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Graphic Cards Supply Chain Problems During COVID-19

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Abstract: The pandemic had generated various impacts towards businesses due to its effects towards the supply chain. One of the most substantially impacted sector was the graphic card supply chain.As such, the main aim of this study would be to investigate the impact of the pandemic towards the supply chain of graphic cards and how to mitigate similar problems in the future. In this endeavor, the author would adopt a qualitative research approach, focusing on narrative analysis of various news articles and studies on the impact of pandemics on supply chains. The data for this study would be mostly obtained through internet searches, focusing on a combination of various news websites and empirical studies obtained from Google Scholar's database. Accordingly, the results of this study indicate that the problem in the graphic card supply chain was mainly caused by the mistaken predictions of the graphic card producers that caused them to reduce their inventories in the face of rising consumer demands, which is caused mainly by the inability of the producers to switch their suppliers due to the centralized and small nature of the producers in the industry.

Keywords: COVID-19 pandemic, graphic cards industry, supply chain, IT industry

1. Introduction

2021 would be regarded as one of the most unique periods for the IT industry, due to its experiencing severe shortages of essential components, including graphic cards. For instance, the launch of the newest RTX-3000 series as well as the RX 6000 series was initially hampered by what was previously assumed to be typical problems caused by the sudden demand spikes during initial product launch periods [1]. However, the shortage would actually persist throughout 2021. These issues simultaneously generate reverberating effects for other industries. Additionally, there are reports that consumers are experiencing severe difficulties in purchasing more recent gaming products, as seen in the case of the PS5 or Xbox One-X [2].

At the same time, Molloy pointed out that the limited availability of these products might be mainly caused by the fact that graphic processing units had been sold out during the earliest days of the pandemic [3]. As a result, the supply shortage is causing significant bottlenecks in various supply chain stages among technology companies.

These entire outlooks showcased the importance of supply chain in the IT industry, and most importantly: the persisting problems throughout 2021 clearly shown that there are problems in the graphic card industry's supply chain. Although there have been various examinations on the impact of the pandemic towards the supply chain, there remained limited specific investigations on the case

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of graphic cards supply chain. Therefore, the main aim of this study would be to investigate the nature of supply chain problems within the graphic cards industry during the pandemic. In this endeavour, the author shall adopt qualitative research's narrative analysis approach to investigate the nature of the data.

2. The Pandemic and the Supply Chain

One of the unique features of the COVID-19 pandemic is the fact that it affects various supply chain members at various points, and disrupting the supply chain relationships one another - creating severe disruptions to the flows of goods and services [4]. This has been mostly attributed to the governmental containment measurements that were implemented by various governments all over the world to prevent the virus' spread. At the same time, such measures also forced businesses in various economic sectors to temporarily close their operations, resulting in shortage of products and services.

For the supply chain, it is described that the lockdown creates movement restrictions that consequently lead to difficulties delivering customers' products at the originally designated time of arrival [5]. This consequently led to bottlenecks for the producers, which exacerbated issues such as the shortage of labor and temporary production closure in response to the implemented containment measures, all of which would lead to reduced productivity.This outlook was further exacerbated by the issues experienced by logistics, as the pandemic reduced their capabilities to acquire and transfer materials in time, due to the disruptions of the trade routes by the pandemic. For instance, the US coast guard had redirected shipping vessels away from docks throughout the pandemic – resulting in jammed shipping vessels and piled containers [6].

Finally, it would also be necessary to examine the nuances of customer demands and their contributions to the pandemic's impacts. There were various instances of panic buying that resulted in severe demand fluctuations [7]. This subsequently led to problems for the producers to accurately forecast demands. As the result, risk-averse producers would prefer to reduce their productions than risks having unsold supplies. This subsequently caused limited materials and components that are demanded by either the end-manufacturers or even end users throughout the pandemic.

3. Supply Chain Structure in the Graphic Cards Industry

3.1. Demand Structure

A significant factor that contributes to the supply chain problem during the pandemic is the dynamics of consumer demands, and the graphic card producers' reaction to these demands. The most intriguing forecast of graphic card demand prior to the pandemic is the significant growth in graphic card demand for data centers, as shown in the following figure:

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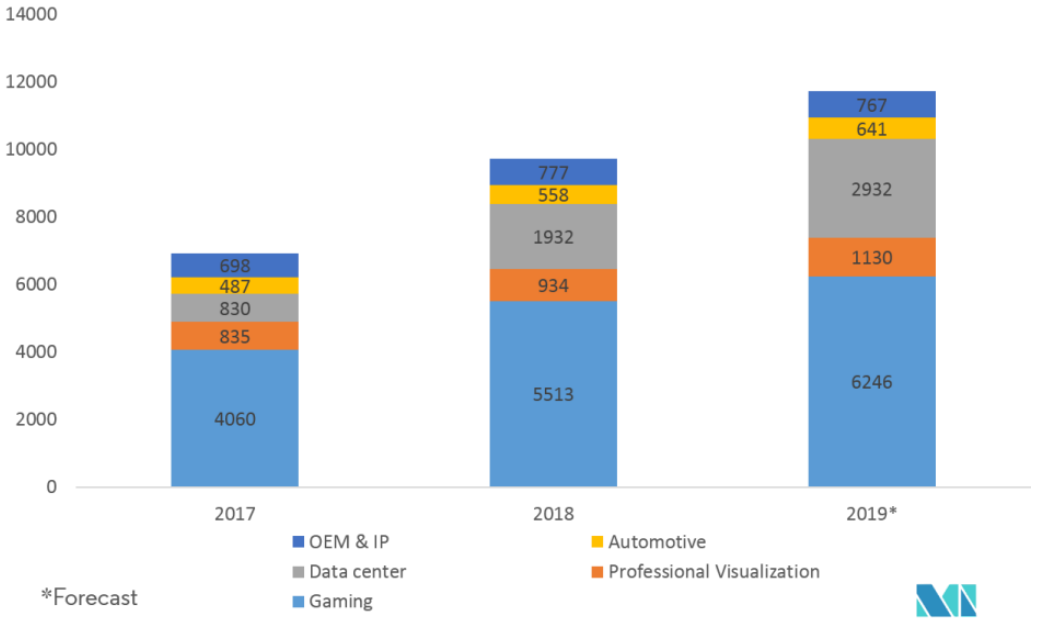

Figure 1: Usage of graphic card amongst PC Users (2017-2019).

The rise of graphic card demands prior to the pandemic was mainly fuelled by the rising trends of Bitcoin mining [8]. Recognising this opportunity, graphic card manufacturers such as Nvidia responded by increasing their productions to meet the rising demands from the market. However, the sharp decline of Bitcoin's value ultimately caused the demands to plummet, hence graphic card manufacturers were severely affected, as they ended up with substantial amounts of unsold inventories. Apparently, this experience had caused graphic card manufacturers to change their views in managing their productions and inventories, with more careful planning as evidenced by their decisions in the beginning of the pandemic, there were indications that the majority of graphic card manufacturers predicted that the pandemic would substantially reduce demands for graphic card due to economic decline and therefore: these producers subsequently responded by cutting down their orders for various components and raw materials [9].

However, subsequent observations in the IT sectors indicates that these producers' prediction were actually wrong, as there are significant increase of demands of electronic products during the pandemic [10]. This was further fuelled by the necessities for employees to comply with the "Work from Home" policies, and the increasing demands for games to replace outdoors recreations – both are which responsible to intensely increase the demands for electronic products, and graphic card as the core components of these products. This situation basically indicates that graphic card manufacturers were producing fewer products during a period when market demand was increasing.

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3.2. Supply Structure

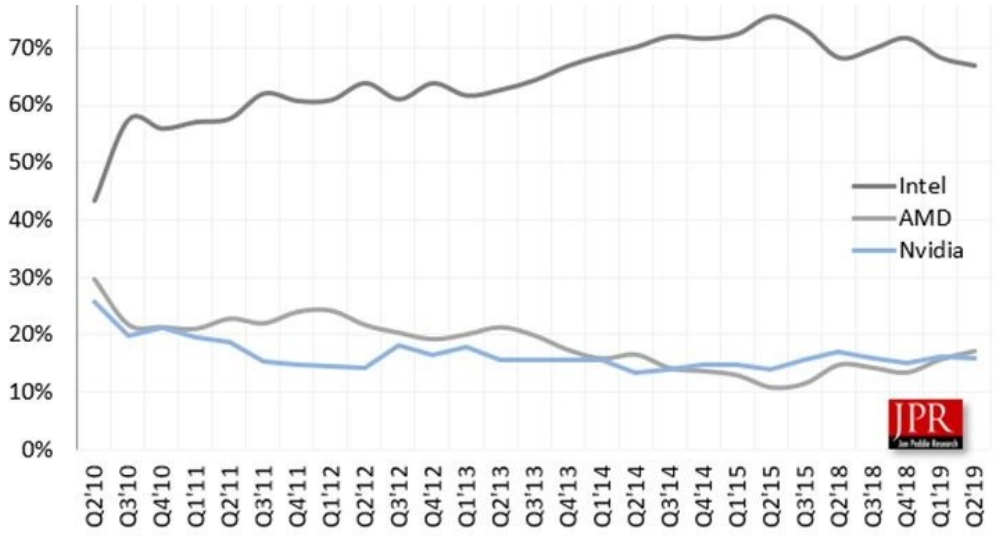

Figure 2: Graphic cards market share.

As seen in Figure 1 above, the graphic card market is dominated by three major companies, with more than 80% market share before the pandemic. At the same time, this also showcased that the graphic card industry is also characterised by highly-concentrated suppliers market. Technically, it would be possible to avert the graphic card shortage if these companies manufacture more chips, and this is also supported by the fact that companies such as Intel and Samsung had planned to expand their productions [11].

Furthermore, it is also necessary to reflect on the fact that the production activities of graphic card is also tend to be concentrated in particular regions, with China responsible in manufacturing more than one-third of graphic card in the world and is also regarded as a prominent supplier of raw materials and components for graphic card [12]. At the same time, as the initial outbreak happened in China, various countries had imposed shipping restrictions for Chinese goods to minimise risks of contaminations. During the initial pandemic outbreaks. For instance, there were reports that various Chinese shipping containers were stranded in the US during the initial outbreak of the pandemic, causing China to be unable to handle accumulated goods in their warehouses due to the lack of containers [13]. It is also important to note that the shipping restrictions also means that the US would not be able to send more containers to allow China to ships not only finished, ready-to-market graphic card, but also other essential graphic card components that are required to produce graphic card outside China. This would expand the crisis beyond the US and China, as well as hampering the US graphic card manufacturers' ability to manufacture their own graphic cards to offset the declining supply of ready-to-market graphic cards from China.

Finally, the graphic card industry is considered unique in a sense that the majority of producers tend to establish partnerships with components manufacturers further down the supply chain. In particular, large manufacturers such as AMD and Nvidia's production is very reliant to their chip manufacturers [14]. Usually, these graphic card manufacturers established arrangements to co-develop their chips with the chip manufacturers, and benefited from obtaining greater priorities in manufacturing their chips at higher margin. Furthermore, by establishing strategic relationships through co-developments of the chips, the graphic card manufacturers could ascertain steady supply of chips.

However, this arrangement would also implies that the graphic card manufacturers also limits their options to replenish their supply from other suppliers. Furthermore, since the co-developed

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components are strongly customised to meet the specific specifications from the manufacturers [15], it is reasonable to expect that these producers would not be able to easily substitute their co-developed components with components from other suppliers. This ultimately causes additional supply chain problems, as companies such as AMD establish strong partnerships with Chinese chip manufacturers [14], causing them to be effectively depleted from the majority of their co-developed chips during the pandemic. This also explains as of why the manufacturers were unable to quickly respond to the surging demands during the pandemic.

4. Problem Analysis

The outlooks discussed on the supply structure of the supply chain of the graphic card industry showcased two particular characteristics of the impact of the pandemic towards supply chain in general. First, it was shown that the graphic card producers experienced difficulties of obtaining their raw materials and components' supply in time, and this consequently led to the limited supply of graphic card in the market. With most of the manufacturing sectors' Tier 2 and Tier 3's global supply chains are negatively impacted by the pandemic [16], it is also possible to argue that the form of which the pandemic affects graphic card industry's supply chain closely mirrors a ripple effect [17], where the disruptions at particular level of supply chains would generate rippling impacts to the end users in the supply chain.

In the graphic card industry, however, this problem was exacerbated by the fact that the market and the suppliers are dominated only by small numbers of major producers and suppliers. The fact that these producers are strongly concentrated at particular geographic regions, hence any disruptions experienced by any of these major companies would generate major disruptions to the end-market. The pandemic was also responsible in rendering the supply chain strategies of these companies to become detriments, as they were unable to rely on their overseas partners to supply them with joint-developed components, whereas the producers were restricted to acquire desired components from other suppliers. These could be seen in the case of the impact of trade restrictions imposed by the US to China during the initial periods of the pandemic.

On the other hand, although the producers are experiencing severe supply chain disruptions that affect their supply chain during the pandemic, the pandemic actually caused surging demands for electronic devices and, by extension, the demands for graphic cards. For this reason, it is also possible to argue that inaccurate forecasting is a problem that seriously hampers the effectiveness of the supply chain and is also a major cause of the shortage during the pandemic.

There were also criticism towards the lean manufacturing system adopted by component producers as a weak point in the graphic card's supply chain during the pandemic. These criticism tends to be focused on the lean philosophy to maintain inventories at the lowest level possible and preventing any excess inventory whenever possible [18] and therefore: responsible in causing the graphic card producers to become unable to respond to the market during the surging demands.

The author personally believes that although the lean production system could, to some extent, be blamed as the causes of shortages and supply chain problems, it is also imperative to note that each systems possesses its own limitations. Under normal circumstances, lean manufacturing is actually very effective to address wastes, inconsistencies and irrelevant requests to the production line – all of which are also detrimental to the supply chain [19]. Furthermore, companies are able to minimise risks and maintaining healthy margins by maintaining small inventory levels [20]. However, the case of COVID-19 pandemic is unique, as the entire industry is simply unprepared and had not yet witnessed problems on the scale of the pandemic, hence the pandemic was generally classified as a "Black Swan Event" to an otherwise, healthy and proper manufacturing approach [21]. This implies that it is possible for graphic cards manufacturers to maintain this manufacturing approach even amidst the pandemic, or during normal situations.

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5. Conclusion

Based on the discussion of the case of the supply chain problems in the graphic card industry above, it appears that the problem was mainly caused by the sharp increases in pandemic-induced demands as consumers shifted to greater usage of electronic devices during the pandemic. On the other hand, the inaccurate prediction amongst graphic card producers had caused them to actually reduce their inventories and raw materials in the face of the surging demands.

The current supply chain setting is considered to be significantly weak due to its lack of responsiveness caused mainly by the inability of the producers to switch their suppliers. These manufacturers were unable to quickly respond to the surging demands as the pandemic slowed down transportation, and this was also exacerbated by the fact that the production of graphic cards is highly centralized among only a handful of large producers, with the tendencies of the graphic card producers to focus on joint component developments with overseas suppliers. These characteristics subsequently limit the capabilities of the supply chain to tap into alternative sources to respond to the rising demands during the pandemic. Finally, graphic card producers' inability to respond to the demands could also be related to their mistaken forecasting, particularly their mistaken impression that the demand for graphic cards would dwindle, while it actually rose significantly during the pandemic.

Based on these findings, the author suggests that graphic card manufacturers consider expanding their supply chains and reconsidering the conditions imposed by their current partnerships on their ability to respond to market changes. The inclusion of arrangements with local suppliers may also help to alleviate this problem, as centralized suppliers overseas were shown to severely stymie supply chain flows during the pandemic. To a greater degree, reassessing forecasting criteria would also help the manufacturers to reduce the risks of having mistaken forecasts in the future, allowing them to plan their manufacturing more appropriately and effectively utilize their supply chain. Accordingly, the author also acknowledged that since this study is focused solely on the graphics cards segment, it might not be able to be implemented to describe the impact of the pandemic on the supply chain in other industries. As such, future studies are also advised to improve the extent of this study by engaging in comparative analysis, focusing on examining the impact of the pandemic in different industries and comparing them to the findings in this study to determine whether there are universal factors that affect the effectiveness of supply chains in various industries during the pandemic or whether the impact was industry-specific.

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