MODERN METHODOLOGIES TOWARDS A SUSTAINABLE FLEXIBLE PRODUCTION

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Abstract: The present paper brings into the light several methodologies used today inside the companies to organize their process in order to respond to continuously evolving and changing customer behavior. It follows the historical timeline from the moment when production was a simple craft to the moment where mass production has been transformed in mass customization.

Keywords: flexibility, agile, scum, jit, kanban, kaizen, lean

Jel Classification: D20 – General

1. Introduction

Growing demands on various customized products are received by companies on a recurrent basis more than before. Specific desires are being formulated by clients, having consequences on the company strategy and father to their production capacity. Several factors have contributed to the actual state in the client behavior. One of them is the globalization, social factor that encouraged the exchange of opinions, ideas and a faster propagation of the information between countries and cultures. Governments and different accredited organizations sustained the spread of the globalization from a regulatory and social perspective. The second factor, a really key pillar, sustained globalization and allowed it to evolve at a higher speed towards new horizons. This second factor is the technology, that brought today human beings under one digital roof, giving new possibilities to generate competitive products and services. Research and development plays an important role bringing to life new generation machines capable to perform complex and flexible tasks that allows companies to use them as resources in order to reach strategic targets. Technology seen from the production corner means powerful computers, long lasting components able to be easily replaced when repaired or upgraded. Many machines have the capacity to easily change between several production processes with little input from the employees. For example computer-aided design and manufacturing machines are using super computers that offer an easy interface to communicate with the human factor. From a service perspective technology refers to the friendly interface tools that do not require advance knowledge from the users. The last 20 years have been characterized by an exponential growth of the social media platforms that encouraged the communication worldwide and sustained the intensification of the globalization. Social media started from simple interactive online spaces between users being adopted in recent years also by companies as a straightforward solution to keep the brand fresh. The fact that around 43% of all online consumers are social media fans or that 85% of internet users have Facebook accounts has to send some signals to those that have not yet been convinced. Globalizations means also being able to access the same information anywhere using the same connection device. Is it mobility that solved the challenge for many tools that now can be accessed via phone, table or laptop. It is estimated that in 2014 four out of five internet users will be a mobile web user.

Having in mind the two mentioned factors, globalization and technology, as contributors to the variety of demands received from the clients, let's go further and see how methodologies and best practices have been built to respond on their turn to the changing environment.

2. Methodologies

Going back in history, years 1950 – 1960 have been characterized by important moments such as placing the production of coal and steel under a common authority, unification performed by Paul Schuman on 18th of April 1951 and several years later in 1957 the creation of the European Economic Community (EEC). Looking now at the company level, efficiency was considered for that period the most important competitive advantage. It was seen a success to produce at large scale keeping under control the costs. Many standard procedures have been created and companies could certify in order to prove their efficiency. The in-depth attention for standardization gave birth to an individualistic thinking and limited interactions at the level of related activities. Coordination and control became two distinct goals that led to complex work organizations but with simple and monotone activities. Passing to years 1970-1980, this are characterized by the launch of Microsoft on 4th of April 1975 and by the first extension wave performed by the European Union. Looking now at the companies, they have realized that standardization was no more enough to generate competitive advantages and started to concentrate on a higher quality. Clients at the same time begun to be more attracted by quality products with a higher fitness for use. After a period of another 20 years, cost and quality were again not enough to sustain further the company future. It is the moment when flexibility appears as a complement to the two initial factors (cost and quality). Flexibility means the possibility to produce various products with little changes brought to the production system itself without having a negative impact on cost or either quality. The picture below describes the relation between clients demands and the competitive advantage.

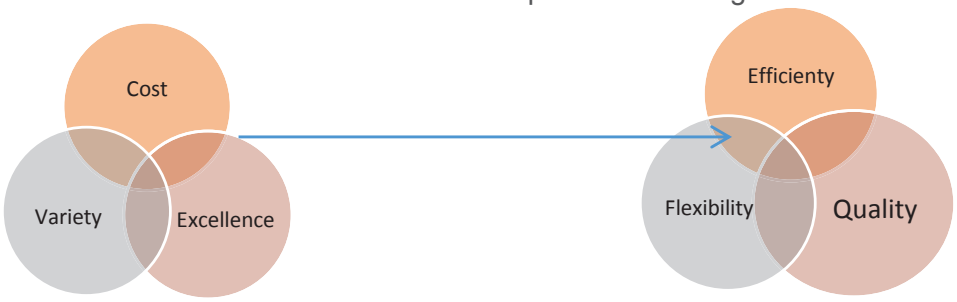

Figure 1 - Clients demands and the competitive advantage

Along the three historical periods described above, scholars and experts have conducted many researches in order to formulate best practices to help companies develop their portfolio of services and products. One of the first philosophies developed by Toyota, back in 1952, was *Just in time* (JIT) that aimed at eliminating waste and continuously improving quality. This was a strategy to reduce the inventory and gain on the return of investment. The JIT methodology was put in place by special cards named, *Kanban* that contained essential information on the product and the remaining stock in the warehouse. The same card was used for future orders to the provider when the stock was finished. Using this process the stock was limited only to the ongoing process eliminating unnecessary materials to be kept in the warehouse with no reason that generated huge costs. To be more clear Kanban is an inventory control system and not a logistical system. Another concept dates back to 1930 from Sakichi Toyoda, founder of Toyota. In 1950 Toyota implemented quality circles leading to the development of Toyota's unique "Toyota Production System". Toyota System is a system of continuous improvement in quality,

technology, processes, company culture, productivity, safety and leadership. The system also called the Deming cycle is based on four step that have to be followed in order to resolve a certain problem appeared. These steps are called PDCA – Plan-Check-Do-Act. Another Japanese concept was burn after the Second World War to defined continuous improvement in quality, technology, processes, company culture, productivity, safety and leadership. The name is *Kaizen,* it comes from the Japanese words 改 ("kai") which means "change" and 善 ("zen") which means "good". The Kaizen process asks each employee in the company from the upper management to the lowest roles to come up with small suggestions on regular basics. Companies such as Toyota and Canon requested from their employees a number of 60-70 ideas per year.
The foundation of the kaizen method consists of 5 founding elements:

1. Teamwork
2. Personal discipline
3. Improved morale
4. Quality circles
5. Suggestions for improvements

Another philosophy derived from the TPS in 1990 was the so called *Lean Management*. Lean is a customer-centric methodology that aims to eliminate waste in all activities and to create a continuous value-added for the client. The interest of the client is captured at any time by creating product and services with a new value.

The term Lean can be described by the following ideas:

- Maintaining an unrelenting focus on providing customer value
- Respecting people most of all
- Adopting a philosophy of continuous learning and everyday improvement
- Using techniques for reducing variation and eliminating waste
- Taking the long-term view
- Improving value not just locally, but globally — across the whole “value stream”
- Providing exactly what's needed at the right time, based on customer demand
- Leading by focusing not just on results, but how results are achieved, where customer value is created, and by building capability in employees
- Building long-term relationships with all its stakeholders, including employees, managers, owners, suppliers, distributors, customers, the community, society, and the environment
- Keeping things moving — flowing — in a value-added, effective manner

	Mass Production	Lean Enterprise
Primary business strategy	Focus is on exploiting economies of scale of stable product designs and non-unique technologies. A product-centric strategy.	A customer-focused strategy. Focus is on identifying and exploiting shifts in competitive advantage.
Organizational structure	Hierarchical structures along functional lines. Encourages functional alignments and following orders. Inhibits the flow of vital information that highlights defects, operator errors, equipment abnormalities, and organizational deficiencies.	Flat, flexible structures along lines of value creation. Encourages individual initiative and the flow of information highlighting defects, operator errors, equipment abnormalities, and organizational deficiencies.
Operational framework	Application of tools along divisions of labor. Following of orders, and few problem-solving skills.	Application of tools that assume standardized work. Strength in problem identification, hypothesis generation, and experimentation.

Table 1 – Mass production versus Lean Management - Natalie J. Sayer and Bruce Williams, Copyright John Wiley & Sons, Inc. © 2012, Publisher: John Wiley & Sons (US)

Not far from 1952, in 1957 it was the moment when incremental software development appeared for the first time being a combination between iterative design, methods and incremental build model. It was only in 2001 when 17 software developers met in Utah to discuss the future of developments methods. The result was a publication called the *Agile Manifesto* that defined new approaches on software development. The four values of Agile were:

- Individuals and interactions over Processes and tools
- Working software over Comprehensive documentation
- Customer collaboration over Contract negotiation
- Responding to change over Following a plan

The Agile methodology is also based on 12 principles presented below:

- Customer satisfaction by rapid delivery of useful software
- Welcome changing requirements, even late in development
- Working software is delivered frequently (weeks rather than months)
- Close, daily cooperation between business people and developers
- Projects are built around motivated individuals, who should be trusted
- Face-to-face conversation is the best form of communication (co-location)
- Working software is the principal measure of progress
- Sustainable development, able to maintain a constant pace

- Continuous attention to technical excellence and good design
- Simplicity—the art of maximizing the amount of work not done—is essential
- Self-organizing teams
- Regular adaptation to changing circumstances

Another iterative and incremental agile software development is *Scrum*, a framework used for managing software projects and products. A key principle of the framework is that unpredictable changes arrived from the client along the development phase that are now treated could not be solved using the traditional planning. As a short insight the traditional method is called the *waterfall model*. It is a sequential design process that flows from one stage to another, for example from requirements collection, design, implementation, verification, delivery and maintenance. Advocates of Agile software development consider that the waterfall model is a bad practice because it is impossible to end totally a development stage before passing to another. If clients change their requirements after the designed was created, the company will have to launch again the whole process from the beginning increasing considerably the costs. To fix this shortcoming, Scum is based on a holistic and empirical approach. Empirical due to the fact that even if changes appear along the development process, the team has to be able to respond quickly. Holistic because it sustains the importance of teams working tight even if distance may not offer an advantage. Teams have to plan face to face meetings and use as much as possible the collaborative work. As the Scrum community started growing from the beginning of 2001, it was expressed more and more the need to gather all the experts under a single organization. It was then when the Scrum Aliance (SA) and Certified Scrum Master (CSM) certification were put in place. There are three roles suggested to be used by the framework: Project Owner, Scrum Team and Scum Master. The project owner is responsible with the creation of the Product backlog, a document containing all the items to be developed together with the related estimations. The product owner is also entitled to prioritize all the items in the Product backlog. The Scrum team develops the product and sends the estimations for the items to the Project Owner. A typical team consist usually of 7 team members with no other roles assigned and implicates a high cross-functional communication. If the Product Backlog describes *What* has to be done, the team breaks down each item in delimited tasks that are included in a separate document, called Sprint Planning. Being an iterative framework, Scrum is based on monthly iterations with one day of planning at the beginning, then 4 weeks of development and at the end one day of review. In all this time enters in stage the third role, the Scrum Master being a coach and gatekeeper for the whole scrum team. In order to manage the time elapsed the Project Owner can use the *Burn Down Chart* that compares the work left versus the time. The figure below scathes an example of such a graphical representation. The ideal line has to show a descend trend to underline the fact that as the number of days elapses also the number of items included the Product Backlog has to decrease.

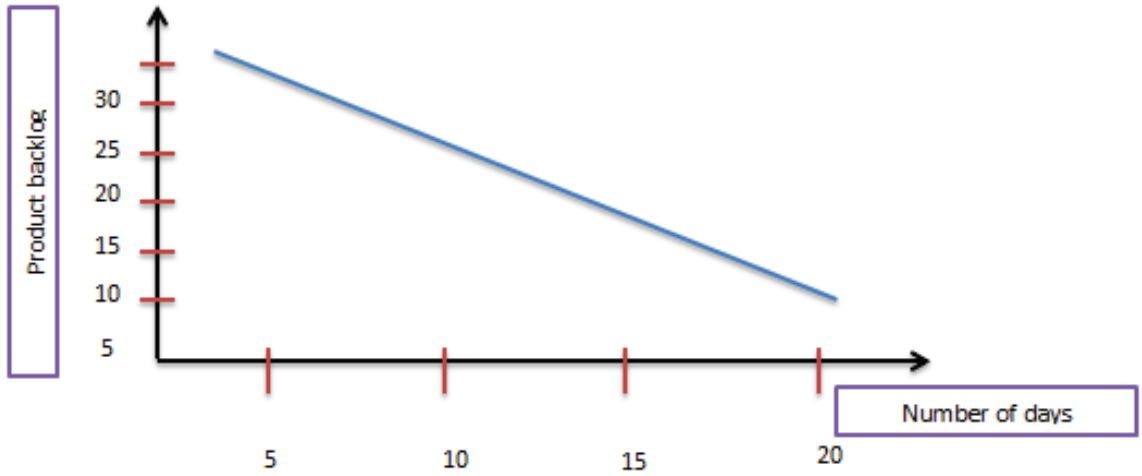

Figure 2 – Burn Down Chart

Scrum framework being based on iterations and continual communication with the users to complete any additional request arrived along the development process offers unlimited benefits and sustains the flexible advantage of the companies. Although the concept started from the software development it is today used in a large range of activities. Below it is a graphical presentation of the flow from the definition of the items included in the Product Backlog until the delivery stage where the product arrives in the client custody.

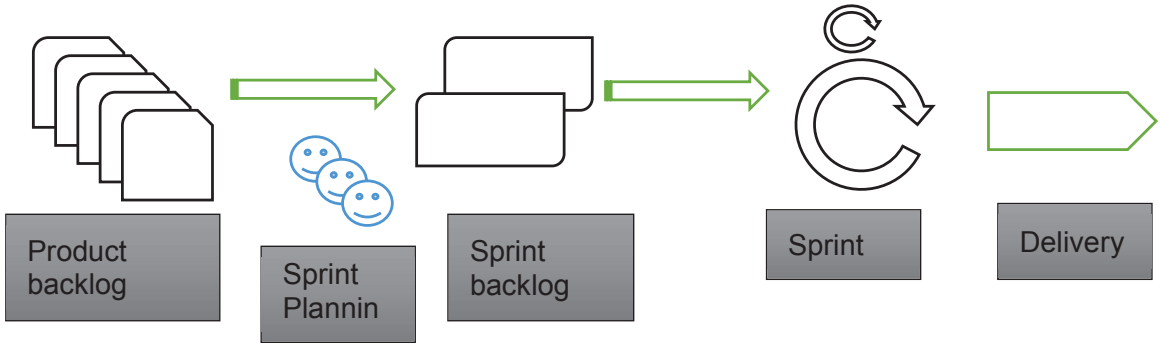

Figure 3 – Scrum process

3. Conclusions

Starting from 1950 companies started to be more conscious about their future being influenced to take action to de increasing demands received from the clients. Companies have traveled through several concepts from Just-in-time that concentrated on eliminating waste, Lean that sustains the creation of value added and finally to Agile and Scrum that develop principles on how to become more flexible. All the methods described brought a competitive advantage to the companies and become instruments used to respond to market evolution. It can be stated that all these methods have one thing in common and this is the opportunity to bring flexibility both in the production system and at management level.

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