



APPLE INC.

Operations Management Analysis and Investigation



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1. Executive Summary

Apple Inc. is fourth on the Fortune 500 list, and is an industry leader in the technology industry. The company is valued at over \$2 trillion, and their mission and organisational objectives are presented and explained how aligned they are. An analysis was done on the company's existing operations and quality management processes which include the *Products, Services, Markets and Distribution, Supply of Components and Research and Development*. The analysis continues using operations management tools such as flowcharts, control charts, FMEA and Six Sigma to explore how Apple utilises these tools in two different scenarios. The current Information Management Systems are explored and how these operations have affects any of the business operations. An AI analysis was done detailing how Apple uses AI to enhance their overall business operations from both an internal and value-add view, lastly giving recommendations on improving existing business operations.

2. Introduction

Currently fourth on the Fortune 500 list, Apple Inc., commonly referred to as Apple, is one of the world's most recognised and respected brands and a leader in the technology industry. Apple was founded and created in 1976 as the brain child of Steven Jobs and Stephen Wozniak, with its first standalone computer, known as the *Apple II*, being released and sold in 1977 (Levy, 2021). Since then, Apple has quickly risen to become a market leader in the industry, currently having a market value of more than \$2 trillion.

Apple's mission statement defines their purpose as a company "committed to bringing the best user experience to its customers through its innovate hardware, software and services" (Apple Inc, 2018). This mission statement defines Apple's business strategy in which they leverage their "unique ability to design and develop its own operating systems, hardware, application software and services to provide its customers products and solutions with innovative design, superior ease-of-use and seamless integration." The strategy further supports the community for any offerings – software, hardware and digital content – that aligns with Apple. Furthermore, expanding the brand through company-owned retail and online stores as well as a distribution

network including third-parties; and investing within itself for research, development, marketing and advertising, forms part of Apple's business strategy and organizational objectives. (Apple Inc, 2018).

Ultimately, there are two elements that define Apple's purpose: user experience and innovation; both of which aligned to achieve the business strategy defined by the organisational objectives which is further extended down into the company's operational and quality processes. The first of the operational processes is the **Products** where a new version of the product is released year on year, utilising Apple's own updated software and latest hardware. The second process is the **Services** which is catered to their customers from a support and digital offering perspective that includes advertising and various forms of digital content. **Markets and Distribution** is the third process that allows Apple to broaden their reach within the domestic and global market and build various partnerships with many third-parties to aid in the distribution and marketing of all Apple products and services. **Supply of Components** is the process that ensures all components utilised in the creation of any products are available and created for Apple's products that allow the company to deliver quality products. Lastly, **Research and Development** ensures that the company will always adapt to any changes in the industry, to remain competitive by developing and building new technology, subsequently improving current products and services offered (Apple Inc., 2020).

2. Existing Operations and Quality Management

Apple's success in the technology industry was the result of their branding, products and ingenuity in industry itself. Jeffery L. Cruikshank studied Apple's management and defined *The Apple Way* into four categories that focus on: the product, the customer, marketing, and leadership (Cruikshank, 2005). This focus aligns to Apple's vision and mission of making exceptional product and can be seen in all of their operations and quality management processes.

3.1. Decisions Areas of Operations Management

The 10 decision areas of operations management can dictate the success or failure of a company if not managed correctly. Apple is an example of how managing these 10 decision areas can lead a company to success. The company has an allocated team of senior managers, each of which are dedicated to handling the implementation of the measures addressing the 10 decisions areas which are:

1. Design of Goods and Services
2. Quality Management
3. Process and Capacity Design
4. Location Strategy
5. Layout Design and Strategy
6. Job Design and Human Resources
7. Supply Chain Management
8. Inventory Management
9. Scheduling
10. Maintenance.

Each of these areas are managed in a way that aligns to Apple's vision and mission statements. For example, Location Strategy and Layout Design and Strategy is a selective process when choosing a location and depending on that location, what would a customer expect in a store of that calibre. Every one of these decisions in operation management are considered very carefully before any implementation occurs, which is why Apple has been successful and will continue to be successful in the industry (Rowland, 2019).

3.2. Products

Apple's line of products include their line of smartphones: the *iPhone*®; the personal computers: the *Mac*® which are both desktop and laptops; the multi-purpose tablets: the *iPad*® range; wearable technology: the *Apple Watch*; the audio product range: *AirPods*® and any of the products in the *Beats*® range; home and streaming devices: *Apple TV* ® and *HomePod*®; and

Apple's virtual assistant *Siri*® (Apple Inc., 2020). From a software perspective, each one these products, those that require an operating system, all execute and run Apple's various operating systems that Apple have developed and continuously updated to bring consumers a constant stream of improvements and features. Apple's new range of devices always include new hardware such as better and faster processors, improved cameras and storage capabilities, higher resolution screens, etc. The constant release of new smartphones, tablets and personal computers year-on-year align to Apple's business strategy of designing and developing their own software, hardware, operating systems etc.

According to their last published fiscal results, Apple's *iPhone* had decreased by 3% in 2020 due to no new model being introduced into the market. Going forward, with the release of the *iPhone 12* and its variations in 2021, Apple should be on board to improve on these sales. The *Mac* sales had increased by 11% due to their new laptop, as well as their *iPad* sales increasing by the same amount. *AirPods* and the new *Apple Watch* had increased the sales of the Wearables, Home and Accessories division by 16% (Apple Inc., 2020). It can be seen that year-on-year Apple's sales continually increase, and a larger increase is seen in years when Apple introduce newer products in their product line. Based on their current organisational operations and processes, Apple will continue to grow in a sustainable manner as long they continue to innovate their products and constantly utilise and develop the latest technology. This introduction and continued innovation will allow Apple to mitigate their risk of the constant introduction of new technology and its application to Apple products (Apple Inc., 2020).

3.3. Services

The services operations within Apple cater not only to the company but the customer as well. These operations form part of quality management processes as well. The first of the services that are offered is the advertising that Apple use to not only boost the company itself but it includes arrangements with numerous third-parties that will utilise the Apple advertising platform. The *Cloud Services* are part of the offerings that Apple provides for the customers that not only allows for customers to store data on the cloud but allows all of the products owned by

customers to receive the most recent content across multiple platforms. Apple also provides *Payment Services* which include their cashless payment and branded credit card. The *Digital Content* is the large umbrella that works on multiple platforms that allows customers to download and use various applications and access and use digital content such as electronic books, music, media, gaming and podcast content. These work alongside a subscription-based service that is offered to the customers across the various platforms and works hand-in-hand with third-party developers to create and publish the various content. The last service offered is *AppleCare* which is the fee-based service and support catered to customers from a quality management perspective. This allows customers to gain support from the company for technical matters, both software or hardware related as well as coverage similar to that of insurance (Apple Inc., 2020).

Over the last fiscal year, the Services operations saw a 16% increase, with a constant growth projected. Apple's agreement with multiple third-parties will allow the company to maintain customer loyalty while increasing the offerings provided through any of their products and services offered through the agreements with various third parties. By continuing agreements with multiple third-parties to utilise the various platforms that Apple services provide as well as continuously improving the platforms themselves; Apple can sustain their growth of the business through their services operations, allowing them to mitigate the risks identified with the ongoing COVID-19 pandemic. This sustainable growth would also mitigate the dependency on various third-parties that provide products, services and content to Apple who form a major part of Apple's financial success (Apple Inc., 2020).

3.4. Markets and Distribution

As described in the book *The Apple Way*, category two is focused holistically on the customer (Cruikshank, 2005). Given the products and services provided by Apple, the customers range from the general consumer market to businesses of all sizes, including the education sector as well as the government. Apple is able to bring their products and services as well as other third-party products to market and directly to the customer through multiple distribution channels that

include their own physical stores, an online store and multiple third-party businesses. These include network carriers, various wholesaler, retailer and even verified reseller stores (Apple Inc., 2020).

The rise of the COVID-19 pandemic has affected the company in multiple ways, forcing many of the stores to close and all staff to work remotely from home. While this has been handled successfully, Apple still has a dependency on network carriers, wholesaler, retailer and reseller stores to continue managing the operations (Apple Inc., 2020). By maintaining their platforms and agreements, the company can potentially mitigate this risk by constantly monitoring global and regional markets as well as the pandemic. This will allow Apple and their relevant third-parties to maintain a successful marketing and distribution network that would ensure continued growth and success (Apple Inc., 2020).

3.5. Supply of Components

In order for Apple to develop and create their products, the company requires essential components that are available from multiple sources with some being sourced from limited vendors. Given the hypercompetitive environment in the technology industry, Apple competes with multiple rivals over components, that creates a major dependency on the component, its respective suppliers and the market itself. However, some components that allow Apple to maintain a competitive advantage over their competitors are custom and are generally available from a singular source. Depending on how new the technology is, this component may be subject to limited supply and supplier constraints. Although Apple has agreements with all their suppliers, there is no guarantee of any extension, renewal or similar-termed agreements with the suppliers. This does create a dependency risk for the company on these suppliers. Along with this, the company outsources all hardware related components, located primarily within the Asian continent (Apple Inc., 2020).

These two risks could be mitigated by ensuring that Apple has the correct agreements in place with all suppliers as well as identifying potential alternatives for some components; which could

result in a much less scarcity issue arising with regards to any and all components. Apple could also continue to create more custom components which will allow them to become more innovative, and remain competitive in the market itself.

3.6. Research and Development

Like many technology companies, research and development play a vital role in a technology company's ability to stay relevant, competitive and successful. Apple's research and development operations are constantly adapting, testing and utilising the latest in technology. In doing so in a continuous and timeous manner, Apple is able to maintain a competitive advantage in all their products and services. Research and development also include intellectual property and licensing it such that it can be offered as a service through their digital content. Furthermore, this entails Apple acquiring third-party businesses and subsequently the corresponding technology that will allow Apple to utilise it within their own operational and quality management processes (Apple Inc., 2020).

Over the last 5 years, Apple has increased their research and development expenses by 86%, using 2% more of their total net sales from 2018 to 2020 (Apple Inc, 2018) (Apple Inc., 2020). The constant investment within the company itself has increased the costing requirements, however it has allowed Apple to maintain a strong competitive advantage in the market and remain a business constantly improving in both technology and value provided.

3. Operations Management Tool Analysis

Evaluating how various operations management tools contribute to the success of Apple's organizational objectives will be done using two scenarios:

- The creation and development of a new product.
- The testing of reliability and safety of products.

4.1. Flow Charts

Flow charts, or process flow diagrams, present a sequential and logical order of steps within a process. Primarily used to describe how a specific process flows, define the steps and order of steps, time frames, decisions and dependencies (ASQ, n.d.). Using the creation and development of a new product, Apple does this in a specific manner as depicted in Figure 1.

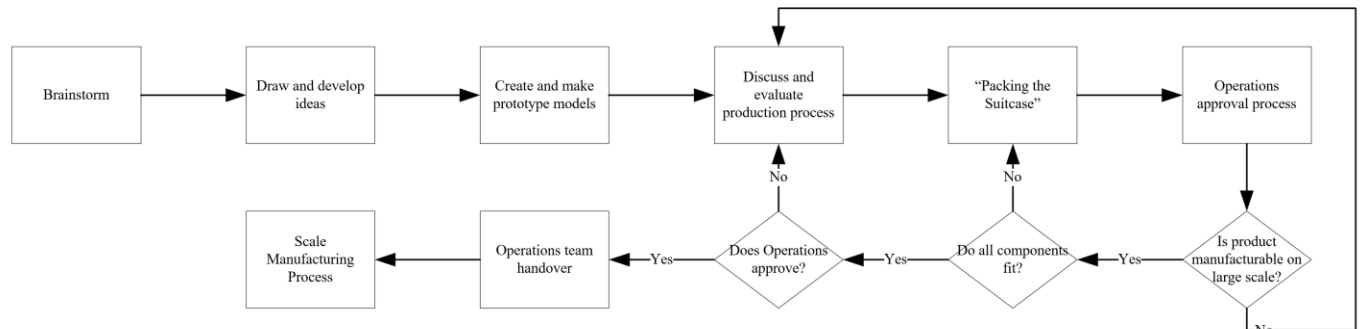


Figure 1: High Level Process Flow of Product Creation and Development (Kahney, 2019)

As seen in Figure 1, the process is a very high-level view of how a product at Apple moves from inception to manufacturing. As per Apple's core value, Steve Jobs had ensured that when a product is being created, it begins with the Industrial engineers, in the design stage. New products and ideas are designed and prototypes are made during the first three stages which is made up of the Industrial Design team; the Product Design team consisting of electrical and mechanical engineers and Device Software group; and the Operations team (Rowland, 2019).

Once the team is happy with the prototype, the process moves onto the Product Design, whereby the various electrical and mechanical engineers work to ensure all necessary components can fit within the design itself, also known as *Packing the Suitcase*. While the Product Design is working on the design of the internal components, the Operations team begins to evaluate the product and begins assessing how the new product and its introduction will affect the current supply chain, in conjunction with planning how the product will be catered for mass production (Rowland, 2019).

By including Operations in the design early into the process, will allow the team to constantly adhere to the limitations of what can and what cannot be mass produced. Operations begins to manage the tools, fixtures and develop the process for the production of the product. This involves designing the parts that are crucial to the manufacturing dedicated to specific components of the product, such as the battery. Once approved, Operations take over completely and begin to scale the manufacturing process on a global scale monitoring where and how the cost can be reduced in all areas (Rowland, 2019).

4.2. Control Charts

Control charts are plotted points of data that allow the user to study how a process changes over time within set threshold limits. These charts can aid in identifying and correcting various problems as they occur, determining whether the process (in this case product) is stable and testing quality (ASQ, n.d.). For Apple, the scenario of testing the reliability and safety of their products will be used.

Within the Apple operations exists two dedicated engineering groups, called Reliability and Safety. These teams perform multiple, often exhaustive tests on the various products; with the focus of the test being on the extreme conditions. For example, *AirPods* are placed into synthetic sweat and this is done to simulate the gym environment and how well would the product itself survive in these environments. Given the highly unlikely, yet possible scenarios, such as dropping the laptop on solid concrete or a phone in a urinal; these sorts of tests are done so to evaluate the product's quality in extreme conditions (Rowland, 2019).

Apple can utilise control charts to monitor the data and progress of their products being able to estimate potential lifespan of products, and how should business evaluate and cater their services provided through *AppleCare*. With testing in this manner, the Reliability and Safety teams must have proposed solutions as problem arises, which could be unknown until testing such as this is done (Rowland, 2019).

4.3. FMEA

The Failure Mode and Effect Analysis is a tool that is used across multiple industries as part of the Lean Six Sigma methodology, that allows a team to identify potential problems and its impact that could arise after the production and analyse and address them in the development stage (Forrest, n.d.). Continuing with the testing of reliability and safety scenario, Apple can utilise FMEA to analyse and identify potential issues that could arise with the new *iPhone* scheduled to release later in the year. Table 1 presents an example of FMEA for this scenario.

<u>Process Step</u>	<u>Potential Failure Mode</u>	<u>Potential Failure Effect</u>	<u>Severity</u>	<u>Potential Causes</u>	<u>Occurrence</u>	<u>Current Process Controls</u>	<u>Detection</u>	<u>Risk Priority Number</u>
Cracked screen and back	Unusable touch screen	Unhappy customer	6	Phone dropped or thrown	3	Develop shock absorbent case and glass screen protector	10	180
	Irresponsive screen	Dissatisfied customer	6	Heavy object knocked phone in pocket	3		7	126
	Loss of display, i.e. screen not turning on	Disgruntled customer	8	User tripped and fell with phone in hand or pocket	4		10	320
Data integrity is compromised	Authentication failure	Concerned and unhappy customer	5	Network failure	5	Automatic switch between WiFi and cellular data)	3	45
	Unauthorised access	Angry customer	10	Phishing attack, keylogging, hacking	8	Set up two-factor authentication	8	640
Battery longevity not as predicted	Expanded battery (close to explosion)	Injured customer	10	Incorrect charger used	1	Supply the correct charger and cable to regulate the correct voltage	6	60
Phone stuck in safe mode	Endless loop of safe mode	Unhappy and disgruntled customer	10	Incorrectly installed operating system	3	AppleCare and in store technicians as well as at home factory resets available	10	300
			7	Unwanted third-party application	2	Factory reset	5	70

Table 1: FMEA Example for iPhone in development

4.4. Six Sigma

The Six Sigma approach was initially developed in the late 1980s by Motorola, with the goal to eliminate errors by improving the systems that handled quality and measurement. While Six Sigma is focused on constant improvement of value for the customer based on their experience, it makes it a useful tool for Apple to use as it treats the customer as king. Although similar to Lean Manufacturing, Six Sigma's approach is to look at variation and performance (GoSkills, n.d.). Using the first scenario of creating and developing a new product, specifically an iPhone, Apple can use the five phases of the Six Sigma in developing a new *iPhone*, seen in Figure 2.

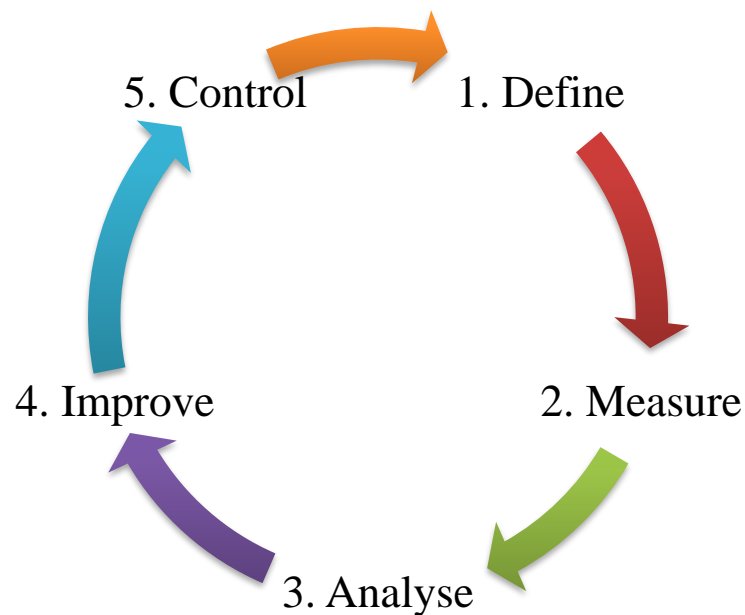


Figure 2: Five Phases of Six Sigma (DMAIC) (GoSkills, n.d.)

4.4.1. Define

Apple needs to release the next generation of the *iPhone*, using the latest technology and addressing all customer concerns. In order to understand the problem, Apple can receive feedback from customers on what would be desired in the next iteration of the *iPhone*. For example, customers may request a better or more camera options; customers have found that the battery life could be improved; Apple's phones do not have the capability to "fast-charge" their phones unlike their competitors; the screen glass cracks too easily. Using this type of feedback

from customers, will allow Apple to define their problem, and begin to design and implement a better smartphone.

4.4.2. Measure

Now knowing what the customer requires in the next iteration of the smartphone, Apple can now measure its current performance and what is currently happening from a customer experience point of view. This will allow Apple to see the true measurements of their current generation of *iPhones* and will be able to create and set baseline values that can be compared to. This is done to ensure that the new product will be improved or not.

4.4.3. Analyse

Using the current data that Apple has gathered and currently has, the team can now begin to analyse the data by identifying where and how performance is currently being hindered. A thorough analysis must be done as the goal is not to simply analyse and identify where the problem is, but rather identify, analyse and resolve the root cause of a problem. For example, battery life could not be performing as desired because of an excessive use of mobile applications, so by analysing, the team can determine that use of less applications will create a longer lasting battery. However, this does not identify the root cause of the problem, as smartphones are constantly being used, and so an investigation and analysis must be done on which mobile applications are causing battery degradation and look at catering for this.

4.4.4. Improve

Once the root causes of all variations have been identified, the team can now begin to plan and design the necessary improvements required. These changes must then be tested and the team must ensure that any and all changes made are resolving the problems identified and defined in the first phase.

4.4.5. Control

In the final phase, the changes made must be implemented and by doing so has a ripple effect on all systems required to develop and make the changes. This is done so in a sustainable manner and with continued monitoring, the team can determine if all the changes and improvements made are still being realised.

4. Management Information System (MIS) Analysis

Management Information Systems form the backbone of an organization's operations consisting of software and hardware; constantly analysing data, reporting on it and ultimately aiding in making decisions (Shopify, n.d.). Apple's major types of information systems are presented in Figure 3.

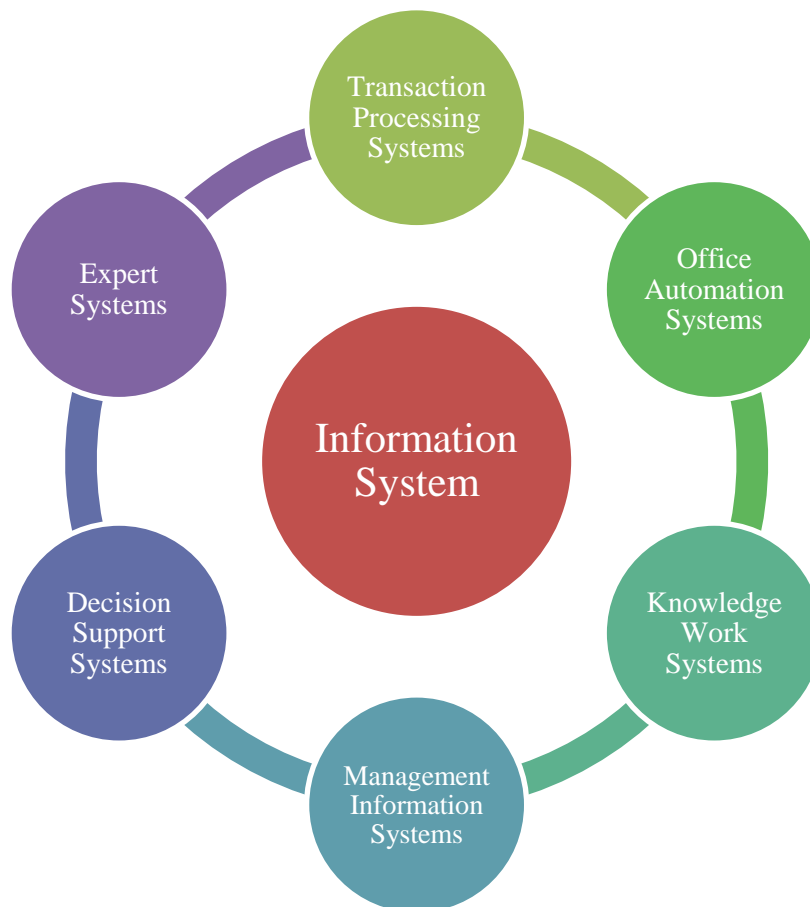


Figure 3: Apple's Major Information Systems (Barzani & Nabaz, 2020)

5.1. Transaction Processing Systems

TPS is defined as information that monitors transactional data and transforms that into a database system. This type of system is key when running an online store (Barzani & Nabaz, 2020).

Apple's Market and Distribution operations include their own online retail store as well, and utilising a system like TPS allows Apple to track online sales of any products. Given the COVID-19 pandemic, and multiple stores being forced to close, Apple still saw an increase in sales of their products, which could indicate the use of the online platform in purchasing the products. The gross margin of the products increased from \$68.887 *billion* in 2019, to a gross margin of \$69.461 *billion* in 2020 (Apple Inc., 2020).

5.2. Office Automation Systems

The Office Automation Systems are those that enable all employees of Apple to utilise personal computers and systems to perform business activities. For example, all computers present within the Apple headquarters in California, granting all employees access to the necessary information (Barzani & Nabaz, 2020). With majority of the workforce being forced to work from home and remotely, this system has extended into the cloud, allowing the employees to work remotely while still achieving objectives and adding value to the customers.

5.3. Knowledge Work Systems

The Knowledge Work System acts like a library for the employees of Apple. This allows all members of the company to learn from others with different skillsets, on how to perform various tasks and complete objectives. It assists the company in knowledge sharing and knowledge organisation while allowing team members to upskill themselves without any cost to company (Barzani & Nabaz, 2020).

5.4. Management Information Systems

The MIS system in this case is more of a process, which begins with searching for information, storing the information, monitoring and identifying conflicts and issues and developing solutions for any that arise. In the case for Apple, the MIS is used for customer satisfaction (Barzani &

Nabaz, 2020). With customer experience being the focal point of Apple's mission and vision, the use of an MIS allows the company to maintain a positive customer satisfaction score by addressing any and all concerns experienced by the customers. This system would form the backbone of Apple's growing success. Year-on-year, Apple increases their spending in the R&D operations of their company, with a 16% increase from 2019 to 2020 (Apple Inc., 2020).

5.5. Decision Support Systems

By collecting data, analysing it and reporting it in more readable and understandable format, the Decision Support System assists the necessary stakeholders in decision making situations and scenarios (Barzani & Nabaz, 2020). The use of these systems has become vital in a company such as Apple, as decisions made by management can ultimately affect the company itself in terms of value and earnings.

5.6. Expert Systems

Expert Systems are one of the most complex ones as they contain elements of AI in its use. Expert Systems are those that are used to simulate human reasoning, analysing and identifying patterns and create reasoning with them. Apple uses the company "NEXPERT", who are responsible for developing AI applications, specifically in the financial payment world (Lozano, et al., 2016). The use of the Expert System allows Apple to extend their operations and services that are offered to their customers, in this case the use of *ApplePay*.

5.7. Overall Analysis

Apple being a leader in the technology industry, indicates that they utilise their Information Systems to the maximise by investing more and more into research and development. The constant and increasing investment in research and development has allowed Apple to develop more products in their range making them better and allowing them to maintain a commanding presence in the market itself. The use of the systems, whether it is for decision making, production, or upskilling, has allowed Apple to increase their revenue over the last year

regardless of the COVID-19 pandemic from \$98.392 *billion* in 2019 to \$104.956 *billion* in 2020 (Apple Inc., 2020).

5. AI Analysis

Artificial Intelligence (AI) is being implemented more and more in the world today in all industries to help gain a competitive advantage of competitors or assist in many business operations within the company itself. Apple does use AI in numerous ways both in an internal perspective, but more within the products that they produce, i.e. affecting the *Services* operations of the business in what is being offered. The virtual assistant *Siri* is the most notable form of AI that Apple has, making it a desirable feature in all of Apple's products as it can be utilised with all products offered in perfect synchronisation.

Over the years, Apple has continued to develop *Siri* from a basic question and answer programme to one where it is able to identify callers not on your contact list; or predict the next application you may open based on what you have done before; or even presenting a map location based on reservations you have made. Apple's AI has evolved from just *Siri* to each product having their own "Apple brain" inside each of the products. The use of the various AI tools and techniques such as machine learning, deep learning and neural networks are constantly running on any of the products and being constantly utilised to aid the user in everyday tasks, such as detecting if a person is currently exercising due to an increase in their heart rate (Levy, 2016).

Apple's development in AI has aligned to their organisational objective of creating a much more user-friendly and personalised user experience. But this does not only include software on the smartphones and tablets but goes further into the actual hardware. The research and rapid development of AI in the products, have given rise to more innovative components being used to enable more machine learning techniques to be used (Levy, 2016).

The machine learning experts within the company do not only focus on implementing various algorithms on the products and services alone, but rather are used throughout the entire company. The machine learning teams are encouraged to work with other teams within the company to help solve other problems and even play an important role in idea creation. Although experts are found within the company, many of those that utilise the machine learning and AI have no experience in it and have been upskilled to utilise it in any of their business operations (Levy, 2016).

Although Apple uses AI to its benefit, unlike their competitors, they do not disclose any of their research to the public, however they counter this disadvantage by purchasing small companies and increasing their manpower. This allows Apple to maintain a competitive advantage against all their competitors by utilising the skillset of the smaller companies and developing more advanced versions of their AI, that would not have been possible at any earlier stage (Levy, 2016).

The major concern that faces Apple and its AI is around data privacy. Although encrypted, the data that is given and used by the team is not the complete set of data involving user's personal data. The first question that is asked is what happens to the information used in training and developing the neural network? The second question asks how can a neural network be developed and trained to predict behaviour without know personal user information? Apple has addressed both concerns utilising their product as a whole, i.e. both software and hardware. The highly personal information is stored locally on the device itself, thus not exposing it to any other forms of data leaks. The second concern is addressed by analysing how users utilise their own device. For example, based on the number of times a person opens an application and in what order is it opened is all calculated and trained in the neural network to predict the probability of that application being the next one the person decides to use. It can also be seen in analysing typing patterns and words used, which is how predictive text works on any of the Apple devices (Levy, 2016).

Ultimately, Apple is able to address challenges that AI places on them by developing and training the various neural networks, deep learning and machine learning algorithms on the device itself, protecting users' privacy.

6. Recommendations and Conclusion

7.1. Recommendations

Apple is constantly improving their operations and quality of products delivered to all their customers. By focusing on the customer experience and aligning all operations to the organisational objectives, Apple has continued to succeed in the technology industry maintaining a strong market share and competitive advantage. In order for Apple to maintain their current growth, it could be suggested that Apple continues to innovate all products and services in a more aggressive manner utilising more recent and experimental technology.

Apple could continue innovating by creating more custom components used in their products to allow them to gain a bigger competitive advantage over competitors. It could also be recommended that Apple considers publishing research to the public like their competitors. Given the dependency of multiple third-party developers; Apple's aggressive corporate approach of buying smaller companies that utilise AI in other ways; Apple publishing their research could invite more third-party developers to be more innovative giving Apple a much larger competitive advantage.

Apple's ongoing and growing investment into research and development increases all headcount-related expenses. The company could utilise their existing AI team that develops machine learning, deep learning and neural network algorithms and align the team to the research and development. By utilising the various forms of AI, the company can begin to continue to innovate and improve on the research and development of all operations, while reducing the constantly increasing headcount expenses.

7.2. Conclusion

Apple is fourth on the Fortune 500 list, and a leader in the technology industry, with their organisational objectives being aligned to their mission statement. The company's operations and quality management processes were divided into five major categories, namely, their Products, which group all their devices and wearables together; their Services, by which they focus on digital content, support, value-add and licensing services offered to various third-parties and customers; their Markets and Distribution, where Apple focuses on selling their product and services through various channels; the Supply of Components, in which they use to develop their innovative products; and research and development, whereby they constant ensure the company adapts to the rapidly changing industry and environment.

The report looked into four operations management tools and how they are used within Apple's operations from a scenario perspective. The tools used for the analysis included: flowcharts, control charts, FMEA and Six Sigma. The company's Information System was analysed and explained, looking at how each of these systems contributed to increasing Apple's gross margin to *\$104.956 billion*, even throughout the COVID-19 pandemic. An analysis was done on AI and how it is used to enhance Apple's operations including their products and services and how any challenges faced were addressed. Lastly, recommendations are given to Apple on how to remain an industry leader and maintain the competitive advantage while benefitting the business and not impacting any existing operations.

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