

Agile In Automotive Manufacturing

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Abstract: The automotive industry is a very traditional industry. But over the past decade the automobile industry is buzzing with advancements from electric cars to vehicle to vehicle connectivity to self driving cars. Customers want a luxurious driving experience and no longer see the car just as mode of travel. And with this growth there is a need to change. As the number of cars on the roads increases, the automotive manufacturers must simplify and shorten the product development process. One model which is heavily used in the software industry is the agile model. This paper focuses on the challenges the automotive industry currently faces and reviews the applicability of agility with respect to automotive industry ie. Agile Project Management, Agile Product development and Agile Supply Chain design.

Keywords: Automotive, Agile Project Management, Agile Supply Chain, Agile Product Development, 3-D printers

I. Introduction

The idea of agile was originally coined by the manufacturing industry, but it was the software industry that actually adopted the agile practices and principles and took advantage of it. Since the release of the Agile Manifesto, software industries have successfully adopted the agile principles and practices[1]. The automotive industry is a very traditional industry. But over the past decade the automotive is growing and evolving. And with this growth there is a need to change. Today, automotive buyers want their vehicles to be equipped with all of the latest technologies. Customers are demanding state-of-the-art cars that ensure a safe, comfortable, and luxurious driving experience. Cars are becoming smarter, more connected and easier to use. Customers no longer accept standardised products, but want products that satisfy their individual requirements. Also automotive manufacturers are facing tough competition from its competitors to offer the latest technologies to its customers in minimum possible time. Automotive manufacturers and suppliers are confronted with increasing complexity as a result of increasing numbers of products and options, shorter technology cycles and increasing pressure to innovate. The challenge automotive manufacturers are facing currently is whether they have the expertise and tools to deal with these changes.

II. Challenges in Automotive Industry

The global automotive industry is growing and with the growth there is a need to change. The typical challenges faced by OEMs (Original equipment Manufacturers) today are :

1. Increasing complexity in a bid to offer the latest technology

In the past automotive manufacturers had lesser number of attributes and longer production cycles. But in recent times for automotive manufacturers to remain competitive they have to offer the customer a variety of product attributes keeping in mind the latest technologies like internet of things which adds to the complexity of the industry[2].

2. Shorten the production cycle

The production life cycle of any car is 3+ years. But the automotive industry is innovating every 2-3 years. At this rate any automotive manufacturer will not be able to survive in the market. Hence what is needed is to shorten the production life cycle of a car[3].

3. Increasing pressure to innovate

Currently there is a wave of innovation in the automotive industry. The car industry is in a race as to who can deliver the latest innovations. Innovations in terms of fuel efficiency, connected cars, in-car infotainment to self driving cars.

4. React quickly to fast changing consumer demands.

For the young generation today a car isn't just a way to travel from one location to another. For many it is a status symbol, a piece of luxury, fast service and they also expect their cars to be environment friendly. Nowadays, the customers' expectations and their satisfaction levels are manifold. Thus, automotive manufacturers should be able to quickly respond to the volatile market.

The question here is that, can the OEMs remain competitive in this turbulent and volatile market. The answer is they can but for that new production concepts and mindset have to be developed to manage the complexity in car production. As the number of cars on the roads increases, the automotive manufacturers can shorten the product development process by using concepts of the Agile model. One model which is heavily used in the software industry is the agile model which could help to overcome the challenges faced by the OEMs today.

III. Agile Model

Agile is a new way of thinking. Agile software development in the field of software engineering comprises of a set of management practices and values centered around the customer and uses iteration and incremental development. Here the user requirements and the solution to the problem domain evolve as a result of collaboration between self organizing and cross functional teams. Since the past 12 years software industry is taking the advantage of agile principles and concepts. The question here is whether agile can be applied to manufacturing industries. Technological innovation has brought major changes in the automotive market. As a result customers are becoming more demanding and there are frequent changes in the product design. Agile hence can be applied as a response to deal with volatility in the market[4].

Agile as a framework can be applied to a number of areas like project management, product development and supply chain. Fig 1 shows the different possible dimension of Agile.

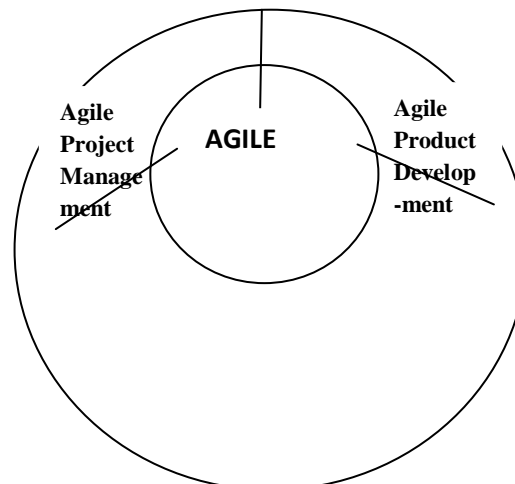


Fig 1: Dimensions of Agile w.r.t Automotive manufacturing

3.1 Agile Project Management

Project planning and control is very challenging for industries involved in new product development and technologies. Project management is a set of processes that helps organizations to improve the quality of projects by including process descriptions, roles, responsibilities, work breakdown structures[4]. Traditional project management is suitable for projects where the requirements are very well defined and the rate at which the requirements change is very low.

Agile project management in contrast has the following characteristics :

1. There is a high level of uncertainty with respect to the project goal and the customer requests are unpredictable or incomplete and may change during the duration of the project.
2. There is a close and frequent collaboration with the customer.
3. This approach lacks documentation.
4. Project plan is iterative
5. Focuses on self organizing and cross functional teams

The project's goal are defined in less detail at the start and a project implementation schedule is roughly prepared. The project is divided into iterations where each iteration lasts 1 to 4 weeks. The most important functions are undertaken at the start and the least important ones are considered in the end. The implementation plan for each iteration is made by the project team and not the project manager which includes the detailed specification i.e the tasks, hours of work etc. also taking into account the client's new wishes or the ideas of the developers. Daily stand up meetings are held where each developer updates the entire team about the progress of his/her work[5].

Despite the enormous popularity of agile project management in the field of software development, there is a reluctance in adopting this type of project management in non IT sector since frequent changes are too expensive and partial deliverables or prototypes might not be used.

3.2 Agile Product development

Agile Product development focuses on engineering activities associated with the project's product eg. an automotive product. One of the most important benefits of Agile is that the cost of change is very low hence creating an environment for adaptable products and projects. For agile product development(hardware) to be successful, the cost of change in fabrication needs to be reduced. This is where 3 D printing technologies boost the agile values. In the absence of 3 D technology, traditional machining or fabricating techniques are generally costly and have lead times that are too lengthy to apply to a short agile iteration. 3 D printers have mobilised the production stage of automotive industry from prototyping to development of tools to the manufacturing of parts. One of the benefits of 3 D printing is rapid prototyping. With the use of 3 D printers organizations can deliver a working prototype in a record time enhancing innovation and creativity.

Use of 3 D printers in automobile manufacturing can give the following benefits[7] :

1. **Rapid prototyping:**

3 D printers can be used in rapid prototyping in the pre manufacturing phase by the automotive industry. This helps to realize the product faster and improving the product using customer feedback.

2. **Low Turnaround Time :**

Use of 3 D printers reduces the time to prototype hence the turnaround time of manufacturing across all subsequent stages. This leads to added business value and lowers the costs.

3. **Low consumption and wastage:**

Use of 3 D printers in automotive manufacturing leads to low consumption and wastage as compared to the traditional approaches.

4. **Increased flexibility:**

3 D printers allows organizations to experiment with multiple options in the development stage. This helps the organization to be more agile to make changes on the fly and helps to them to stay in tune with the market requirements.

5. **Reducing inventory :**

Currently millions of components are kept in the warehouse waiting to be supplied to the customers. One of the biggest advantages of 3 D printing is to store parts digitally and built them on demand hence reducing the inventory.

3.3 Agile Supply Chain

Automotive Supply chain is quite different from the supply chain of other industries like pencils, cricket bat or aerated drinks. There are automotive manufacturers like Ford , Mahindra, Toyota etc. called as OEMs (Original equipment manufacturers) . Though they produces some original equipments, their real strength is in marketing the cars , ordering parts from the various suppliers and final assembly of the car. Most OEMs create 30-35% of the product in house and the rest of the product is produced outhouse[8][9]. Companies that produce parts and supply directly to the OEMs are called Tier 1 suppliers. Tiers 2 suppliers are organizations that supply components to Tier1 suppliers. Tier3 organizations produce raw materials that firms in the supply chain require to make products and components. The complexity of the automotive supply chain can be understood from the fact that a typical car contains about 20,000 components[10]. The automotive supply chain consists of a large number of Tier1, Tier 2, Tier3 suppliers and also a number of dealerships. In short the automotive supply chain is very complex. In addition nowadays buyers demand for certain features and specific configuration which needs a quick response from the automotive supply chain. Also as customer's buying patterns are changing rapidly hence there is a change in supply change management. The solution to the various supply chain challenges is Agile supply chain. Agile supply chain is not an alternative but a necessity for the success of any organization in today's volatile market. Agile supply chain is an approach to manage the supply chain network flexibly in order to keep up to the customer demands.

To be an agile supply chain , a supply chain should have the following characteristics[11] :

1. **Virtual Integration**

Virtual Integration means information about real market arising from customer demands is shared among all the members in the supply chain. Based on the requirements of the market , every member in the supply chain responds with it's capability to fulfil the demand. This virtual integration results in end to end visibility and helps to identify bottlenecks in the supply chain network.

2. **Market sensitivity**

Today the automotive supply chain is market driven. Forecasting demands of the market from past trends is an obsolete way to sense the demand in such a volatile market. Nowadays organizations are focussing on future , hence they need to use best techniques to forecast the demand based on daily Point Of Sale. This means that an agile supply chain should be demand driven and not forecast driven.

3. Process Alignment

Nowadays as more and more organizations outsource every function, it is important to have a trust based relationship between the suppliers and buyers. This transparency of information between the members of the supply chain network helps the organizations survive in turbulent markets.

4. Network Based

There has to be a structure, co-ordination and better relationship management between all parties in the supply chain. The whole supply chain should be viewed as a single entity to respond to the customer demand and reduce the total cost of the supply chain.

IV. Agile in Automotive R & D[6]

There is a growing scope of applying agile in automotive R & D. Today's automotive industry is facing a transformative change. Here mechanical centered industries need to compete with the digital industry, increasing customer demands, and intensive competition from its competitors. Currently automotive R & D is all about creativity, risk taking which includes a lot of undefined factors and unpredictability. The products designed by the R & D team have to be innovative, with a shorter time to market and more complex in nature. The existing processes used are highly structured and work only for predictable environments. In the wake of these conditions agile approach works for automotive R & D systems. Agile approach uses shorter iterations and emphasizes using a self organizing and cross functional teams and changes requested by the customer can be incorporated easily since agile approach has a scope to incorporate variations. Hence agile approach can be successfully adopted by embedded and mechanics development projects also.

V. Conclusion

The automotive industry is buzzing with growth. Customer expectations are changing and so is the technology. Hence the need of the hour is to change the development process to overcome the challenges which includes shorten the product development life cycle of an automobile and quickly respond to the volatile market. One model which is used heavily in the software industry to respond to unpredictable customer requirements is the agile model. An agile mindset is a new way of thinking. Agile as a framework can be applied to project management, product development and supply chain with respect to the automotive industry.

Agile Project Management focuses on requirements specification, project schedule (dividing the project into short iterations), team work and team collaboration (self organizing and cross functional teams) and client collaboration. Agile product development focuses on the engineering activities associated with building the product i.e the use of 3 D printers for producing prototypes, parts and tools. Agile supply chain focuses on making the supply chain network of an organization flexible and responsive in turbulent markets. Also it is researched that there is a scope of applying agile to automotive R & D since automotive R & D is all about creativity, risk taking and unpredictability.

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