CHAPTER 9: MANUFACTURING

9.1. Sector overview

Manufacturing plays an important role to economic growth in the APEC region, particularly due to its important role in trade. Manufactured goods represent the largest share of APEC's intra-regional and inter-regional trade. Since 1996, intra-APEC trade in manufactured products has increased by about 6 percent per annum and represented about USD4.5 trillion in 2017.[133] Despite its position as one of the main drivers of economic growth in some economies, however, the manufacturing sector can hardly be perceived as stable. Firms have seen the need to continually reinvent themselves as they seek to maintain their competitive advantage and ensure the viability of their businesses. For example, the increase in labour cost in some economies, coupled with improvements in telecommunications and logistics services among others, have led to the internationalization of production such that a significant share of world trade takes place within the framework of global value chains (GVCs). Nowadays, a product is likely to be made up of parts and components sourced from across the world.

Increasingly, firms also have to adapt to producing more high mix, low volume parts, components and products, as opposed to those that are low mix and high volume. This is particularly so for some industries such as consumer electronics where the upgrade cycle is relatively shorter (i.e. about once or twice a year). For firms who face challenges in responding fast to the changing demand, they have preferred to focus on B2B instead of B2C businesses since the lead time is relatively longer.

The competition from different players have also meant that manufacturing firms often have to utilize and/or offer the whole spectrum of services from R&D and engineering to leasing and after-sales such as maintenance, repair and overhaul (MRO) services in order to stand out from the rest. Indeed, the boundaries have blurred that some manufacturing firms have been asked if they can still be categorized as such firms considering the range of services that they provide and the corresponding revenue that can be attributed to them. One way of looking at the critical role of services in manufacturing is through the OECD Trade in Value Added (TiVA) database. Based on the latest year where data is available (2011), it can be observed that services made up between 20.7 and 58.6 percent of the value-added share of gross exports of manufacturing in APEC economies covered by the database[134]. Advancements in and introduction of technologies such as cloud computing, Internet of Things (IoT) and artificial intelligence (AI) are likely to further increase the share of services value-added in manufacturing.

Different types of data are believed to contribute significantly to the daily operations of these manufacturing firms, including ensuring that services are utilized and offered optimally. These can range from ensuring the smooth functioning of the global value chains (GVCs) operations to increasing the demand for products among others. Specifically on the former, examples include making sure that parts and components are delivered on time and that downtime on factory floors are minimized, while on the latter, examples include employing data for targeted advertising and utilizing usage statistics for product improvements.

[133] Data for Papua New Guinea are not available and the latest data for Viet Nam and Thailand are from 2016. Data can be accessed from StatsAPEC Bilateral Linkages Database http://statistics.apec.org/index.php/bilateral_linkage/index.

[134] The total value-added share of services in gross exports is obtained by adding the domestic and foreign value-added of services in gross exports. Data for all APEC economies are available except for Papua New Guinea.

For instance, coordinating the activities of its suppliers without relevant information being exchanged between them would have been close to impossible for Apple[135]. The same can be said for Volkswagen, where its 55 strategic suppliers are based in different economies including Japan, Korea, Mexico and the United States[136]. In fact, there is very close collaboration between Volkswagen and its suppliers to synchronize and refine their strategic goals. In some cases, Volkswagen involved their suppliers early in the innovation process. To allow its supply chain to respond more flexibly to increasingly complex markets, one Japanese firm shared that it employs the supply chain management system developed by a data solutions company. Essentially, the system allows demand information, actual results, constraints and other data inputs to design a single production, marketing and inventory plan globally. Bain and Company shared that one firm streamed data from stores the moment shoppers purchased the products so that they can quickly restock popular items and minimize lost sales. Some leading firms such as Fast Radius[137] and Adidas[138] are already deploying 3D printing in locations that would enable them to reach customers within shorter lead time.

Manufacturers are indeed starting to realize the value of data, specifically big data[139] on their businesses. In a reference to a joint survey conducted by SCM World and MESA International, Forbes (2015) noted that 47 percent of manufacturers expect big data analytics to have a major impact on their performance. 49 percent also expect advanced analytics to reduce operational costs and utilize assets efficiently[140]. Additionally, the same survey noted that 49 percent of manufacturers are either piloting or planning to invest in big data analytics. On the most likely use cases of big data analytics in the factory, those identified by respondents include real-time factory performance analysis, real-time re-planning (material requirements planning and factory scheduling), real-time supply chain performance analysis, as well as production quality and yield management.

In terms of impacts, a publication by McKinsey Global Institute (2017) focusing on Artificial intelligence (AI), which is heavily reliant on data as inputs for decision-making, showed that using AI to improve R&D process has led to 10 percent yield improvement for integrated-circuit products[141]. Employment of AI to determine timing of goods transfer and to predict sources of servicing revenuers have also led to 30 percent increase in terms of timeliness of material delivery and 13 percent improvement in earnings before interest and tax, respectively.

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[135] https://www.apple.com/supplier-responsibility/pdf/Apple-Supplier-List.pdf.
[136] https://www.autocarpro.in/news-international/vw-picks-55-strategic-supplier-partners-fast-initiative-20039
[137] https://www.ibm.com/blogs/think/2019/02/how-future-factories-will-change-manufacturing-and-supply-chains/
[138] https://www.bain.com/insights/build-a-digital-supply-chain-that-is-fit-for-the-future/
[139] There is currently no agreed definition of big data. However, one general understanding is that it is a collection of large datasets obtained through a wide range of online and offline sources. The data collected may be unstructured, structured and/or both and organizations are able to analyse them to predict patterns and trends among others depending on their ability.
[140] Columbus, L. 2015. Big Data Analytics, Mobile Technologies and Robotics Defining the Future of Digital Factories. Forbes. https://www.forbes.com/sites/louiscolumbus/2015/02/15/big-data-analytics-mobile-technologies-and-robotics-defining-the-future-of-digital-factories/#d458e367e9d8
[141] McKinsey Global Institute. 2017. Artificial Intelligence: The Next Digital Frontier? https://www.mckinsey.com/~/media/McKinsey/Industries/Advanced%20Electronics/Our%20Insights/How%20artificial%20intelligence%20can%20deliver%20real%20value%20to%20companies/MGI-Artificial-Intelligence-Discussion-paper.ashx

This chapter seeks to better understand how data are used in various aspects or process of the manufacturing sector. It has been structured as follows. Section 2 provides the profile of firms interviewed, section 3 provides the role of data in firms' business models, while section 4 discusses on how policies and regulations are impacting their business model.

9.2. **Profile of firms interviewed**

Firm A is a multinational manufacturing company based in Japan. For fiscal year 2017, its consolidated revenue reached USD10 billion. It has over 20 manufacturing and R&D subsidiaries and over 80 sales and services subsidiaries with 80,000 employees in six continents. Firm A provides a wide range of products from home and commercial printers, projectors, smart glasses and watches, to industrial robots and semiconductors.

Firm B is a Fortune 500, Japan-based company with over 250,000 employees and 600 subsidiary companies globally. Its net sales in fiscal year 2018 (which ends in March 2018) reached USD70 billion. Firm B produces a wide variety of products across multiple manufacturing industries, including consumer electronics such as televisions, home communication and entertainment products, kitchen appliances, air conditioners, beauty and living product; energy and electronic devices such as automotive batteries and semiconductors; avionics such as inflight connectivity and entertainment systems; mobile and camera products such as laptops, projects, displays and cameras and etc.

Firm C is a Japanese manufacturer producing products across a wide range of industries for public sectors, businesses, as well as general consumers. Examples of the products include firefighting command and emergency radio systems, traffic control systems, satellite communications, mobile phone base stations, biometric solutions such as facial recognition products, as well as computers, projectors and cameras. Its annual net sales averages USD20 billion and it hires over 100,000 employees globally.

Firm D is a Japanese automotive manufacturer which has established R&D, design and production sites in around 20 economies, and offers automotive products to above 160 markets worldwide. With more than 100,000 employees, it produced over 5 million vehicles globally and achieved over USD100 billion in net sales in fiscal year 2017.

Firm E is also a Fortune 500 Japanese manufacturing company. Its annual revenue is more than USD80 billion and it employs over 300,000 staff. Its businesses range from large social infrastructure products such as elevators, railways, power generation systems, to small electronic components such as semiconductor chips, magnetic materials, wires and cables, and consumer goods such as home appliance, refrigerators and air conditioners.

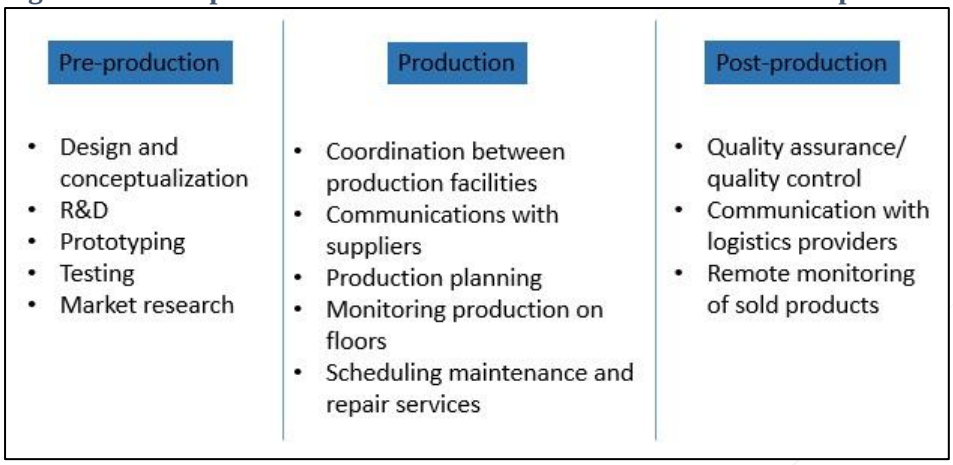
Firm F is a Japanese construction machinery manufacturer producing a wide range of machinery and transportation equipment such as excavators, wheel loaders, trucks, cranes, compaction and demolition equipment. It has manufacturing facilities in Europe, the U.S. and Asia. With more than 50 overseas subsidiaries, firm F hires over 20,000 employees globally and enjoys an annual revenue of over USD8 billion.

Firm G is a terminal solutions provider based in Japan. It produces bank branch terminals, ATMs, cash recycle machines, as well as various card reader products for financial, retail and security industries. With around 1,000 employees, its products are widely deployed in many economies such as India, Thailand, Indonesia, Chinese Taipei, and China.

9.3. Role of data in firms' business models

Depending on the products, value chains within the manufacturing sector can vary from one another in terms of structure and complexity. One way of categorizing the different parts of a value chain is to group them into pre-production, production and post-production (including post-sales) (Figure 13). Interviewed firms shared the critical role of data across various parts of the value chain.

Figure 13. A simplified illustration of a value chain and some examples of activities



Source: Authors

Pre-production

In the pre-production stage, firms indicated that they collect and use data to facilitate product design and conceptualization. Since firms have facilities in different economies, data collected in one economy often has to be shared with that in another economy. As several firms also involve some of their suppliers in the product design stage, data often has to be shared with these external partners as well and they may not always be located in the same economy where data was generated. It is worthwhile to point out that cross-border data transfer is usually not unidirectional. In fact, data have to be sent back and forth between the facilities involved throughout the entire process.

The same can be said for R&D activities which tend to be scattered across different economies for reasons including availability of talent and supporting ecosystem. Firm D shared that its R&D activities can generally be divided into two main groups: a) one works very closely with the design and conceptualization team to come up with new technology and parts; b) another undertakes activities to improve on existing technology and parts as well as ensuring that products function optimally in different regions (e.g. thermal insulation, tire tread depth, etc.). Both groups collect and have to share data across the borders since the different teams involved are usually located in different economies.

Production

In the production stage, firms use data collected from different manufacturing facilities to better exercise control and coordination activities. For example, several firms including Firms A, B and D shared that its HQ in Japan analysed the data provided by different facilities and used them to allocate production plan such as the models and corresponding quantity to produce over the next quarter or so. One of these firms indicated that it is in the midst of consolidating the production planning system across different facilities into a single platform. Once completed, it would allow the HQ to live monitor production in these facilities (which are located in different economies) and better coordinate activities across them.

On the production floor, data are used for a broad range of activities. For example, data are used by production planning software to identify machines which are available for the next production run. Data are also used to determine if a particular production run is operating efficiently and if not, where the bottlenecks are so that they can quickly be rectified. Pertaining to this, Firm E shared that while it has always relied heavily on the skills of its experienced master engineers (known as meisters) to keep production going, it has never really get around to complete understanding of what these meisters did correctly until very recently. With the advent of big data, firm is now able to measure things such as the cutting angle, speed and force that these meisters apply to the materials. This leads to better monitoring of such activities and the collected data can also be used to train new meisters. Furthermore, the same firm indicated that the ability to share live data from its regional facilities to its HQ in Japan has allowed it to reduce the need to dispatch engineers to these facilities where possible. The data centre of Firm C which is located in Japan remotely monitors data generated by its facility in India and provided technical assistance when necessary. Data are also used to monitor machines and therefore minimize unplanned downtime through predictive maintenance.

Particularly on communications with their suppliers, firms including Firms F and G noted the importance of being able to share data with them to ensure that parts and components are delivered on time. Firm C shared that since it obtained 70 percent of parts and components for its products from overseas suppliers such as Chinese Taipei and China, its procurement activities rely heavily on unimpeded cross-border data flow. The importance of communications with suppliers is even more pronounced for firms which have put in place just-in-time manufacturing system and only have a small warehouse to store parts and components for a short period of time (e.g. maximum of one day). Too early or too late a delivery would have negative implications on the firms' production plan.

Post-production

Once production has been completed, data from quality assurance/quality control activities are collected and analysed to ensure that products adhere to certain standards and are ready to be shipped out and/or delivered to the customers. Data would also need to be shared with logistics providers to schedule pick-up and delivery.

In the past, with the exception of the provision of warranty services, it can be argued that the responsibility of the manufacturers ends once the products have been sold and are in the hands of the customer. Increasingly, however, this is often not the case anymore. To ensure that they remain competitive relative to other players in the sector, firms have to provide more than just the products. Provision of maintenance and repair services is becoming the new normal and in some cases, could generate more revenue for the firms than the products themselves. Effective maintenance and repair services necessitates that products can be monitored and data can be shared remotely with the manufacturers so that predictive and preventive services can be provided before they break down.

Value-add can also be generated by collecting and analysing usage information to a greater extent. For example, knowing the features that are more commonly used by customers and their corresponding feedback can enable firms to enhance them and hopefully build loyalty. Linking the features used to customer profile can enable firms to promote the availability of these features to potential customers of the same profile and garner more purchases. Likewise, a better understanding of customer profile can allow firms to target new markets whose potential customers have similar profile.

Firm D shared that it is currently working with insurance companies to analyse usage data of its vehicles and in doing so, can enable them to set premiums which are more in line with the behaviour of individual drivers. This could act as a strong incentive for drivers to be more careful when on the road.

Ensuring data protection and security

Considering the importance of data in their business models, firms recognized that their policies pertaining to data should be clear, transparent and designed in such a way to ensure that data in its possessions are kept secure and private. One firm noted the current predicament faced by Facebook and would like to avoid the same situation. As a start, the same firm shared that it seeks customers' permission to collect any data from the electric vehicles purchased by them. If customers do not give the permission, no data are collected from the corresponding electric vehicles. Once data are in the possessions of the firms, strict rules have to be followed when using and analysing them. As an illustration, data are anonymized before they are transferred for further use and analysis by another team. Firm B also shared that access to data within the same firm are restricted based on sensitivity level. Furthermore, senders are recommended to encrypt sensitive data before they are sent to the recipients. The same firm indicated that it has a strong cyber protection team which would do its best to ensure that data are kept secure and private. Firm F indicated that they also ensure that their suppliers are also compliant with the information management regulations, privacy information management rules and agreement that it abides to, including the GDPR. It also has protocols in place to allow for steps to be taken promptly by the relevant units and departments in the event of a problem. Moreover, all employees are regularly provided training in these areas.

9.4. **How policies and regulations are impacting their business model**

Pre-production

Similar to the approach taken to describe the role of data in their business model, firms were also asked to indicate if data-related policies and regulations are impacting the various parts of their value chains and elaborate on them. On pre-production which includes R&D activities, firms shared that none of the data-related policies and regulations in the jurisdictions where they operate are affecting them negatively at the moment. They have been able to transfer and share data such as technical specifications across the borders within their companies and also with other stakeholders such as their suppliers. However, one firm noted that uncertainty with regards to implementation of an upcoming intellectual property (IP) law in one economy had led it to consider moving its R&D operations to another economy because it may not be able to transfer data as freely as the current situation. In addition to the cost of relocating its operations, firm may also lose access to the existing pool of talents.

Production

Firms also did not express any specific concerns about policies and regulations that are currently affecting the production stage of their value chains. For those that coordinate manufacturing activities across different facilities from several centralized locations, they have been able to receive data from these facilities and likewise, send data back to these facilities. Indeed, one firm shared that since its production planning software currently differs between regions, it is trying to synchronize the software and may be able to coordinate activities from a single centralized location in the near future. For those that need to send data to their suppliers to ensure that parts and components are manufactured and sent to their facilities in time for assembly, they have also been able to do so without any challenges. Similarly, firms have also not encountered any difficulties in sharing machine-generated data to schedule maintenance and repair services of its production machines.

Post-production

While firms do not encounter any issues sharing data on product quality across the borders, the insights provided by firms on post-sales activities appear to indicate that data-related policies and regulations have more implications here. As shared in the previous section, firms are increasingly tapping on customer data to improve their products and offerings. In some cases, firms are re-sending the data that they have analysed back to the consumer to recommend certain course of actions such as maintenance and repair among others. Since many of these data are personal data and/or can be associated with an individual, firms would technically face more barriers in sending such data across the borders. For example, if these data belong to citizens of the EU, firms would have to adhere to strict GDPR requirements before transferring data across the borders. The good news for the interviewed firms is that Japan has been conferred adequacy status pertaining to GDPR and therefore, data can generally flow freely between the borders. Nevertheless, one firm shared that it has had to hire extra lawyers to ensure compliance with GDPR requirements.

While firms have not encountered any specific issues in other economies and are still able to transfer data freely, they are concerned that they would be at some point. If this happens and Japan has no adequacy status with these economies, then they may face difficulty transferring data in the future. Firms opine that the implications of this are likely to be greater than the situation of not having adequacy status with the EU because these are relatively larger markets than the EU. Moreover, firms have the perceptions that data-related policies and regulations in some economies are unclear and discretionary in nature.

Preferred regulatory approaches

On the ideal situation, firms hope that there could be a single data-related policy that is applicable across the region so that they do not face challenges in finding and adhering to different regulations which may tend to be duplicative in nature. Recognizing that aligning different data-related policies and regulations between economies would be an onerous process, firms noted that the CBPR is a step in the right direction. It allows a firm fulfilling the data privacy regulations of one economy to be regarded as meeting those of other economies which are part of the mutual recognition system. Interestingly, despite knowing the existence of CBPR, none of the interviewed firms are currently part of the system. Reasons can include the limited number of economies currently participating in the CBPR and firms not encountering much issues transferring data between these economies.