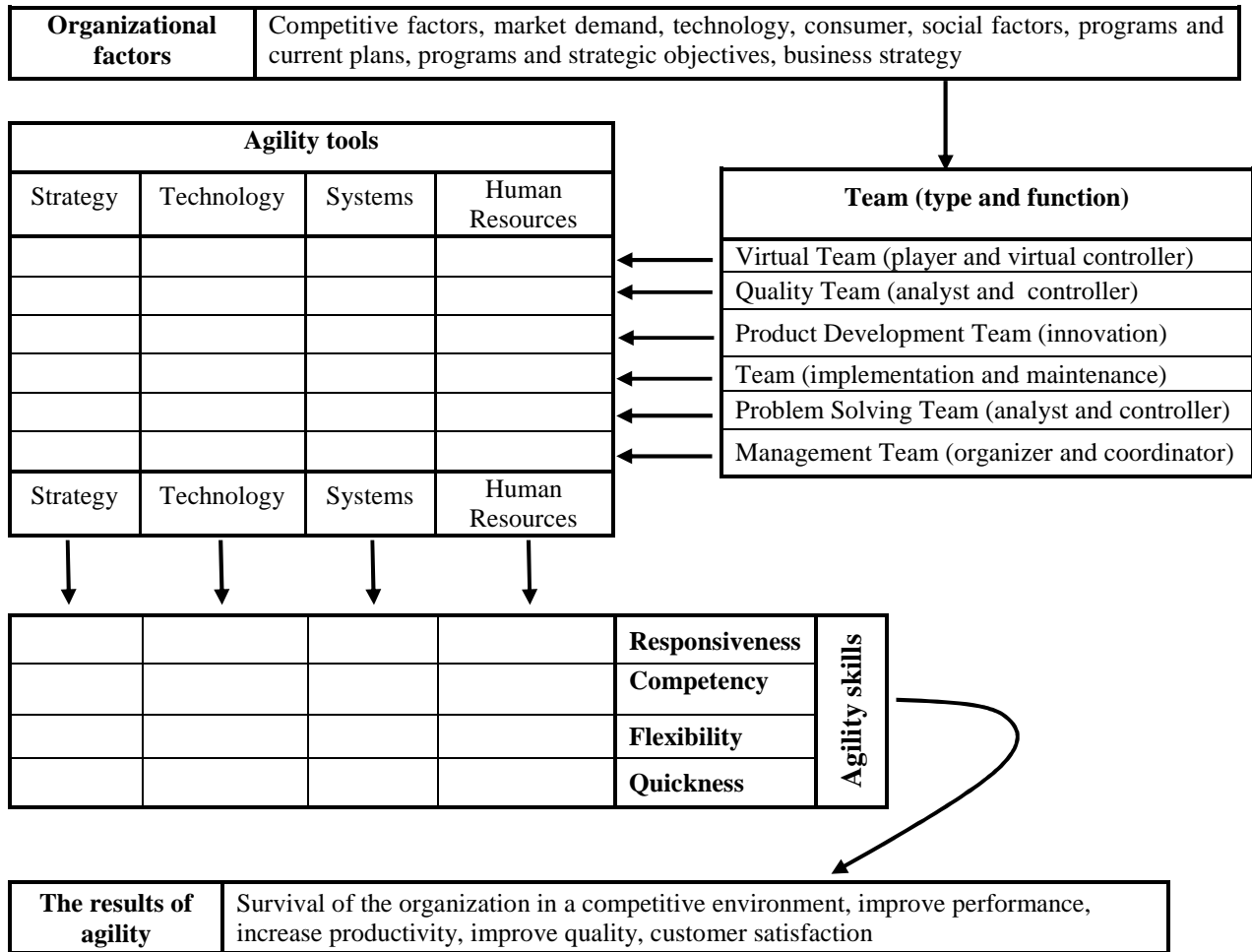


Figure 1: Conceptual model of the relationship between teamwork and agility

There is also another statistical measure in table 3. Let's look at the column sig in table 3 means the power of test. It is the probability of accepting null hypothesis when it is false. If the probability is less than 0.05, H_0 hypothesis is rejected and as result, the hypothesis H_1 will be accepted. For example, focusing on the relationship between virtual teams with agility tools, the probabilities for checking the relationship between virtual teams with technology and virtual team with human resources are calculated as 0.004 and 0.019, respectively. Since these numbers are lower than 0.05, the null hypothesis will be rejected and it is concluded that there are relationships between virtual team and technology on the one side and human resources and virtual team on the other side. Similar amounts of t are now highlighted in yellow in table 3 to identify the connection ways of relationship. Connecting highlighted numbers reveal that there is a significant relationship between team works and agility tools.

Similar consideration and conclusion can be also done to check the relationship between agility tools and agility skills. T test values have been also tabulated in table 4. Paying more attention on the column sig, in table 4, reveal that there is also significant relationship between agility tools and agility skills. For example, checking the relationship between technology and agility abilities (when their obtained values in column sig. are lower than 0.05) shows that there are significant relations between technologies and competence and flexibility. The similar conclusions are also observed for the remained values and parameters.

According to what has been mentioned before on the existence of relationship between each team and agility through passing the agility tools, all significant relations can be depicted as figure 2. In figure 1, shaded cells show that there is a significant relationship between two sides. Following their connections revealed that team works can improve organizational abilities on agility to overcome real problems in today competitive environment.

Table 3: Results of statistical analysis of the relationship between teams and agility Tools

Team (type and function)	Agility Tools (as defined in Table 2)							
	Strategies		Technology		Systems		Human Resources	
	T-stat.	Sig.	T-stat.	Sig.	T-stat.	Sig.	T-stat.	Sig.
Virtual team (player and virtual controller)	0	0.5	3.872	0.004	1.133	0.115	2.645	0.019
Quality team (analyst and controller)	1	0.177	3.872	0.004	2.5	0.023	1.986	0.047
Product development team (innovation)	2.121	0.039	2.121	0.039	4.582	0.001	2.828	0.015
Team (implementation and maintenance)	3.872	0.004	3.872	0.004	2.5	0.023	2.520	0.022
Problem Solving Team (analyst and controller)	0.420	0.344	1.549	0.086	2.121	0.039	2.121	0.039
Management team (organizer and coordinator)	4.582	0.001	1	0.177	1.441	0.099	6.971	0.0002

Table 4: Results of statistical analysis of the relationship between agility tools and agility skills

Agility Tools (as defined in Table 2)	Agility Skills							
	Responsiveness		Competency		Flexibility		Quickness	
	T-stat.	Sig.	T-stat.	Sig.	T-stat.	Sig.	T-stat.	Sig.
Strategies	6	0.0004	4.582	0.001	2.5	0.023	2.828	0.015
Technology	1.921	0.051	6	0.0004	4.381	0.002	1.549	0.086
Systems	1.549	0.086	6	0.0004	2.121	0.039	3.872	0.004
Human Resources	2.121	0.039	2.828	0.015	2.291	0.030	2.828	0.015

4- Conclusion

In this paper, the main aim was to investigate the relationship between team works and agility over the production organizations. A conceptual model, which illustrates the relationship between team works and agility tools on the one side and agility tools and agility skills on the other side, has been designed and validated using some filled out questionnaires. Utilizing the well-known statistical technique of T test revealed the below results:

- In manufacturing organizations, quality teams, made up of employees who regularly work in a field on solving problems in the workplace and provide recommendations and solutions analyst role he played in the organization controller, are able to communicate with agility tools through technology, systems and human resources. So, improving the organizational agility is a result of applying team work applications on production organizations.
- Product development teams, who design new products, services or innovation in order to meet customer needs and provide satisfaction, have significant relations with agility tools through strategy, system and technology.
- Problem-solving teams can solve specific problems in the workplace playing the role of the analyst and controller, through systems and human resources.
- Running and holding teams have also direct relations with agility abilities.

- Management teams consisting of all managers in different areas who are responsible for coordinating and organizing activities have relations through strategies and human resource agility.
- Virtual team has relation with agility abilities through the agility tools of technology and human resources.

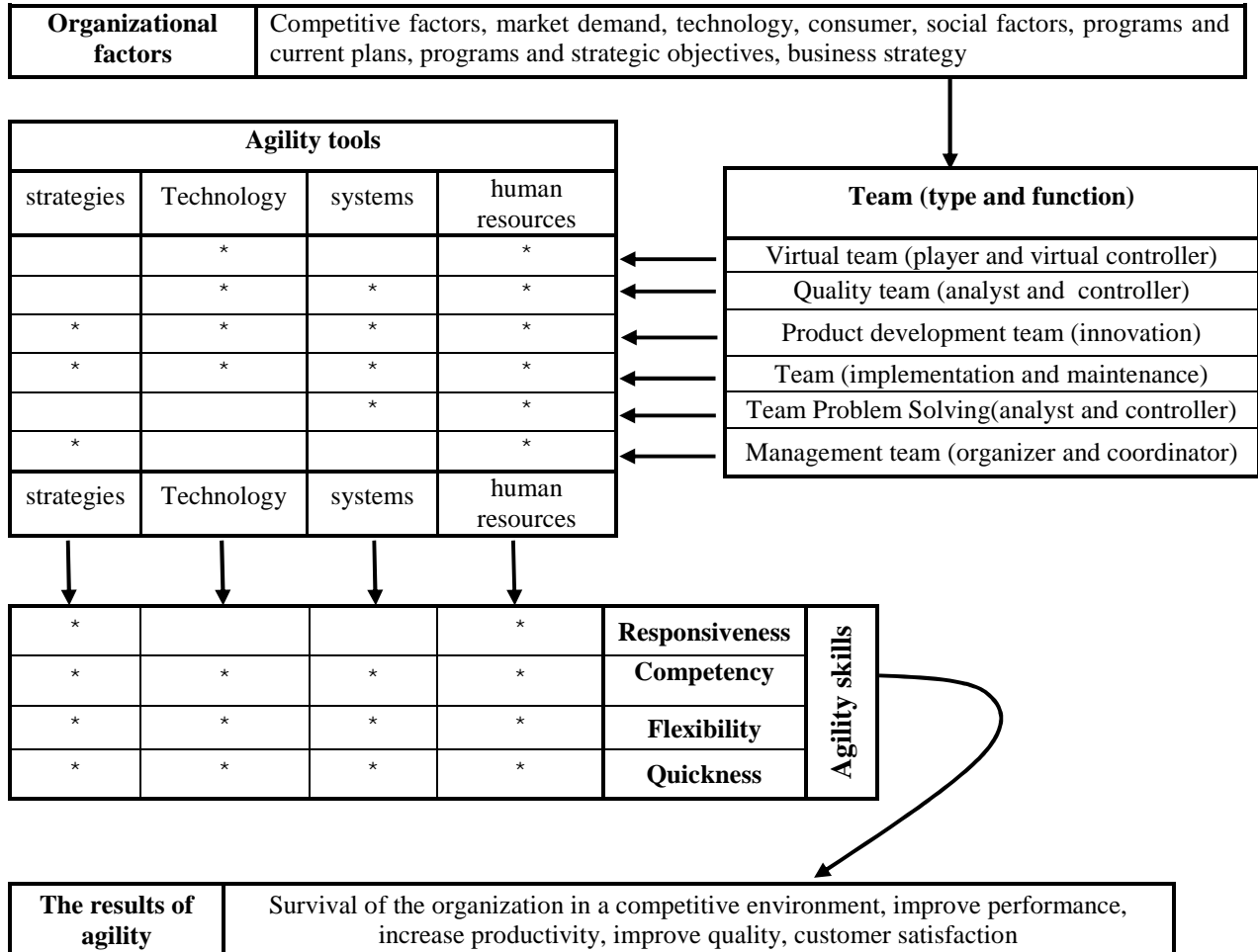


Figure 2: The relationship between teamwork and agility in manufacturing organizations

On the other hand, agility tools as well as agility capabilities are connected as follow:

- Technology has relation with the agile ability through the flexibility to respond the changes in organizational factors.
- Capable system has relations with agile abilities through competence, flexibility and speed.
- Strategy and human resources are connected with all capabilities of agility including responsiveness, competence, flexibility and speed.

As you can see, it can be concluded that with the participation of teams in the organization and communication that they make contact with agility tools, can be directed organizations toward agility to use the capabilities of agility. Could arise from changes in the business environment. Institute use it as an opportunity to achieve success or be able to quickly change the feelings, perceptions and predictions and respond to them as action or reaction to maintain their survival in today's competitive and complex environment and achieve increased productivity, improved quality, performance and customer satisfaction is the goal of agile manufacturing. So, according to the results of research, we can say that between teamwork and agility in organizations, there is a significant relationship.

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Appendix 1: Questionnaire designed for investigating the relationship between team works and agility tools

Agility Tools > Teams	Strategy					Technology					System					Human Resource				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Virtual team (player and virtual controller)																				
Quality team (analyst and controller)																				
Product development team (innovation)																				
Executive team (implementation and maintenance)																				
Problem Solving team (analyst and controller)																				
Management team (organizer and coordinator)																				

1-Very strong, 2- Strong, 3-Moderate, 4-Weak, 5-No relation

Appendix 2: Questionnaire designed for investigating the relationship between agility tools and agility abilities

Agility Skills > Agility Tools	Quickness					Flexibility					Competency					Responsiveness				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Strategies																				
Technology																				
Systems																				
Human Resources																				

1-Very strong, 2- Strong, 3-Moderate, 4-Weak, 5-No relation

Biography

Donya Nader is Msc. in Industrial Engineering and works in the field of production planning. She works as an expert in industrial engineering and production systems and published some papers in national conferences mainly related to agility and production planning.

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