Agile Manufacturing

A Complete Guide

TULIP

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OVERVIEW

Manufacturing is changing. Quickly. Call it Industry 4.0, the Fourth Industrial Revolution, or the new status quo, but the fact remains the same: manufacturing is experiencing an era of acceleration.

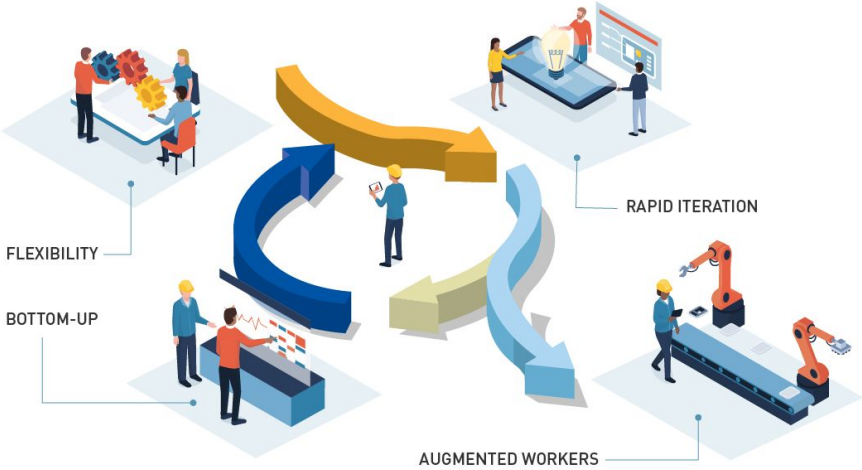
To keep up, manufacturers need to adopt an approach that welcomes change.

Increasingly, that approach has been Agile. Across industries and verticals, manufacturers apply Agile methods to access faster time to value and increase resilience in a time of disruption. Initially designed for software development, Agile allows manufacturers to harness a fast rate of change for competitive advantage.

By emphasizing rapid iteration, operator augmentation, operational flexibility, and bottom-up innovation, Agile Manufacturing enables a fast response to customer demands while empowering workers to innovate.

This guide will introduce you to Agile Manufacturing. We'll review history, dive deep into each of the principles, and give concrete tips on how to adopt this method of working on your shop floor.

FUNDAMENTAL VALUES OF AGILE MANUFACTURING



CHAPTER 1

What is Agile Manufacturing?

Agile Manufacturing is an approach to manufacturing that leverages flexibility, bottom-up innovation and augmentation in order to adapt, through an iterative process, to changing conditions.

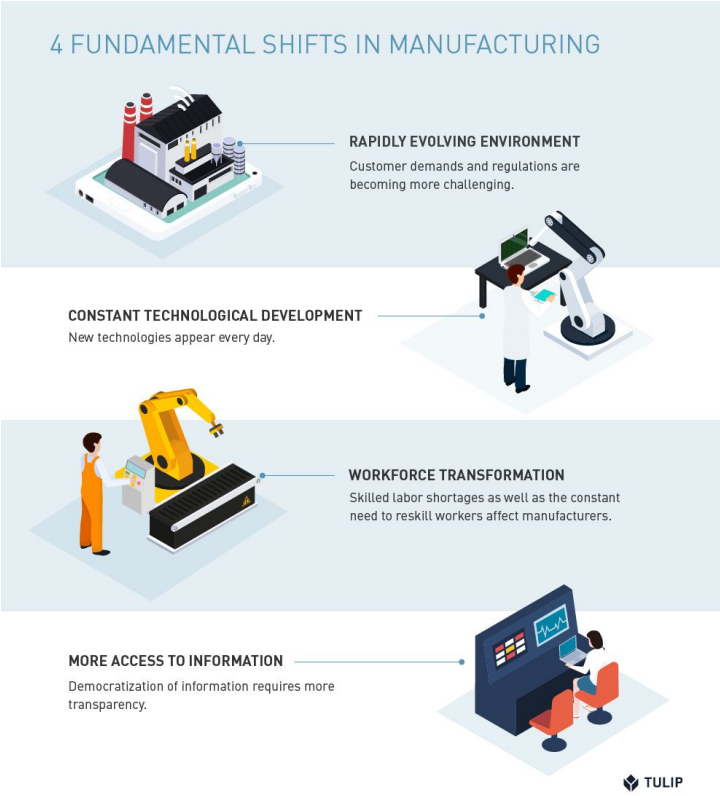
Four major shifts in the manufacturing landscape have made Agile methods necessary.

1. Rapidly evolving environment

Technology is driving significant changes in manufacturing. But technology is not the only moving part. Customers are also evolving quickly. They now have higher standards. They expect product customization, fast delivery, and cheaper production. Regulations are changing as well, increasing in number and severity. Add to this increasingly complex supply chains and questionable trade stability and you have an environment that demands flexibility.

2. Constant technological development

New technologies appear every day, and manufacturing is getting its bearings in the digital age. Moving forward,



manufacturers will feel the effects of new technologies in unexpected ways. According to a report published by McKinsey in 2018, manufacturing will experience more disruptions in the next five years than in the past twenty years combined.

3. More access to information

Connected factories product data on an unprecedented scale. Data will enable leaps forward like predictive maintenance and supply chain optimization. Companies will be able to act on real-time data at every level. Upper management will be able to evaluate plant-level performance in real-time. Production managers will diagnose quality issues before they reach downstream. And executives interested in contract manufacturer performance will gain new visibility.

4. Workforce transformation

Low unemployment rates and an enduring skills gap make it difficult for manufacturers to recruit skilled workers. Research by Deloitte shows that this skills gap may leave over two million manufacturing positions unfilled between 2018 and 2028.

By incorporating Agile, manufacturers can survive these shifts and remain competitive. But too often, “agile” is a buzzword, dissociated from its real meaning and principles. Let’s go back in time and recall the development of the now-famous approach.

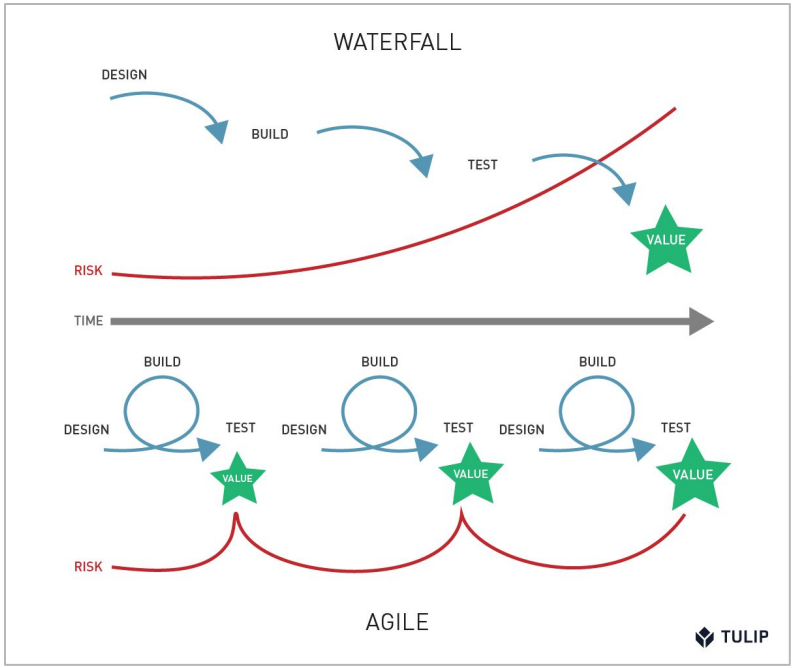
CHAPTER 2

History of Agile

The Agile movement was born in 2001, when seventeen software developers gathered in a ski lodge in Utah. They all had at least one thing in common: a deep dissatisfaction with the Waterfall model.

The Waterfall model is a development method that is linear and sequential. Practitioners must complete each step of production before they start the next. Though structured and easy to follow, the Waterfall model has many pitfalls.

Primarily, the Waterfall model discourages changing course until the end of the development cycle. Because it privileges forward progress, the waterfall model delays incorporating feedback, makes it challenging to adapt to changing requirements, and slows production as engineers go to great lengths to avoid mistakes.



In the Waterfall model, production steps are followed one after the other, with no back-and-forth, until the final product is obtained. In the Agile model, multiple cycles of production take place.

Nestled in the Rocky Mountains, the software developers started contemplating an alternative, flexible model. They put on paper what would become known as the Agile Manifesto. Outlining four values and twelve principles, the manifesto would revolutionize the software engineering industry, and business as a whole.

Some key takeaways from the Agile Manifesto laid the ground for the Agile Methodology.

- Organizations should highly value interactions between individuals.
- They should strive to have an ongoing conversation with customers.
- They should modify their product or service based on customer feedback.
- Teams should be self-organized.

The Agile Methodology was quickly adopted by development teams around the world for its capacity to reduce the time lag between business needs and technological developments.

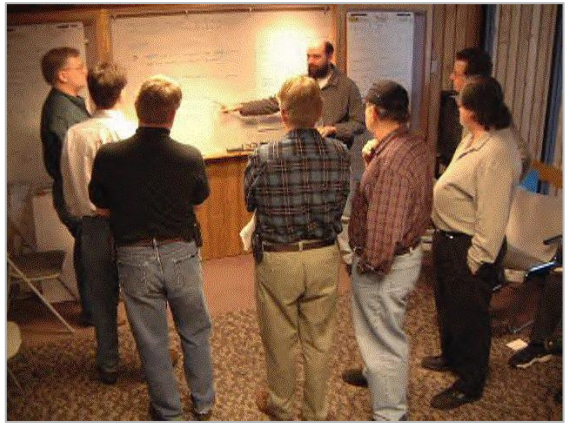


Photo of some of the software engineers, during their conference at Snowbird resort in Utah in February 2001.

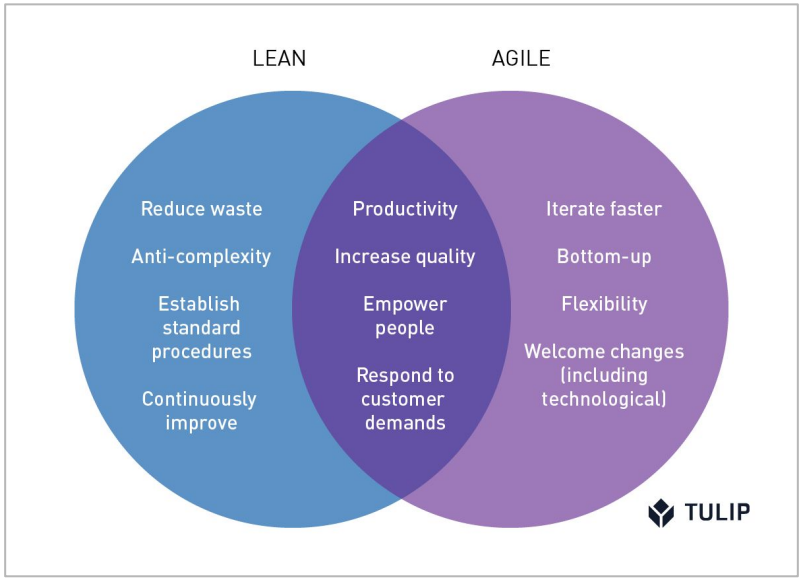
The Agile approach has proven its worth. It decreases costs and time to market. It also increases cross-functional collaboration, revenue growth, and customer satisfaction. Agile also mitigates risk because teams take multiple low-stakes decisions rather than a big, high-stakes one. Regularly delivering small pieces of value reduces the risk that the final product doesn't meet customer needs.

CHAPTER 3

Agile Manufacturing Principles

The Lean and Agile approaches are both wildly popular. However, they should not be confused. On the one hand, Lean Manufacturing is focused on increasing efficiency by reducing waste. On the other hand, Agile Manufacturing aims to increase efficiency via flexible, parallel problem solving.

While some of the ideas of Lean Manufacturing and Agile Manufacturing overlap, the fundamental principles are different.



Key Principles of Agile Manufacturing

1. Iterate Faster

The idea of delivering smaller pieces of value more frequently is central to Agile Manufacturing. Rather than attempting to design a single, perfect product in one go, the objective is to rapidly produce multiple versions. Each iteration, with its flaws and strengths, reveals new insights that make it possible to improve the process. As the process improves, each new version of the product surpasses the previous.

Why does this incremental, iterative method result in a superior result? Because process engineers deal with many variables. Iterations allow them to test different solutions, and gather data on individual variables. Without this data, it is difficult to determine which changes are necessary at a given stage to optimize production.

2. Flexibility

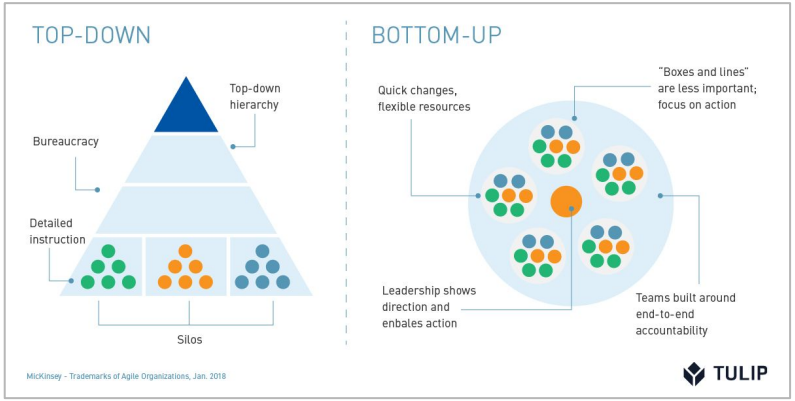
According to McKinsey, "Volatility is rising and taking its toll. Whether from increasing fluctuations in demand, labor rates and input prices, or from disruptive events like natural disasters and financial crises, volatility has damaged supply chains, increased costs and eroded profits. [...] Companies are increasingly recognizing that they must alter their manufacturing strategies in the face of rising volatility."

In order not to bend under external forces, manufacturing companies need to have flexible systems. Their internal structure needs to be dynamic enough to rebound quickly from external disruptions. Agile manufacturers are aware that environmental factors - economic, political, environmental, social, technological - require them to constantly stay on their toes. They make sure that every component of their system can grow organically and adapt to changes.

3. Bottom-Up

For decades, goals and directives have passed from the top of the organization, to the bottom. The top-down approach has its advantages, such as the quick implementation of decisions taken by upper levels of a company. However, this comes at a cost. Employees at the bottom can feel disconnected and disengaged. Low engagement can discourage accountability and innovation.

Agile manufacturers favor a bottom-up approach, in which ideas and directives flow seamlessly between all layers of the company. With this approach, directors and managers give operators and shop floor workers a voice. Agile Manufacturing supports the idea that those closest to manufacturing challenges understand them best. The more operators, engineers, managers, and business executives collaborate, the more effective operations will be as a whole. Collaboration across functions and seniority levels yields higher value products and processes.



Agile organizations abandon the hierarchical, top-down approach to adopt a flexible, bottom-up approach.

4. Augmentation

Augmentation is best understood in contrast to automation. Automation consists of automating workers' tasks - in other words, of replacing workers by machines. Augmentation, on the other hand, enhances workers' capabilities through technology.

For years, automation was considered the solution to high labor costs and human error in the factory. Yet automation is also expensive, difficult to maintain, and inflexible.

Agile manufacturing argues that humans will perform best if they have tools that enable them to evolve their work. From computer-vision assisted quality checks to error-proofing work instructions, Agile manufacturers use technology to help their people do more work, better.

CHAPTER 4

Features of Agile Organizations

In order to successfully implement Agile Manufacturing, manufacturers need to apply its principles and encourage some changes to their organization. These changes will vary depending on the organization's size and structure, but some underlying features are common to most successful Agile organizations.

1. Culture and purpose

Agile culture puts people at the center. Agile organizations are structured in a way that team members have ownership over their work. Leaders in an Agile organization do not rule over their employees, but rather provide them with tools to achieve results on their own.

These autonomous Agile teams are goal-oriented. After setting their goals and deciding how to achieve them, teams are held accountable for their progress. Even if different teams work on different goals, there is an organization-wide cohesion: all goals fit into a greater purpose. Agile organizations understand that purpose is essential to give meaning to the short-term goals that teams work hard to meet.

Purpose also increases productivity: when employees work with a sense of purpose, they are more engaged and motivated. Agile organizations share their purpose with everyone so that every employee knows why they're doing what they're doing. A purpose-driven mindset fuels people and boosts motivation and engagement.

2. Network of teams

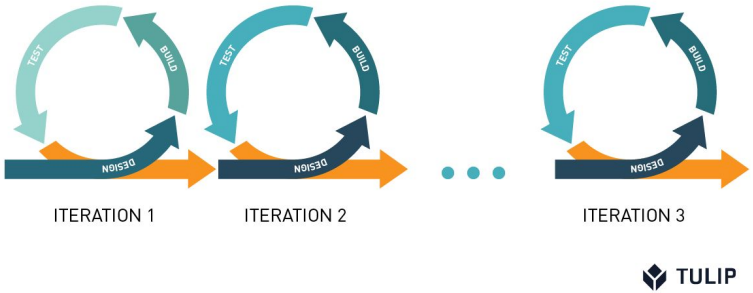
Teams hold great importance in Agile organizations. Accountability, transparency and collaboration are crucial within teams. Team members have clear roles, but they do not necessarily have a single role and roles can be shared among multiple people. The work environment should be open and safe. Finally, teams should be in touch with each other, so that members can source knowledge and insights from other teams.

3. Rapid cycles

The “Iterate Faster” principle of Agile Manufacturing encourages teams to quickly go through multiple versions of a process or product. The ability to implement this principle is a core feature of successful Agile organizations.

In order to iterate faster, Agile teams work on concrete goals over short, predetermined periods of time. Both the goals and the timeframe are critical to agility.

AGILE PROCESS



An Agile process consists of multiple, quick cycles of iteration.

Goals should be realistic and measurable. Team members are held accountable for them. The timeframe should be fairly short - on the order of weeks - to keep teams iterating quickly.

4. Technology

Technology is essential to all of the cornerstones of Agile Manufacturing. Without the right technologies, it is impossible for companies to deliver value at a fast enough pace to keep up with customer demands and market fluctuations.

Examples of enabling technologies include real-time communication and work management tools, to improve flow and organization; hackathons, to swiftly push out new solutions and products; and interactive digital work instructions, to easily keep employees’ skill sets up to date.

But Agile isn’t about adopting solve-it-all technologies. Rather, it is about finding the right technologies to improve their unique processes, workers, and products.

CHAPTER 5

Applications of Agile Manufacturing

Manufacturers can bring agility to their organizations by adopting the right technologies.

To **iterate faster**, Agile manufacturers turn to technologies that help them collect data. To become **flexible**, tools and software that enable quick turnovers are essential. To follow a **bottom-up** approach, Agile manufacturers award their workers more trust and power. To **augment** their workers, they equip them with the proper tools and training.

Let's look at some examples of enabling technologies in action.

Using Real-Time Data to Guide Iteration

Contract manufacturer Jabil supports a wide variety of customers and is subject to fast-changing requirements. Moreover, Jabil's customers need to receive their products as fast as possible. This means Jabil also had to increase its speed.

Thus, non-value-add steps had to be identified and eliminated quickly. The only way to achieve this is to run processes again and again, and collect data on each iteration. Jabil started using IoT connected tools and sensors to collect real-time data on every iteration. This data, collected through the use of a manufacturing app platform, allowed process engineers to incorporate feedback after each process completion. This cycle of iterative improvements stripped processes of non-value-add steps. With such visibility into their processes, process engineers were able to take control over their operations, following a bottom-up approach. The result: cycle times were reduced, and production yield and throughput were significantly increased.

Using 3D Printing to Prototype Faster

3D printers have the potential to greatly accelerate designing and prototyping. Iterative cycles become shorter as new versions of products are tested in a fraction of the time. Indeed, new prototypes no longer need to be designed and manufactured in a process that can take months. Rather, they are simply printed and tried immediately. Products are thus tested early and often, and improvements are made with each version. The result: optimal end products that satisfy customer demands.

3D printing also makes mass customization realistic for manufacturers. For example, 3D printing is transforming the jewelry industry by allowing the rapid production of highly detailed, custom parts. 3D printing allows manufacturers to be much more flexible to changing customer demands.

Using Computer Vision to Augment Operators

Computer vision systems can assist operators through a production process. These systems track the operator's movements and inspect the product as it is being made. Based on ongoing context analysis of the manufacturing environment, the computer provides assistance and performs the relevant quality checks.

With computer vision, manufacturers can deliver a much greater array of products without sacrificing productivity or quality. When used to assist operators in line, computer vision systems can help fatigued workers detect defects, and provide error proofing in complex assemblies where workers or prone to miss or mis-execute steps. With computer vision assisting with cognitively taxing tasks, operators have more attention and focus for problem-solving and innovation.

Using Manufacturing Apps to Amplify Training Programs

At Merck, a multinational pharmaceutical and life sciences company, the complex lab equipment requires highly skilled operators. Training used to be excruciating and expensive. The firm's paper-based training instructions were difficult to follow, and training programs required taking experienced operators to supervise new hires through each step of the training process.

Interactive training apps with step-by-step work instructions were a game changer. The photos, videos and live stream sensor data transformed the training experience, making it more interactive and constructive. For Merck, the outcome was remarkable: training costs were reduced by 57%, and training times by 92%.

The new training program augmented workers' capabilities: rather than using technology to automate workers' tasks, Merck leveraged it to simplify re-skilling and close the skills gap.

Using Digital Work Instructions to Error-Proof High-Mix Assemblies

Dentsply is the world's largest provider of dental solutions. Their implants division receives thousands of custom orders every day, and each requires a very specific kitting combination.

A senior process engineer at Dentsply created an app to simplify the kitting process. The app was connected to IoT devices like pick-to-lights and break beams that would guide workers to the bin with the right part from for each kit.

Process engineers were able to improve the process by building the apps themselves. They no longer needed to go through IT or get the change reapproved as part of their Quality Management System. Moreover, production became as flexible as Dentsply's customized products required it to be.

CONCLUSIONS

The Agile Methodology has been in the spotlight for almost two decades. 41% of the organizations surveyed by McKinsey say their companies have fully implemented or are in the progress of implementing a company-wide Agile transformation. However, it is only in recent years that technologies enabling agility in the manufacturing sector have emerged. Now, there is promising potential for manufacturing companies to join the digital revolution and leave the past behind.

Tulip's flexible and intuitive manufacturing app platform is designed to help manufacturers become more Agile. Using Tulip, engineers can create applications without writing a single line of code, gain real-time visibility of their production, and digitally transform their shop floor.

Learn more and try Tulip risk-free for 30 days at tulip.co.

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