

SYNERGY EFFECTS BETWEEN THE LEAN AND AGILE MANUFACTURING

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Abstract

Lean production and agile manufacturing are well known production concepts. Modern literature is full of the articles about their comparison, merger, opposition, analysis, etc. Many authors agree that their synergy will lead to better results, rather than these concepts will be used separately at the company. That is why it is important to combine the lean and agile manufacturing for creation of the competitive production concept. Their synergy can be divided on two different types, such as an integrative and emergent. The purpose of this article is to introduce different effects from synergy, which can be not only positive, but negative as well. However the positive effects will be more considerable than negative synergy effects.

Keywords: lean production, agile manufacturing, synergy, effects

1. INTRODUCTION

Lean production is worldwide known concept, which was created more than fifty years ago. Lean production is an integrated socio-technical system whose main objective is to eliminate waste by concurrently reducing or minimizing supplier, customer, and internal variability [1]. Waste means Japanese word Muda. Seven main types of wastes are: overproduction, waiting (time on hand), transportation or conveyance, overprocessing or incorrect processing, excess inventory, unnecessary movements and defects [2], [3], [4]. Also, Liker includes the eighth type of waste, which is unused employee creativity [5]. Another production concept, agile manufacturing, was created more than twenty years ago. Agile manufacturing organizations produce a high quality and defect free product with short lead times. The product is able to be upgraded and reconfigured, rather than be replaced. The agile manufacturing organization integrates design, engineering, and manufacturing with marketing and sales in such way that the products are customized to the exact needs of the consumer. Agile manufacturing implies breaking out of the traditional thinking and producing highly customized products, where and when the customer wants them [6]. Nowadays these concepts are described together, like a leagile concept. Leagile is the synergy between the lean and agile production concepts. The result of their synergy at the company will be the synergy effects, which can be positive and negative. The novelty of this article is that these effects will be described.

2. LEAGILE CONCEPT

Most of the authors claim that lean and agile manufacturing is better to use together. The agility cannot exist independently without lean manufacturing. Without assumption of leanness, the transition to agile manufacturing is difficult to achieve [7], [8]. Lean manufacturing can also be an element of agility in some circumstances, but it does not allow meet customer requirements faster [3]. These two production concepts are different, but together with the focus on customer satisfaction and producing high-quality goods they can achieve the high level of competitiveness. By opinion of [10], Leagile is a combination of lean and agile paradigm within the total supply chain strategic location of decoupling point so as to best suit the need to respond to fluctuating demand and the subsequent granting of planning at the level upstream from the decoupling point. Leagile is a system that combines the benefits of lean and agile manufacturing [4].

The decoupling point is best to apply in supply chain, when the lean system will be upstream from the “decoupling point”, because production should be forecast driven, with close attention paid to economic batch sizes and the replenishment of depleted stock levels as quickly and cheaply as possible. While agile system should be applied downstream, because production management policies should be highly responsive to meeting customer demand. Such situation is usually associated with the product strategy of postponement [4], [9], [10], [11] (see Fig. 1). The strategy of postponement means the postponement of operational activities in the system, until the customer order is delivered, i.e. activities wouldn't be completed in advance and then waiting for orders [3].

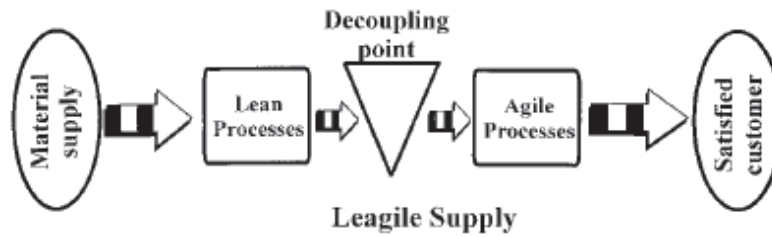


Fig. 1 Leagile concept [7]

By our opinion decoupling point will have different location for different production branches. For example, for the metallurgy production, the supply chain will be more lean and less agile, because this type of the production cannot make a big changes at the technology for the production of new products. For this production it is more important to eliminate inventory and overprocessing, and only then become agile, which will be fast respond to the customer needs. Another example is fashion industry, where lean part will be smaller than agile part. Because for clothes production, it is important to have an inventory of different materials for big amount of products, because customer needs change at least every 3 months (see Fig. 2).

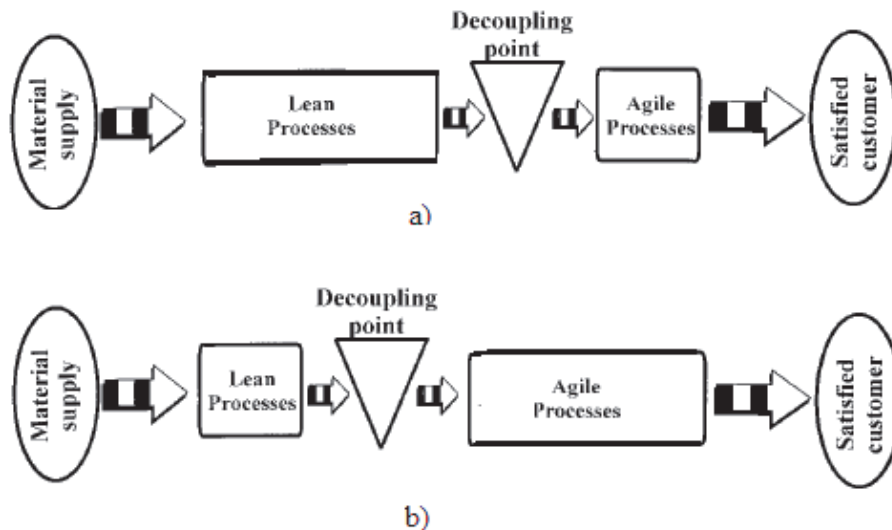


Fig. 2 a) Leagile at metallurgy production, b) Leagile at fashion industry

The level of the integration between the lean and agile manufacturing is possible to measure with help of fuzzy logic [12]. As a result of lean manufacturing implementation at the beginning of the process and agile manufacturing during the closing stages of the process will be that the company realized benefits far greater than using them separately [11]. Their benefits can be called the synergy effects, and these effects will be described in this article for better understanding of what kind of benefits companies can get from leagile production. But first it is important to understand meaning of synergy effects in modern management.

3. SYNERGY EFFECTS IN MODERN MANAGEMENT

Synergy, as a word, was created long time ago in ancient Greece, but only in 1980s it became popular in relation to management [13]. Synergy has a lot of definitions, but one of the most popular definition of synergy is “2+2=5” [14]. By opinion of another author, synergy shares with organization the idea of the positive benefits of togetherness: it is a collective effort, so that it achieves an outcome potentially superior to that of individuals acting or working alone [13]. Also, synergy is the result of collaboration between two or more subsystems (organization), where the newly created effect of this cooperation is greater than it would be if subsystems operate separately (without a binding mutual interconnection [14]. The leagile production is a good example of this definition of synergy, because synergy between lean and agile manufacturing will lead to better competitiveness as one of the results. Synergy itself can be two different types [14] like as:

Integrative - the effects of this synergy can be quantitatively evaluated (for example, production co-operation of two plants brings to the better use of machines).

Emergent - when synergy effects are qualitatively new (for example, 2 atoms of H plus atom of O are equal water molecule, where characteristics of water is totally different than characteristics of elements from which it was created). Emergent effects cannot be easily measured.

By other words, synergy is a change in behavior and performance of the system due to the creation of the interaction effect of the subsystems. The result of these interactions is a synergistic effect. Synergy between the lean and agile manufacturing will be also integrative and emergent, also these synergies types can be divided on positive and negative effects. These synergy effects will show to the companies what they can expect from the integration between the lean and agile manufacturing.

4. SYNERGY EFFECTS BETWEEN THE LEAN AND AGILE MANUFACTURING

Synergy effects can be divided in two groups like as effects from integrative synergy and effects from the emergent synergy, which are also divided on positive and negative effects (see **Table 1**).

Table 1 Synergy effects between the lean and agile manufacturing

Effects from integrative synergy	
Positive	Negative
Increase in profit	Increase in production costs on certain period
Increase in customer satisfaction	Increase in labor intensity
Better use of resources	Reduction of the level of employee satisfaction
Improvement in communication between employees, suppliers, customers	Reduction of the workforce
Expansion in the production	Increase in severity on the transportation
Increase in the amount of multiskilled and flexible personal	Increase in severity on the suppliers
Development and improvement of the used technology	
Increase in company competitiveness	
Effects from emergent synergy	
Positive	Negative
Increase in success of the company	Influence on the environment
Securing corporate culture	
Development of the new markets/ new products	
Introduction of the new technology	
Influence on the environment	

It is easy to determinate the positive and negative effects from the integrative synergy. In this case first positive effect is the increase in profit, because leagile manufacturing will help to satisfy more customers, which will

have an influence on profit. The second positive synergy effect is the increase in customer satisfaction; lean and agile manufacturing will help to have a high quality with the appropriate price. The third positive integrative effect is the greater use of the resources, because leagile concept will help to plan and eliminate in appropriate way resources, which are needed for leagile production. Next effect is the improvement in communication between the employees, suppliers and customers. It is important to build the trustful relationship for faster delivery of products. Satisfied customer will help to make a good reputation at the market; this reputation will influence the expansion of customers, which will lead to the expansion of the production. The sixth effect is the increase in amount of multi-skilled and flexible personal, because production lines and people have to be ready for changing because of the customer needs. Next effect is the development and improvement of the used technology, because cost effective production with fast customer satisfaction needs technology improvement. The last and the main positive effect will be the increase in company competitiveness.

Also the negative effects from the integrative synergy can be determined. The introduction of the leagile production will cost some expenses at the beginning, that it is why negative effect is the increase in production costs on some certain period. The next effect is the increase in labor intensity, because production can be more demanding. Also quick changing of the production for the customer satisfaction can lead to the reduction of the level of employees' satisfaction, because constantly changes in the production can be hard and people can be tired because of it. Possible next effect is the reduction of the workforce, because agile manufacturing uses the robotic production. Amount of the administrative employees can be increased, because the integration of the lean and agile manufacturing is a broad process. But some laborers can be fired, when technologies will be modernized, for example the robotic technology will be used, or employees will be multi-skilled and they can execute and mix work of other laborers. Increase in severity on the suppliers and increase in severity on the transportation are next effects. The quick delivery can be sometimes difficult for the suppliers, but if company and supplier have a good communication and understand the customer needs, than these effects wouldn't rise.

Another type of the synergy effects are effects from emergent synergy. There will be five positive effects and one negative effect. The first effect is the increase in success of the company, more customers and more profit will lead to the success. Company's success is impossible to measure in quantitative way. The second effect is the securing in corporate culture, because employees will be multi-skilled and educated. Development of the new market and new products will be for the leagile production concept qualitative new, that is why it is an emergent effect. Next effect will be introduction of the new technology. It will be a new emergent effect, because in some cases the totally new technology will be used for the production. Also synergy between lean and agile manufacturing can lead to the influence on the environment. This influence can be positive and negative as well. In some cases, improved or introduced technologies will require fewer resources, for example less electricity. In other cases, production will use more material and it will be a negative environment effect. Environment effects will depend on the production, technology, customer requirements, environment policy and protection.

CONCLUSION

The synergy effects between the lean and agile manufacturing can be different. It is important for companies to know what they can expect from the integration between the lean and agile manufacturing. Because their integration can lead to the positive effects, and sometimes the negative effects can acquire as well. Their influence can be cautioned in advance. These effects can stimulate the interest in integration of the lean and agile manufacturing at the companies.

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