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Productivity in Manufacturing

1. Overview of Productivity in Manufacturing

Manufacturing is a continually evolving sector of the global economy. It is also a major economic driver. Globally manufacturing is set to benefit from an expected doubling of worldwide consumption by 2030. Increasing affluence in developing economies and the continued strong consumption in established economies will contribute to an expected $64 trillion growth in total consumption over the next 15 years. Figure 1 shows the relative growth of manufacturing.

2. What are the challenges to productivity in manufacturing?

Such growth will provide massive opportunity for manufacturing companies and impetus for innovation and continuous improvements to increase productivity. These innovations can be in manufacturing methods, materials used in manufacturing, and developments in process and production. For example, it is possible today to prototype a product completely through Computer Aided Design, and when physical prototypes are required, 3D printing is a technology that can make the process fast and cost effective.

The cost of automation have also declined, opening up the possibility of robotic production lines in industries and businesses which may not have been able to afford such technology in the past.

While these enablers are promising, they may also represent challenges for some manufacturers. The need to overcome traditional challenges such as competition, labour, and shifting consumer needs and expectations will remain for all manufacturers. In addition, there are modern challenges like the impact technology-based business model might have on traditional operations. The key to survival, then, is adapting to innovations for productivity.

There are businesses in Asia and across the world that are already innovating to raise productivity in response to growing consumption. These companies are leaders in their own right, and it is not too late for companies that have yet to react to take action now. We believe that through improved productivity, manufacturers could take advantage of the anticipated worldwide consumption growth of 1.8 billion consumers over the next 15 years.

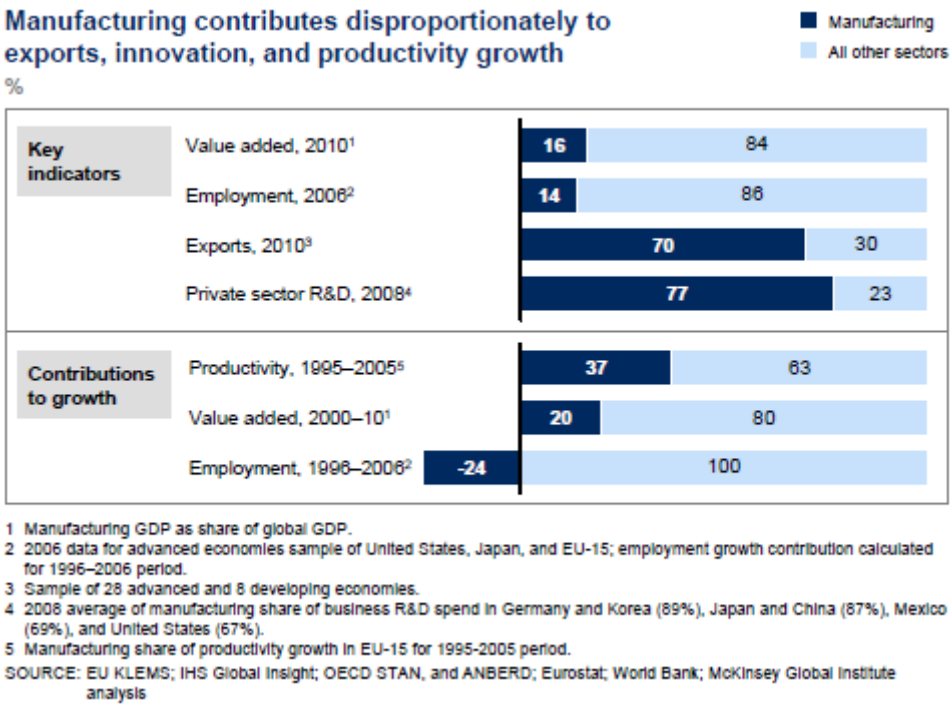


Figure 1: Growth of Manufacturing Globally
Source: http://www.mckinsey.com/insights/manufacturing/the_future_of_manufacturing

3. What are the Barriers/Challenges to Increasing Productivity?

The basic challenges that businesses face in the manufacturing sector includes demand, supply, policy, regulation, and technology. These obstacles are closely linked to risks and uncertainty. Figure 2 shows the factors affecting the future of manufacturing.

3.1 Risks and Uncertainty in Demand

The most evident change in demand will be the shift of demand to emerging markets. Markets like the People's Republic of China, Russia, the Philippines, India, Indonesia, and older markets like South Africa are still considered emerging economies by organisations like the International Monetary Fund, Dow Jones, and S&P. Emerging markets affect supply chains and manufacturing of products. As products change to cater to emerging markets, production methods and locations may need to be reconsidered

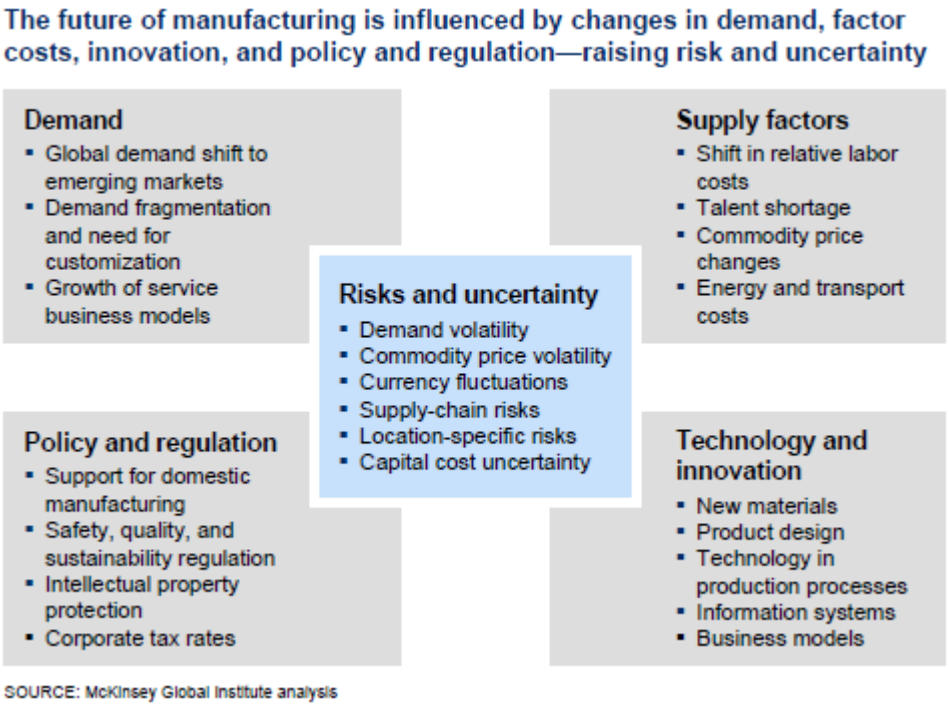


Figure 2: Figure 2: Factors affecting the future of Manufacturing
Source: http://www.mckinsey.com/insights/manufacturing/the_future_of_manufacturing

3.2. Logistics of Supply

For entry into emerging markets, manufacturers may find that relocation, sub-contracting, and outsourcing could be viable solutions. Without adapting to cater to emerging markets, manufacturers are at risk of encountering unfavourable labour costs in relation to their market and products, as well as increased energy and shipping expenses.

3.3 Regulation affecting Manufacturing Productivity

Policy and regulation such as tax rates, local labour laws, IP (intellectual property) protection when outsourcing, and maintaining consistent quality with sub-contractors are aspects that need to be carefully managed.

3.4 The Challenge of Technology

Though technology is an enabler of innovation, it may also pose as a challenge for some existing business models. The challenge could be the understanding and incorporation of new materials and designs, and the use of technology for production. New business models and information systems could affect back of house and administrative tasks as well.

4. What Enablers could boost Productivity in Manufacturing?

According to Fard Johnmar and Rohit Bhargava in their new book, "ePatient 2015: 15 Surprising Trends Changing Healthcare", digital technology is poised to tackle healthcare's biggest challenges, such as

Businesses who are able to quickly adapt and react to growing consumer demand and new production processes can leverage key enablers and opportunities listed below. Exploiting these enablers can result in potential growth through new markets and growing markets, while increasing efficiency through the use of new technologies and processes.

4.1 Operational Change

Operational change, especially in the thought process of manufacturers can have a dramatic effect on productivity. McKinsey & Company, a leading market insight publisher, promotes a productivity enhancing approach that is based on five core beliefs. These are:

a. Thinking Lean

The lean process refers to the streamlining of a manufacturing process to the point where every active process adds value to production. This approach to boosting productivity is key to creating the most efficient manufacturing processes.

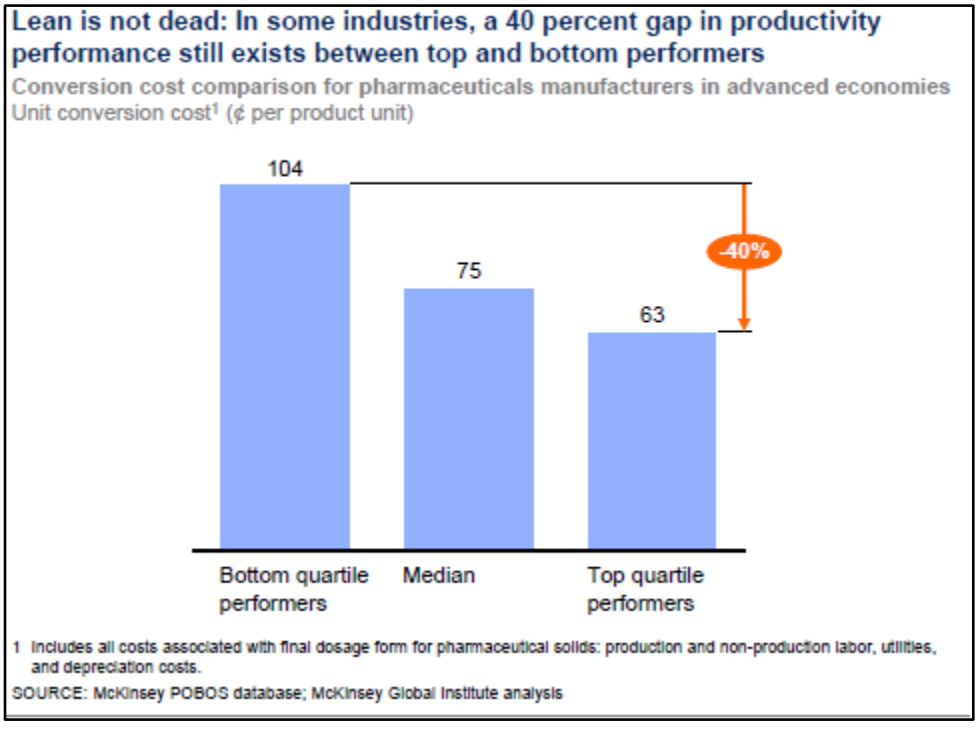


Figure 3: Opportunity for Benefiting from Lean
Source: http://www.mckinsey.com/insights/manufacturing/the_future_of_manufacturing

b. Thinking Limits

In traditional continuous improvements, especially when considering thought patterns like Six Sigma, the current process is considered the benchmark in production, and is improved incrementally. Changing the limits of thinking can have a profound effect on productivity and efficiency, and can promote innovative h processes. When businesses thinking limits set the maximum theoretical ceiling of productivity as the benchmark, which may be impossible to achieve in the real world, such a benchmark gives managers, consultants, and improvement specialists a higher ceiling to work towards, which can lead to larger leaps in productivity.

c. Thinking Profit-per-Hour

Profit-per-hour can be useful when differing initiatives cause conflict. Increasing production line efficiency may cause reduced energy efficiency within a manufacturing plant. This would mean that eventually two separate areas of a business would be in conflict as they both try to reach their goals. Thinking profits can give clear direction when it comes to prioritising projects, because it sets a goal that is quantifiable and beneficial for any department within a manufacturing company.

d. Thinking Holistically

Boosting productivity requires widespread buy-in to new projects and initiatives. This means that managers must ensure a unified workforce from the highest level of management, right down to production workers and distribution chains. This includes processes of managing human resource, as well as technical systems and machinery operations.

e. Thinking Circular

Focusing on sustainability, circular thinking means that businesses need to look at their supply chains as revolving concepts, rather than as linear and disposable channels. Value can be added by recycling products, ideas, materials and components back into the production process. An end of product life cycle does not mean that a particular supply chain has ended. Business can find innovative ways to reuse ideas, manufacturing components, equipment, and even the raw manufacturing materials.

4.2 Industry 4.0 – The Rise of Smart Manufacturing and IoT in the Cloud

Concepts of operational change can be complemented with Smart Manufacturing. It could be said that we are currently on the verge of the fourth Industrial Revolution. Analysts predict this newest phase will be strongly characterised by Smart Manufacturing.

Smart Manufacturing will enable production increases by incorporating advanced computerised information systems that will not only control production, but will also be able to analyse and exchange data between systems to manage complex production processes, even when there are significant variables.

The Internet of Things (IoT) will be significant in enabling productivity increases. An integral part of Smart Manufacturing, IoT seamlessly integrates physical machinery with on-site internet protocol networks and cloud based infrastructure. With sensors, data can be instantly shared and analysed from an advanced computer system. This can significantly reduce the manpower required in production, which can cut costs while increasing productivity.

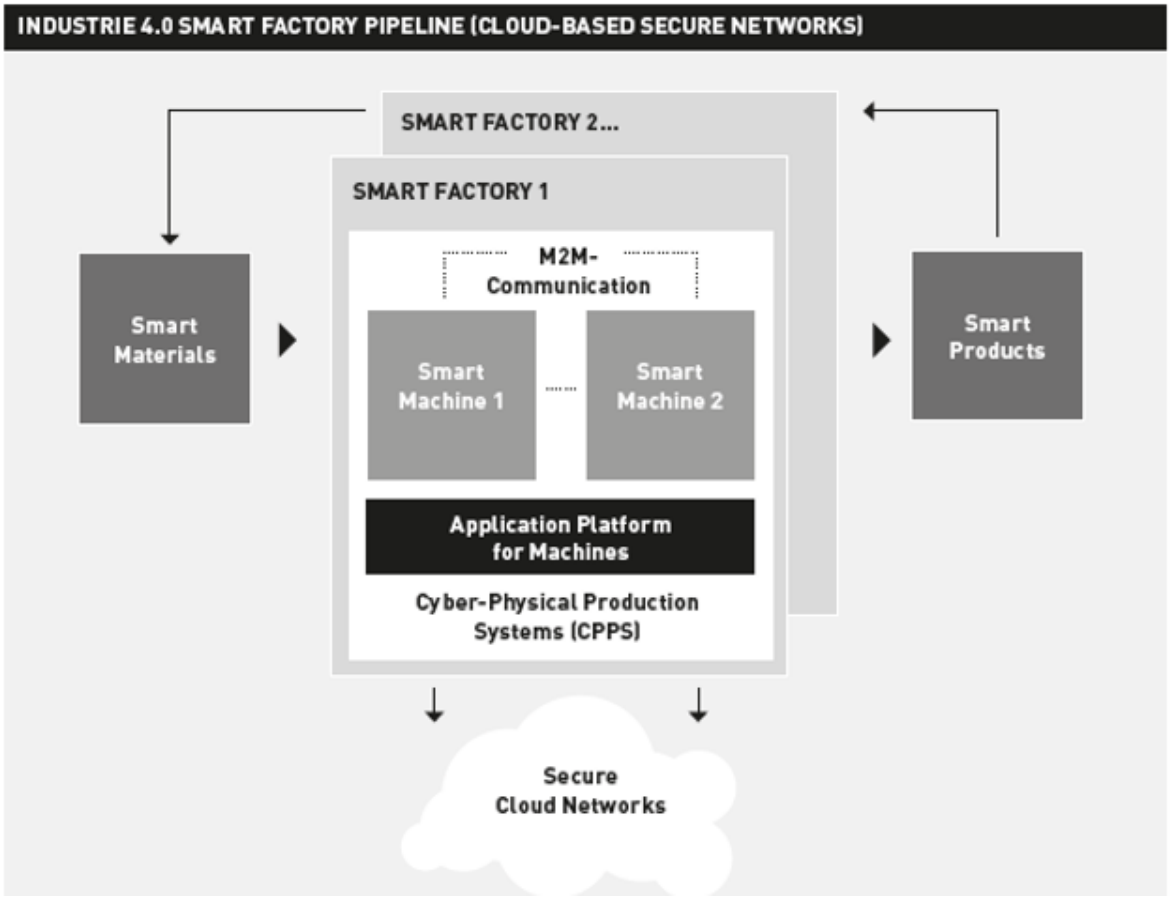


Figure 4: Smart Factory
Source:
http://www.gtai.de/GTAI/Content/EN/Invest/_SharedDocs/Downloads/GTAI/Brochures/Industries/industrie4.0-smart-manufacturing-for-the-future-en.pdf

Although Smart Manufacturing and IoT technologies are relatively new, and in some cases expensive, they are expected to become widely adopted and more affordable in the near future. In the short term, value may offset the initial investment. Value is evident in the expanded list of benefits that these two technology groups can bring to manufacturers as listed below:

- Streamline interaction with external parties, including suppliers and distributors. Collecting data on the fly allows for almost immediate analysis and action, which can automate materials ordering, dispatching, and almost any aspect of the production process.

- Cloud based technologies allow for faster analysis of data to analyse trends, faults, and areas for improvement etc.

- Integration of adaptive cloud technologies could allow for automated customer ordering. Customer orders could be created through a web portal, or even semi-automated systems. In each situation, the start-up of production lines will be controlled with IoT technologies linked to manufacturing equipment.

- A cloud based approach can save overhead by centralising IT support. IT issues can be resolved within the cloud, reducing the need for on-site staff, or site visits. This can mean that incidents are quickly resolved, reducing downtime and increasing productivity.

4.3 Further Automation through Robotics

The concept of Smart Manufacturing is not limited to infrastructure and Information Communication Technology implementations, but can also include increased automation through robotic machinery. In this sense, an updated operation could be considered a Smart Factory.

Even though automotive and electronic manufacturing plants are heavily automated using advanced machinery and robotics, there are further opportunities to implement robotic solutions. BMW is one company that has demonstrated how robotics can increase productivity. In the last two years they have automated the installation of electronic protective foil inside their vehicle doors at their Spartanburg plant. The lightweight robots used can work safely alongside humans. The addition of these robots increased productivity, and decreased the risk of repetitive strain injuries for the BMW plant workers.

Robotics in other industries can be used to automate parts of production including packing and palletisation. Delivery of manufacturing equipment on the floor can be carried out by robots, a concept that has been demonstrated by Amazon.com with 10,000 delivery robots that carry goods across their warehouse floor on a constant shift rotation. Manufacturers can use similar robots to carry tools and equipment around factories. BMW is leading the way in this aspect and is currently working on implementation throughout their manufacturing plants.

Robotic devices for mobility help patients return home more quickly while reducing the costs of long-term care. Robot-assisted recovery and rehabilitation for patients affected by amputations or brain and spinal cord injuries are an example of leveraging enablers through robotic and human collaboration.

5. What Immediate Actions can Manufacturers Take?

Like any major change initiative, it will take a significant amount of time to create buy-in, modify concepts to a particular business, and implement them. The size and complexity of a manufacturing operation will also affect how easy it is to implement changes.
One way that businesses in Singapore can take immediate action is through the assistance of Technology and Adoption Programs provided by the Agency for Science, Technology, and Research (AStar).

Growing Enterprise through Technology Upgrade (GET-Up), is an initiative designed to help SMEs to improve their competiveness through new technologies. This kind of assistance could help manufacturers incorporate technologies and concepts unfamiliar to their businesses. The program includes implementing technology to facilitate upgradability, road mapping of operational and technological functions, and the introduction of technical advisors to assist with progress and transition.

The Technology Adoption Program, also run by AStar, further fosters change and advancements in technology by networking SMEs with experts from a number of important technological sectors. These innovators come from research institutes and universities in the public sector, and successful consultancies and businesses in the private sector. The focus of this program is to introduce manufacturers with technology implementers and developers, and can help to drive innovation and productivity in their operations.

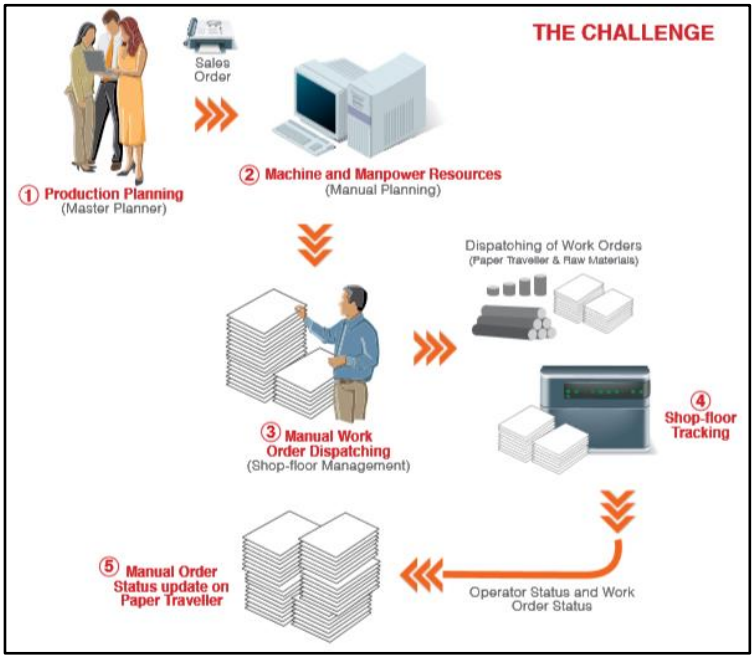
Case Study 1: Singapore Study – Riso Seiki (S) Pte Ltd

Riso Seiki is a local manufacturer with a business model characterised by short production runs on fast turnover schedules. Manufacturing a diverse portfolio of products, Riso Seiki is the perfect example of a manufacturer with a complex operational structure.

Managing Director, Mr Lim Sim Tiong, wanted to find a better solution for the company's labour intensive process. This process covered all aspects of planning, production, tracking, and dispatching. Mr Lim was able to increase productivity and operational efficiency after incorporating an integrated online system that computerised much of the production process. The new system allowed sales orders to be loaded through work orders to a computer based tracking system. Shop floor management could then create barcode work orders to be sent to the shop floor. Barcode tracking means less manual input, and easy visibility of the production process through the computer based planning system.

The results of the integrated planning and shop floor tracking system included a reduction in lead times, better machine utilisation, a drastic cut in planning time (90%), better staff performance and competency, and a growth in business due to the increased production efficiency and improved process management.

The Challenge (Before)



The Solution (AFTER)

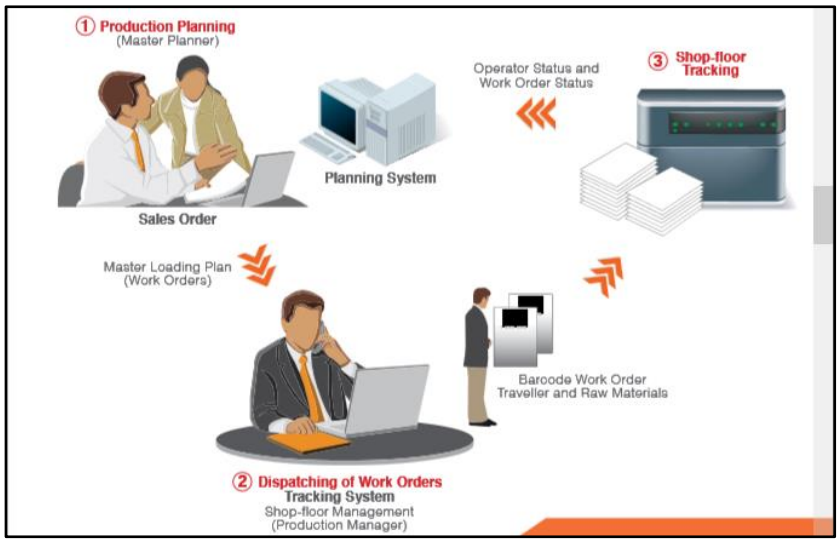


Figure 5: Riso Seiki: Online, real-time production planning and shop-floor tracking
Source: http://www.simtech.a-star.edu.sg/MPTC/media/2582/mptc-case-studies-using-technology-to-increase-productivity.pdf

Case Study 2: International Case Study, Pratt & Whitney USA

Pratt & Whitney is an internationally renowned aerospace engineering firm that has been on the cutting edge of technological innovation. Since 1925 the company has developed aircraft engines and gas turbines.

Though 3D printing is not practical for every manufacturer, Pratt & Whitney through the adoption of 3D printing has increased efficiency, overall production, and also reduced waste in the manufacturing process. 3D printing is an additive process. This means that products are manufactured in stages, using only the materials required for each stage. Through this process there is no additional cutting or finishing required, and essentially no material waste produced.
Pratt & Whitney has taken additive 3D printing to the extreme by producing the first aircraft engine assembled using components produced by additive printing. The company's PW1500G engine uses 24 unique parts produced by an industrial 3D printer.

The benefits to Pratt & Whitney are numerous:

• The new engine incorporating 3D printed technology has improved fuel consumption, and is 75% quieter than their previous models using conventionally manufactured parts.
• Design and prototyping times were reduced due to the ability to use CAD design and produce a component almost immediately.
• Pratt & Whitney reported that additive 3D printed parts used 50% less raw materials than traditional components, which improved efficiency and reduced costs.
• Less waste is achieved due to a more favourable raw material to final product weight ratio. Using certain materials, that ratio can be as low as 2:1.

6. Conclusion

Industry case studies like the additive printing manufacturing at Pratt & Whitney and the operational improvement achieved by Riso Seiki both hold important lessons. They both demonstrate that the methods used to increase productivity in manufacturing can vary depending on the needs and nature of a business.

What is clear, is that manufacturers should be ready to make changes and adopt new thoughts and technologies. Those who actively raise productivity and increase efficiency will be in the best position to meet the needs of growing markets in South East Asia, and around the world.

Recommended Readings

Title: The 12 Principles of Manufacturing Excellence: A Leader's Guide to Achieving and Sustaining Excellence
Author(s): Larry E. Fast
Publisher: Productivity Press
Year of Publication: 2011
ISBN: 978-1439876046

Title: Implementation of Robot Systems: An introduction to robotics, automation, and successful systems integration in manufacturing
Author(s): Mike Wilson
Publisher: Butterworth-Heinemann
Year of Publication: 2014
ISBN: 978-0124047334

Title: The new industrial revolution: consumers, globalization and the end of mass production
Author(s): Peter Marsh
Publisher: New Haven: Yale University Press
Year of Publication: 2012
ISBN: 9780300197235
Call Number: 338MAR-[BIZ]

Remarks Please check availability via http://search.nlb.gov.sg/

Publications which are in the holdings of the National Library or Public Libraries are denoted by [call number] at the end of each reference. Please check the library's online catalogue to confirm the availability.

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