Event studies on the market value effects of new product introduction delays for focal companies and suppliers

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Matt Mitchell MSc BA (Hons) AFHEA

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Abstract

New product introduction delays can be caused by various factors, including setbacks in overly ambitious technological advancements and quality issues. Sometimes organisations deliberately delay a new product introduction for strategic reasons, such as to avoid cannibalisation of existing products. Such delays can have negative consequences for profitability, market share and firm value. Extant studies find that such delays can be managed by designing for manufacture and optimising project scheduling. Despite this, new product introduction delays continue to plague organisations. This research shows that there is a negative market value effect not only for focal companies announcing a new product introduction delay but also for their suppliers. For focal companies, the roles of several key firm resources are studied. More specifically, when experiencing a new product introduction delay, the research observes that there is a more negative change in market value is experienced by more profitable firms and those with higher advertising intensity. However, operational slack positively moderates the impact of advertising intensity on market value. Furthermore, a study of the Boeing 787 Dreamliner's introduction delays shows that the negative market value effect spills over from the focal company to their suppliers, irrespective of whether or not they were directly involved with the affected product. Further insight demonstrates that the initial new product introduction delay is more negative compared to a further delay.

A systematic literature review of new product introduction delays forms the foundation of the subsequent empirical research. Following this, the short-term event study method followed by cross-sectional regression analysis is used in this research to empirically investigate the role of firm resources on market value effects for S&P 500 companies experiencing a new product introduction delay from the perspective of signalling theory. To do so, a dataset is compiled using secondary data on new product introduction delays from LexisNexis News and stock market data from Wharton Research Data Services (WRDS), spanning a 20 year period from 1999 to 2018. Data on firm resources is retrieved from Compustat. Moving beyond the focal company, the short-term event study is also used to uncover the spillover effects of such delays for suppliers of a focal company. To do so, the Boeing 787 Dreamliner's introduction delays are used. This enables study of market value effects of new product introduction delays for the focal company (i.e. Boeing) and its suppliers. Further classification of suppliers gives further insight via t-tests. Secondary data is compiled from Bloomberg SPLC and Airframer to identify Boeing's and the Dreamliner's suppliers, whilst stock market data and further supplier data is retrieved from Datastream. This data focuses on the initial delay to the Dreamliner introduction in 2007 and a further delay in 2009.

The findings of this research provide important contributions to research and practice. The results advance the field by improving the understanding of the market value effects of new

product introduction delays for both focal companies and suppliers. The findings provide knowledge to how their firm resources may be associated with a more or less negative market value if and when they experience a new product introduction delay. It is imperative to uncover the market value effects of new product introduction delays beyond the focal company for other parties, such as suppliers, because not doing so missed a large part of understanding of what impact such delays have on various organisations. This research is intended to stimulate further research on what new product introduction delays mean for organisations in the hope of developing more effective ways of managing and potentially preventing such delays. The main limitations of this research are that the event study method assumes the efficient market hypothesis when in reality markets may not always operate perfectly efficiently. Secondly, event studies measuring market value changes can only analyse public limited companies (PLCs), meaning the impact of such delays on companies which are not listed on a stock market is uncertain.

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Chapter 1:

Introduction

1.1 Introduction to the research

New product introductions are when a firm brings a new offering to the market, often via searching or solving problems (Katila and Ahuja, 2002). Organisations must continually develop and successfully launch new products to survive and remain competitive via attracting customers and generating revenue. Successful new product introductions have been found to improve survival, market share and market value of firms (Banbury and Mitchell, 1995; Chaney and Devinney, 1992). However, firms are often late to the market with their new products, known as a new product introduction delay (Hendricks and Singhal, 1997; 2008; Chen *et al.,* 2007). For example, the Boeing 777X has been delayed until 2025 (Shepardson, 2022). This is an innovative wide-body aircraft with enhanced efficiency due to new technological advancements, such as folding wingtips which increase the surface area of the wing to reduce drag and thus fuel burn. Such delays not only have implications for organisations related to their development but also for consumers, society and the planet. Other examples of similar delays include the Tesla Cybertruck which would represent one of the only electric pick-up trucks, reducing carbon emissions at an important time in the climate crisis (Reuters, 2022). This vehicle was delayed due to setbacks relating to the COVID-19 pandemic according to Tesla.

Organisations often use preannouncements to signal to the market that they have an upcoming new product in the hope of exciting investors and customers (Sorescu, 2007), although this is potentially risky if the organisation cannot fulfil their promise by introducing their new product on time. Sometimes organisations preannounce new products before they even exist, known in the IT industry as vaporware (Bayus, Jain and Ambar, 2001). A new product introduction delay can have negative consequences for focal companies, i.e. those which are experiencing and announcing the new product introduction delay. For instance, a reduction in market value (Hendricks and Singhal, 1997), a decrease in operating performance (Hendriks and Singhal, 2008) and an erosion of brand trust (Hern, 2003). Furthermore, these consequences can affect other parties beyond the focal company, such as competitors who can experience a negative impact on market value too (Chen *et al.,* 2007). This is due to an information-signalling effect. Therefore, a comprehensive understanding of how new product introduction delays can affect a focal company and other partners, including suppliers for instance, is imperative. This could help to inform better ways of managing and potentially preventing new product introduction delays. Since new product introduction delays continue to be so prevalent and can

have significant negative consequences for firms, more needs to be done in their effective management. In particular, if environmentally friendly new products and new drug developments were introduced on time more often, the society and the planet could benefit too. Understanding the impacts of new product introduction delays has never been more critical due to recent worldwide social, political and economic events. For instance, the COVID-19 pandemic and invasion of Ukraine to name a few, have all caused large disruptions and challenges for organisations and their suppliers, contributing to new product introduction delays (Rockeman, 2022; Simchi-Levi and Haren, 2022).

This empirical research focuses on the impact of new product introduction delays, specifically on the change in market value associated with such a delay. In line with previous research featured in top journals in the field, including Management Science, by Hendricks and Singhal (1998; 2008), the reason for the delay is not accounted for. This assumes that delays are negative, undesirable events.

This research aims to further understanding of the market value effects of new product introduction delays for both focal companies and suppliers. This is important because in order to develop effective means of managing and potentially preventing such delays, organisations must first understand what impact such delays have on themselves and their suppliers. This forms an important and novel contribution as the role of firm resources in the impact of such delays for focal companies and the impact of delays on suppliers remains understudied. In doing so, this research fills important gaps in the literature on the impact of new product introduction delays for both focal companies and suppliers. This is intended to stimulate further research on the impact of new product introduction delays on both focal companies and their partners, such as customers and suppliers. Further study could lead to more effective ways of managing and potentially preventing new product introduction delays. This is important because of the known negative consequences of such delays.

Overarching aim: To improve understanding of the market value effects of new product introduction delays for focal companies and suppliers.

Research question: What are the impacts of new product introduction delays for the market value of focal companies and suppliers?

This introduction chapter provides context for the subsequent research. Firstly, it outlines the research aim of the overall thesis, as well as providing further detail of the various studies which make up the overall narrative. The research background is discussed about the key literature on new product introduction delays. The empirical background of the thesis is also discussed. Additionally, research philosophy is analysed. This research follows the thesis-structured-as-papers approach, with an overview of each details discussed later in this introductory chapter.

1.2. Research background

This section provides a literary summary of the key papers included later in the systematic literature review chapter of this thesis. This provides a research background for the subsequent empirical chapters. Important studies are critically analysed and synthesised together here to form a basis and motivation for the thesis. A comprehensive literature review is provided in the next chapter.

1.2.1 The impact of new product introduction delays on focal companies

Hendricks and Singhal (1997) use the short-term event study method to find empirical evidence for a negative stock market reaction associated with a new product introduction delay for publicly listed companies using a sample from the Trade and Industry Index (TRND) database and the Dow Jones News Service (DJNS) between 1984 and 1991. Th short-term event study method assumes the efficient market hypothesis, that is that capital markets respond quickly to new information. The event study method assumes the efficient market hypothesis, in other words that capital markets will respond quickly to new information (Fama, 1970; Ding *et al.*, 2018). The researchers motivate their research because consistently developing and launching new products had become more important during the time of publication because of increased competitive pressures; more firms entering markets wanting market share. Therefore, effectively introducing new products is key for maximising shareholder wealth, the primary goal of publicly traded companies. The study finds significant penalties for being late to market beyond a promised introduction date.

This paragraph will discuss Hendricks and Singhal's (1997) seminal paper in further detail. The market value of the study's sample decreased by 5.25% on average, representing a substantial dollar value of around -$119.3 million for these large organisations. Cross-sectional regression analyses reveal further insight into what factors affect the direction and magnitude of this change in market value. The test results reveal that the following are statistically significant predictors in the market value changes: competitiveness of industry, firm size and diversification. More specifically, more diversified firms experienced a less negative stock market reaction, highly competitive firms experienced a more negative stock market reaction, while providing an estimate of the expected delay time was associated with a less negative stock market reaction. This seminal paper was the first known study to provide empirical evidence for a negative market value effect of new product introduction delays for focal companies. However, this study, which was conducted quite some time ago, only considers a few basic dimensions in the cross-sectional regression model. Important factors, such as those relating to operating performance for instance, are missed. Additionally, the authors only consider the impact of such delays on a focal company. This only provides a narrow view of the impact of new product

introduction delays on market value because firms do not exist on a vacuum and rely on their suppliers to bring new products to fruition, customers to purchase such products and are influenced by competitors.

Hendricks and Singhal (2007) later studied the effect of product introduction delays on a different dependent variable to market value: operating performance. In particular, the study finds a decrease in profitability, measured as return on assets (ROA), following a new product introduction delay. They also consider sales over assets and return on sales, which both decreased too. Cross-sectional regression analyses reveal that profitability is more negative for firms that were more profitable before the new product introduction delay as well as for firms which operate in larger and more profitable industries. Overall, this paper shows that new product introduction delays can have negative consequences for operating performance, adding to their previous work on the negative impacts for market value (Hendricks and Singhal, 2007). However, there could be more consideration for the role in which various firm resources play prior to a delay. Additionally, they still only focus on the consequences for the focal company. This again limits our understanding of the impact of new product introduction delays for other partners.

1.2.2 The impact of new product introduction delays beyond focal companies

Building on Hendricks and Singhal's (1997) work, Chen *et al.* (2007) find that negative market value effects associated with new product introduction delays can also impact competitors. Using a sample of 324 new product introduction delay announcements from 52 industries between 1989 and 1997, they find that competitors of a firm announcing a new product introduction delay experience a statistically significant negative stock market reaction. Further analysis using cross-sectional regression reveals that the impact is negatively related to the degree of relatedness of the focal company announcing a new product introduction delay, for competitors in industries that are more likely to have delays and the level of the focal company's free cash flow relative to that of its competitors. Meanwhile, they find a less negative reaction related to the announcement effect of the focal company delaying the product, degree of industry competition and industry growth opportunities. This is the first known study to provide empirical evidence for the impact of new product introduction delays beyond the focal company, demonstrating a negative market value effect for competitors. However, no researchers have yet considered the impact of such delays for other key partners, including suppliers and customers for instance.

Overall, research on new product introduction delays so far has demonstrated negative consequences for the market value of being late to the market for focal companies and competitors. However, other key partners remain unstudied. Some factors which affect the

magnitude and direction of this relationship have been explored. Although, many other potentially important factors remain ignored, such as the role of firm resources prior to a delay for instance. Furthermore, existing research often does not use theory explicitly in their studies. However, this body of research broadly relates to signalling theory.

1.3. Empirical background

This research context draws on data from a couple of sources and empirical backgrounds in order to achieve the research aim of studying the market value effects of new product introduction delays for both focal companies and suppliers. This section gives an overview of the empirical background of the thesis.

1.3.1 New product introduction delays from the S&P 500 Index

To investigate the impact of new product introduction delays on focal companies, in particular the role of firm resources, delays from the Standard and Poor's (S&P) 500 index are utilised. This is a US stock market index which includes stock performance information of 500 of the largest companies listed on stock exchanges within the US. This also makes it one of the most commonly followed equity indices. As such, this enables the empirical research to be of broad importance and generalisable to similar contexts.

1.3.2 The Boeing 787 Dreamliner introduction delays

To investigate the impact of new product introduction delays on suppliers, a more focussed approach is taken on one particular new product introduction delay by a focal company and their suppliers. To enable this study, new product introduction delays from the Boeing 787 Dreamliner programme are used. This approach is taken because it is possible to dissect the impact of such delays on suppliers into different categorisations. More specifically, suppliers which were and which were not involved with the product being delayed as one example.

The Dreamliner programme was a large-scale undertaking for Boeing in an attempt to develop an innovative new aircraft (Aboussalah *et al.*, 2013). Not only were Boeing ambitious in terms of the product, which utilised a new material to aircrafts, carbon fibre, which enabled the plan to be lighter and therefore more environmentally friendly and lighter, whilst allowing for bigger windows to enhance the passenger experience and enable them to reconnect with the 'magic' of flight' but also in terms of supply chain management (Boeing, 2010).

In a departure to the usual approach to previous commercial aircraft manufacturing, Boeing decided to adopt a 'global manufacturing model'. This entailed a number of larger suppliers who

would take on the responsibility to manufacture various sub-assemblies; for example, the fuselage, wing assembly, engines, flight control systems; using parts and components from smaller suppliers across the world which were then assembled together to create the 787 Dreamliner at Boeing's plant in the North Charleston, South Carolina, the US. However, this radical new approach for the company proved problematic. Issues arose with quality, delays from suppliers and differences in standards when it came to bringing together components and sub-assemblies in the final assembly. This was time-consuming, costly and resource-intensive to eventually resolve. Although, the Dreamliner did go on to become a successful product in respect of sales, despite a number of other setbacks after its initial launch, such as battery fires which required addressing not without cost (Gokhale, Raghavan and Tremblay, 2014; Schwartz and Busby, 2014; Song *et al.*, 2014). The challenges Boeing found with its new approach caused a number of delays to the introduction of the new aircraft. This affected Boeing's Dreamliner customers, with the launch customer being All Nippon Airways (ANA), who had to find alternative aircraft either within their fleet or from Boeing or Airbus to fulfil their needs during the introduction delays of the 787 Dreamliner.

These empirical contexts enable the study of the impact of new product introduction delays for both focal companies and suppliers. Additionally, further analysis can be conducted on the role of firm resources for focal companies and various classifications of suppliers which will be detailed later.

1.3.3 Secondary data

Secondary data alone will be used to achieve the thesis' research aim of improving understanding of market value effects of new product introduction delays. This is because due to the phenomenon of the dependent variable being stock prices, such data can only be obtained by a secondary nature. Data will be collected from key databases, including: Bloomberg, Datastream by Refinitiv, Wharton Research Data Services (WRDS) and Lexis News. This empirical research follows literature obtained from a range of platforms, including: ABI Inform, Business Source Complete Science Direct and Web of Science.

A number of existing empirical studies in top journals (ABS 4* and 3*) utilise secondary data, with this approach increasingly attracting researchers. This is because secondary data analysis can enable research questions to be answered that otherwise would not be possible via primary data. Xiong *et al.* (2021) use secondary to find empirical evidence for a negative market value effect of environmental violations in China for supply chain partners. Meanwhile, Jacobs and Singhal (2020) utilise secondary data to study the 2015 Volkswagen emissions scandal. They find a negative market value effect across the automotive industry. Ding *et al.* (2021) find a

negative stock market reaction for firms' competitors in other countries using evidence from the 2016 Kumamoto earthquakes.

1.4 Research philosophy

This sub-section will reflect on research philosophy of the thesis. Ontology, epistemology and axiology considerations and research strategy and theory will form this discussion because these are highly influential on the research aim and questions and how the research is approached.

All of the data within this research is of a quantitative nature, enabling a coherent approach across the three papers. The underpinning paradigm of this research is of a positivist nature, whereby I view the phenomenon as if through a one-way mirror. This is approach is appropriate for the phenomenon under investigation because stock prices are numerical financial data, not involving a human aspect. Therefore, qualitative approaches involving interviews for instance would not be possible with this research design to achieve the research aim of studying the market value effects of new product introduction delays for focal companies and suppliers. This research aims to answer "what" style research questions, as outlined earlier, to quantify the impacts of new product introduction delays on stock prices for focal companies and suppliers.

The proposed research aim of improving understanding of market value effects of new product introduction delays for focal companies and suppliers looks to empirically study the stock market reaction to such delays. This will be done by using the short-term event study method which enables measurement of change in market value associated with new product introduction delays for both focal companies and suppliers.

Ontological considerations are centred around the nature of social phenomena. Objectivists view the social world as a dynamic entity that is changed by people. For example, implementing new policies and practices. This can lend itself to quantitative research. Ontological considerations for the chosen research area are objective because the financial reputation of suppliers can be measured using the share price. (Bryman and Bell, 2015). This does not require value judgements on human behaviour which would lean towards subjectivism; doing so would significantly alter the research question. This research takes an objective view on measuring changes in market value associated with new product introduction delays for focal companies and suppliers.

This research takes a positivist view. This involves formulating hypotheses and then testing them using precise measurement techniques, with similarities with natural sciences. The phenomenon of interest in this thesis is suitable for being studied this way as market value is perceived as an objective measure.

For this thesis, axiological issues are limited due to the nature of the research being positivist and objective; meaning by its very nature it excludes value judgements to measure the world in

the natural science way. However, there are still some important factors here. These include the consequences of objectivity. The findings of such research have some implications. Furthermore, ethics can also be a consideration here. Overall, the following section on practical considerations becomes more apparent for this type of research because of the research strategy being to use secondary quantitative data with an event study method. Edmondson and McManus (2007) stress the importance of methodological fit with the type of research phenomena being investigated. The event study method fits studying market value changes because the method allows researchers to see the impact of an event associated with a companies' stock price.

Epistemological and ontological considerations can have a significant impact on how business and management scholars within social science approach theory. The thesis' research area leans towards deduction because it intends to study the market value effects of new product introduction delays for focal companies and suppliers. The proposed research is based on theorical lenses of signalling theory and spillover effects, which are discussed in greater detail within the relevant chapters.

There is little consensus for what constitutes a theory, with more agreement on what a theory is not. (Sutton and Staw, 1995). For instance, they state that a hypothesis alone is not theory because it may lack enough supporting evidence. This would then need to be tested and verified by collecting data. Quantitative research, as with this thesis, can typically start with hypotheses due to its nature of theory testing.

However, there are elements of good theory that many scholars agree on. Good theory is important because it can help to justify why and how things are done. Whacker (1998) questions whether theory can be built that a collective can subscribe to or if it is always interpreted differently by people. Their research identifies elements of good theory; such as empirical riskiness which refers to underpinning arguments. This means that theory is testable and open for falsification by finding evidence to support or reject it. Parsimony means theory should contain the fewest possible elements to explain a phenomenon. Whereas, elements and arguments should not contradict other parts of a theory. In the proposed research, signalling theory and spillover effects help to explain the phenomena of market value changes associated with new product introduction delays for focal companies and suppliers respectively. In other words, new product introduction delay announcements send signals to the stock markets about focal companies. Through the lens of spillover effects, this thesis studies whether this impact flows to suppliers too. There are a number of criticisms of whacker's perspective. They do not include impact for industry and policy in their list which is increasingly important in terms of knowledge transfer and accessibility. This may perpetuate theory-driven research for the sake of advancing theory, lacking real impact on society and organisations. Additionally, abstraction and parsimony are questionable in an increasingly complex world. This contradiction could perhaps be resolved with representatives as an alternative.

In an attempt to help researchers build better theory, theorising can be useful in bridging the gap of what theory is. Weick (1995) recognises theorising as thinking about theory, seeing theory as a process which virtuously uses fact-finding to create and test theory (Cornelissen & Durand, 2014). However, there is a case against theory and theorising. Critics claim that too much of an emphasis on theory neglects the importance of fact-finding too which feeds into the process of theory-building and is necessary for theory to exist and industry impact. Theorising is important for finding common ground for debate on issues as theory can be difficult to agree on.

Corley *et al.* (2011) identify elements of a theoretical contribution. Originality can be more incremental in reality, such as adding boundaries to existing theory. Revelatory is bringing new phenomenon to the table and explaining or providing a better understanding of it. The idea of prescience is that rather than starting with the literature it should start with a particular issue organisations are facing then develop theories that explain how, when and why a phenomenon occurs in practice. Whetten (1989) refers to 'prescience' as a way of creating interesting research questions that have future impact, bridging theory and practice. Shapiro *et al.* (2007) also recognised that research should make a positive impact in practice rather than just be about finding the justified 'truth'. Empirical research is important in theory building. It could be concluded that although ultimately knowledge requires theory, theory does not just always appear out of nowhere and is closely linked with empiricism; the two are cyclical. Furthermore, it may depend on the state of the field (Alvesson, 2013). In conclusion, this research has a direct relevance to practice, which is analysed in detail within the discussion chapter. (Tranfield and Starkey, 1998; Rousseau, 2006; Bryman and Bell, 2015).

As explained earlier, this research uses solely secondary data. Therefore, no ethical approval was required to conduct these studies. Nonetheless, I have completed the University of Liverpool's ethics training on the 15th of May 2019, Epigeum certificate number: 00947. Even when using only secondary data, ethical considerations may still be important when exploring the implications of research findings and their application. Ultimately, no ethical issues are foreseen in this research. The unit of analysis of the research is not at the person level so no individual privacy concerns of anonymisation matters apply. No risk assessment was needed.

1.5. Thesis structure

This thesis follows a structured-as-papers approach to break the research up into digestible chunks that also relate together to form an overall narrative, linked by the introductory and discussion/concluding chapters. An outline of this structure is provided in Table 1. Collectively, these chapters come together to achieve the research aim stated earlier about studying the

impact of market value effects of new product introduction delays for focal companies and suppliers.

Table 1. Outline of Thesis-Structured-as-Papers.

Paper:	Paper 1	Paper 2	Paper 3
Title	Causes, effects and managing new product introduction delays: A systematic literature review with guidance for future research	The effects of new product introduction delays on market value: The role of firm resources with evidence from the S&P 500 Index	Suffering together? The effects of new product introduction delays on the market value of suppliers: Evidence from the Boeing 787 Dreamliner
Methods	Systematic literature review	Short-term event study, Linear regression analysis	Short-term event study, t-tests
Research Questions	1. What are the causes, effects and ways of managing new product introduction delays? 2. How have new product introduction delays been studied and understood so far, e.g. method and theory? 3. What are the future research avenues for new product introduction delays?	1. Do investors react differently to positive (preannouncements) and negative (delays) signals? 2. Which firm resources moderate market value when there is a delay? 3. Are there interaction effects between firm resources?	1. What is the impact of Boeing's Dreamliner introduction delay on its suppliers? 2. Is there a difference in impact depending on whether suppliers are involved with the Dreamliner? 3. What is the impact of a further delay to the Dreamliner on suppliers? 4. How do the impacts of the Dreamliner introduction delay vary across suppliers based on their location? 5. Is there a difference in impact depending on supplier relationship value?
Theoretical Lens	Not applicable (systematic literature review)	Signalling theory	Contingency theory

As identified in table 1, this thesis will be structured as three papers and will form an overall narrative. As such, each paper has its methodological approach. The first paper will take the form of a systematic literature review, whilst the following two papers will be of the empirical kind, employing the short-term event study method. Although both these papers are short-term event studies, they use the method in different research contexts and therefore with some nuances which will be explained in more detail below and within each paper.

The first paper in the thesis takes the form of a systematic literature review of 54 peer-reviewed journal articles, providing an integrative view of the state of the literature on new product introduction delays. The review categorises the literature according to causes and effects of new product introduction delays, as well as ways of managing them. From this review, potentially fruitful future research directions are derived. These key research avenues form the basis of the subsequent empirical studies of this thesis. In particular, there are significant gaps on the role of firm resources on the market value effects of new product introduction delays for focal companies. Additionally, the market value effects of these delays for suppliers has not been studied.

The second paper in the thesis is a short-term event study of 194 new product introduction delays experienced by S&P 500 Index companies in the US from 1999 to 2018. This empirical study investigates the impact of new product introduction delays on the market value of focal companies from the perspective of signalling theory. Following analysis of the main effect, cross-sectional regression analysis is used to uncover important firm resources which may affect the direction and magnitude of this relationship. More specifically, profitability, advertising intensity, operational slack, and the interaction effect of operational slack and advertising intensity are studied.

The third paper of the thesis takes a retrospective study of the Boeing 787 Dreamliner's introduction delays, also using the short-term event study method. However, here the method is used to measure the impact of the delays on Boeing, as well as all of Boeing's suppliers and all of the Dreamliner's suppliers to test whether there is a spillover effect beyond the focal company and beyond suppliers which are directly involved with the affected delayed product. Multiple event studies are used to explore the market value effects of the Boeing 787 Dreamliner's introduction delays on suppliers which are related in the US, the same country as Boeing, or not; based on whether they have a high or low relationship value with Boeing and also the market value change associated with the first delay compared to a further delay is analysed. Following this t-tests are used to compare these classifications to see if there is any significant difference.

To summarise, the three papers are presented in chapters 2, 3 and 4 respectively. Following this, a discussion and conclusion chapter is included to bring together the findings of each paper into a coherent analysis and situate the findings in the body of literature on new product introduction delays. Additionally, potential future research directions are highlighted.

1.6. Conclusion

This introduction chapter has provided an overview of the research problem about the gap in understanding of the market value effects of new product introduction delays for focal companies and suppliers. Little empirical attention has been paid to the role of firm resources on the market value of focal companies experiencing delays and how such delays may also affect suppliers. Such knowledge could provide important contributions in developing more effective ways of managing and potentially preventing new product introduction delays. This introductory chapter has also outlined the structured-as-papers approach to the thesis, including a systematic literature review followed by short-term event studies relating to focal companies and suppliers. This thesis is quantitative, adopting a positivist paradigm.

The key literature summarised new product introduction delays can have a negative impact on the market value of focal companies (Hendricks and Singhal, 1997) as well as on their operating performance (Hendricks and Singhal, 2008). Furthermore, such delays can also affect competitors (Chen *et al.,* 2007). However, this leaves major gaps in understanding of the impacts of new product introduction delays on market value.

The first paper within this thesis takes the form of a systematic literature view to provide a comprehensive and integrative view of the state of the literature on new product introduction delays by identifying the causes, effects and ways of manging such delays, as well as providing guidance for future research. This forms the basis upon which the following two empirical papers are derived. The second paper studies the impact of new product introduction delays on focal companies by considering the role of firm resources. The third paper investigates the impact of new product introduction delays on suppliers by using evidence from the Boeing 787 Dreamliner programme. Finally, a discussion/conclusion chapter brings these findings together into a coherent narrative and positions the findings within the existing body of literature. Future research directions are identified.

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Chapter 2:

Causes, effects and managing new product introduction delays: A systematic literature review with guidance for future research

2.0 Abstract

Through a systematic review of 54 peer-reviewed journal articles, this work provides an integrative view of the state of the literature on new product introduction delays. This aims to critically synthesise existing studies in the mainstream literature on new product introduction delays which is done by categorising the literature according to causes and effects of such delays as well as ways of managing them. From this, key gaps in the literature are derived to provide directions for future research on new product introduction delays, particularly involving under researched areas such as the impact of delays beyond the focal company, intended to advance the debate on product introduction delays in general.

Key Words: New product introduction delays, causes, effects, managing delays, systematic literature review

2.1 Introduction

Organisations must introduce new products to survive by keeping the interest of their customers to generate revenue (Owens, 2007). However, all-too-often delays occur in this process. New product introduction delays occur often, defined as being late to the market (Hendricks and Singhal, 1997). 'New' products can refer to new technologies and innovation being implemented into novel products as well as other types of new products identified in the literature, such as implementing existing technologies into new products or transferring technologies from other products or markets into a new product or market (Johannessen, 2001). Despite some research on new product introduction delays, they still occur frequently in industry. In the literature, 'product' can typically refer to either a product or service and often researchers do not differentiate between product type, i.e. technologically new products or existing technologies which are used in new products or transferred from other contexts for instance. By drawing on this literature and identifying gaps in what is known on product introduction delays, this paper poses potentially fruitful future research avenues to improve the

understanding of product introduction delays. This is intended to spark further discussion on product introduction delays and how to address them (Ozer and Uncu, 2013).

Despite vast research on product introduction delays, they still occur frequently in industry. This is the problematisation of this research (Lock and Golden-Biddle, 1997). Delays may be persistent and can be due to a range of internal and external issues, such as challenges arising from complexity, difficulties relating to project management issues and supply chain management problems (Chirumalla, 2018). They can have detrimental impacts on their organisations, such as harming the share price, reducing sales volume and revenue, and losing out to competitors. (Hao and Wang, 2016). Whilst it is accepted that product introduction delays can be harmful to their organisations, less is understood about the supplier-specific impact. This is key in manufacturing firms due to the nature and criticality of their supply chains. New product introductions are highly important to organisations, both within and outside of an operations and supply chain context. This is because they act as signals to external parties, such as signifying shareholder value or consumer confidence. This paper will explore the nature of product introduction delays and their characteristics (Cole and Matsumiya, 2007). This review's research questions are:

1. What are the causes, effects and ways of managing new product introduction delays?

2. How have new product introduction delays been studied and understood so far, e.g. method and theory?

3. What are the future research avenues for new product introduction delays?

This will be tackled by systematically reviewing all appropriate literature on new product introduction delays to assess the state of the field in an attempt to analyse causes, effects and ways of managing delays, as well as to uncover missed yet fruitful research avenues to further the knowledge base. This will draw from fields beyond operations and supply chain management (OSCM); including economics and marketing; as the pertinent literature on product introduction delays in these areas is informative and insightful for the research question in creating a holistic understanding of product introduction delays. The literature will be categorised into causes, effects and managing delays. The systematic nature of the literature review seeks to retrieve all relevant papers on new product introduction delays. Therefore, logically categorising the literature into causes, effects and manging delays follows the nature of how delays unfold. In light of the overall research aim of the thesis to improve understanding of the impacts of new product introduction delays, groundwork must first be appropriately conducted via this systematic literature review. In order to understand the effects of delays, causes of such delays must first be reviewed. Alongside knowledge of current ways of managing

delays, understanding the state of the literature on new product introduction delays holistically is key to identify gaps in knowledge. It is hoped that by addressing these gaps and in seeking to further understand the impact of such delays that better ways of managing delays could be developed in the future.

This literature review and the subsequent research avenues derived from it are important as a contribution to knowledge in the area of business and management because the long-term survival of businesses often depends on their ability to successfully introduce new products (Owens, 2006). With Owens even describing this as the 'lifeblood' of an organisation. This is of particular interest at the time of writing because customers are demanding more products quicker than ever before and expecting a higher quality with impressive technological advancements. Such demands and in particular technology advancements, can put further strain on the product introduction process by adding complexity and requiring the need for supply chains configured in new ways. Due to recent supply chain challenges, many projects failing to meet their critical success factors, and ambitious technological advancements, navigating successful new product introduction has never been more paramount.

2.2 Methodology

A systematic method has been chosen over other forms of literature reviews to be reproducible, transparent and comprehensive, capturing all relevant literature (Tranfield, Denyer and Smart, 2003). This helps to avoid systematic bias in the review which could otherwise influence any conclusions drawn if the researcher were to select articles themselves. The process will be documented to enable such replicability, enhancing external validity. Despite this being a systematic literature review, elements of critical reviews will be included to analyse, compare and evaluate the literature in-depth. Conceptual review elements will also be used to group articles thematically. The search was updated as of the end of December 2022.

The search was not restricted to only top four and three star journals in the discipline of operations and supply chain management; for example Operations Research, European Journals of Operation Research, International Journal of Operations and Production Management, Journal of Product Innovation Management, Journal of Operations Management, International Journal of Production Economics and Management Science. This is because doing so would have excluded insightful literature which has contributed new knowledge or moved research forward into other areas, such as Cole and Matsumiya (2007). Conference papers were excluded due to their provisional nature. A range of databases has been used to ensure that all relevant literature is captured, as detailed later.

Exclusion criteria included any papers which were not directly related to new product introduction delays within relevance or implications to the domain of operations and supply

chain management; or any papers which merely mentioned delays, with the inclusion criteria being the reverse. This ensured all related papers were found, giving a reasonable sample. No date criteria were used to ensure all relevant literature was retrieved. Seminal papers or any date were also used, via manual searching and citation tracking for efficiency, relevance and depth. The systematic search process was as follows consecutively and shown below in Table 2 and was inspired by Tranfield, Denyer and Smart (2003).

1. Search and elimination of duplicates

The key words [product introduction delay*][1] were searched for in the titles and abstracts of the papers. Other similar search terms, including [new product delay*] were tried but returned a large amount of irrelevant papers. Other ways of phrasing the search terms, such as product launch delays found practically no difference in search results. After initial experimentation, the defined search terms were most suitable for relevancy and finding all related papers. The combined searches across the 4 databases; Business Source Complete, Web of Science, ProQuest and Science Direct; resulted in 905 results. This large number is expected in the initial search during a systematic literature review due to duplicates between the 4 databases used.

2. Title and abstract analysis

The different databases were merged and duplicates removed. Many duplicates were expected due to the nature of searching the same search terms across multiple databases in order to be exhaustive in capturing all relevant literature. The titles and abstracts were read to assess whether the papers fulfilled the basic criteria of relevance, as explained earlier. Considered as non-relevant articles were those not investigating product introduction delays with some OSCM relevance. This resulted in a reduction of papers, leaving 75 remaining.

3. Full text analysis

All remaining articles were retrieved from their databases and put into reference management software: Mendeley. The full texts were read to enable a comprehensive assessment of relevance, leaving 45 papers. This relatively small discrepancy between the previous step is due to the care taken earlier on in narrowing down the search results to those which are relevant to this review.

4. Manually searching and citation tracking

Through manually searching and citation tracking, a further 6 papers were added. There was a final sample of 54 papers.

[1] Truncation: Asterisks (*) at the end of keywords are used to enable searching of similar variations of the same root word. (e.g. Using delay* will enable results containing words such as delays, delayed and delaying).

Table 2. Systematic Search Procedure.

Filter	Description	Business Source Complete	Web of Science	ProQuest	Science Direct	Total
Step 1	Articles with selected keywords	44	344	349	168	905
Step 2	After merging results from different databases, deleting duplicate articles and reading titles and abstracts.					75
Step 3	After reading the full articles and eliminating non-relevant articles					45
Step 4	Manually searching and citation tracking					9
	Final Sample					54

Search criteria for Business Source Complete: Search Modes (Boolean/Phrase); Apply related words; Only Scholarly (Peer-reviewed) Journals; Publication Type (Journal Article); Language (English); Document Type (All); Geographic Region (All). Search strings: product introduction delay* in title or abstract.

Search criteria for Web of Science: Date Range: Citation Databases: Science Citation Index Expanded (SCI-Expanded); Social Sciences Citation Index (SSCI); Arts & Humanities Citation Index (A&HCI). Document Type (Journal Article); Language (English); Search strings: product introduction delay* in title or abstract.

Search criteria for ProQuest: Only Scholarly (Peer-reviewed) Articles; Search strings: title(product introduction delay*) OR abstract(product introduction delay*)

Search Criteria for Science Direct: Source (Journal); Subject: Business, Management & Accounting. Search strings: product introduction delay in abstract or title.

2.3 Descriptive Results

This section will provide descriptive statistics for the results of the sample. Figure 1 demonstrates the distribution of articles per year, showing that the research area has a steady growth rate and reinforcing that this is an important area of interest for researchers with potential for further studies to develop understanding of new product introduction delays. The papers and the discussion section of this review were categorised, as detailed in Table 3 and shown Figure 2, to allow a coherent and integrated analysis of the findings. The papers and themes were then re-ordered to enable a logical, integrative, analysis. In the Appendix 1, Table A6 shows an overview of all papers retrieved from the literature search.

Figure 1: Maturity of the Field

Figure 2: Literature Output by Category

Managing delays
22%

Cause of delays
50%

Effects of delays
28%

Table 3. Literature Output by Category.

Category	Literature Output
Cause of delays	27
Effects of delays	16
Managing delays	11

Figure 3: Overview of Themes and Sub-Themes

Strategic delays	Financial consequences	Avoiding preannouncements
Causes of delays →	Effects of delays →	Managing delays
Technological innovation	Shortened product lifecycle	Design to manufacture
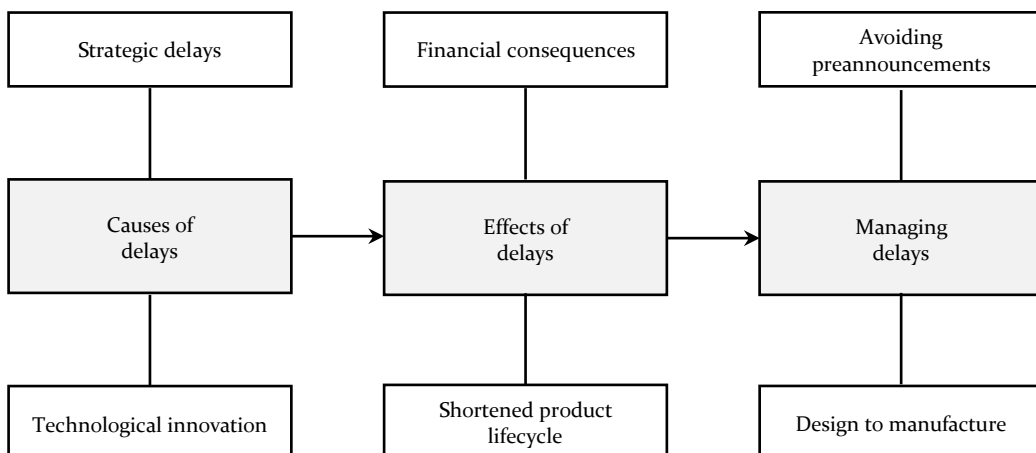
Only 6 of the 54 papers captured in this review were qualitative studies. The vast majority of papers relied on econometrics modelling. This assumes a positivist view, unsurprising in the field of operations and supply chain management and for this phenomenon where the unit of analysis is not individuals, human behaviour or psychometrics. Nonetheless, the literature could benefit from interesting insights from a broader range of methods. Thematic taxonomisation has been used to visualise in Figure 2 the split between the number of scholarly peer-reviewed journal articles between key themes. These is an overlap of some of the themes as the phenomenon cannot be distilled into neat silos. Major themes like causes can be identified containing interplaying factors, such as technology and innovation. The themes derived from the literature were then ordered logically in a sequential manner pertaining to product introduction delays. Some specific themes relate to broader themes: causes and delays on purpose are both causes in general and financial implications and consequences are both consequences in general. This approach of discussing the literature in grouped themes enables a logical and detailed analysis, such an approach follows similar approaches used by other authors like Elgazzar, Tipi and Jones (2019) who use the literature they are reviewing and how the papers' authors identify their literature as causes or implications and then builds this into their framework. Figure 3 shows an overview of themes and sub-themes. Ultimately, the scope of this is driven by the review's research questions.

Table 4 and Figure 4 show the split of the literature by method. The vast majority of the literature used is quantitative, mostly being econometrics; with only 6 studies being qualitative, using interviews. To be noted, this graph groups the methods used in the literature rather than the quantity of papers themselves so there may be more methods here than accounted for by paper number due to some few authors selecting to use multi-method approaches. The methodology used most by authors in the new product introduction delays area is econometrics modelling. Some papers also use questionnaires or event studies. This analysis of the method used so that there is great scope for methods beyond econometrics. For example, there are only a couple of event studies in this area so that could be expanded to apply to other distinct areas of new product introduction delays. Furthermore, there are very few qualitative studies which could be interesting in this area of OSCM. Ultimately, a holistic approach to methodologies is required to better understand the phenomenon so a wider range of methods used with more balance could be insightful for future research in this area.

Table 5 shows the use of theory across the papers identified. Most of the papers lack explicit use of specific theory altogether, highlighting the need for stronger theory support in studies relating to new product introduction delays. For those that did use theory, game theory was the most popular; unsurprising due to the economics nature of many of the papers. It should be noted that some papers used more than one theory, reflected in the table.

Overall, this section has provided insight into a statistical overview of the literature reviewed. This shows that most of the research is quantitative, assuming a positivist underpinning, and often relies on economics modelling for the method. The literature can be categorised into broad themes derived from the literature, relating to causes, consequences and resolution.

Figure 4: Literature Output by Method
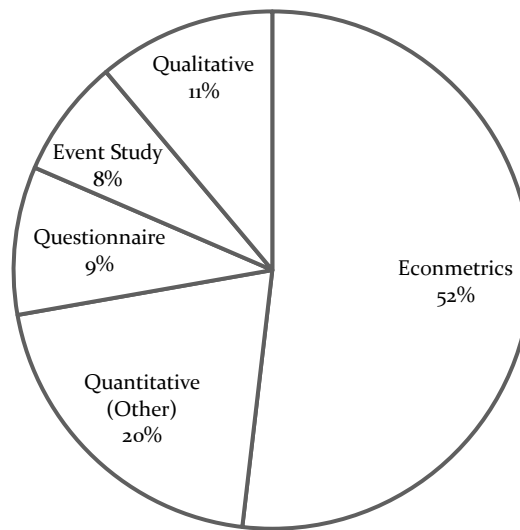
Table 4. Literature Output by Method.

Methodology	Literature Quantity
Econometrics	27
Quantitative (other)	12
Questionnaire	5
Event study	4
Qualitative	6

Table 5. Literature Output by Theory.

Theory	Literature Quantity
Not explicitly stated	42
Game theory	3
Behavioural theory	1
Performance feedback theory	1
Trade-off theory	1
Informational leverage theory	1
Single-person decision theory	1
Ratchet effect	1
Signalling theory	1
Spillover effects	1
Competitive effects	1
Viral dynamics theory	1
Commitment-trust theory	1

2.4 Discussion

Researchers of new product introduction delays write from many different perspectives, such as strategy and marketing. Being holistic and combining these approaches is imperative in building a comprehensive view of product introduction delays. A significant number of the papers talk about cannibalisation and how firms may choose to delay product introduction delays on purpose for strategic reasons, such as to maintain strong sales growth of existing products before they begin to wane (Moorthy and Png, 1992; Boone, Lemon and Staelin, 2001; Krankel, Duenyas and Kapuscinski, 2006; Li *et al.*, 2010; Wang and Hui, 2012; Bilginer and Erhun, 2014). This is relevant to the research question of this literature review even when product introduction delays are made as a deliberate decision because they still have a multitude of consequences on various related parties, like suppliers. Although some of these papers assume that product introduction delays are a deliberate decision, this is not always the case. This does not focus on issues outside of the organisations control, such as natural disasters causing logistical issues for example. Though, whatever the cause, delays still lead to a range of consequences. This section will critically review the literature identified earlier via the themes set out to enable a logical analysis. Much attention has been paid to studying the causes of delays but less to the effects and

managing delays. Better understanding the effects of such delays could help to inform more effective ways of managing delays.

2.4.1 Causes of delays

Delays happen for a reason and there can be various factors that lead to a new product introduction delay (Hendricks and Singhal, 1997). This sub-section will critically review the literature on the causes of such delays. For instance, sometimes organisations decide to delay on purpose. Other times, there may be technological or innovation reasons for delay. Theory used in the literature on delays is mostly deductive (Seuring *et al.*, 2020). Although, many extant studies lack explicit use of theory. The current knowledge on new product introduction delays could be extended via further investigation (Breslin and Gatrell, 2020).

Owens (2007) focuses on a UK context and SMEs and provides empirical evidence for a number of propositions derived from innovation management literature on the introduction of new products. Reasons are found for delays: poor definition of product requirements, technological uncertainties, senior management support, lack of resources and poor project management. Concerns include management and organisational style lack of attention to detail, support for innovation, lack of strategic thinking and poor manufacturing capabilities. However, this paper does not consider cost and profit pressures. Rosas-Vega and Vokurka (1980) explain how research showed that being first to market is critical, as opposed to quality as the top competitive priority. This contrasts to Rosas-Vega and Vokurka's (2000) later paper which found quality was key in achieving competitive advantage in the 1980s as an order-winner. However, now industry pressures make first-mover advantage critically important.

Parker *et al.* (2017) argue that when quality performance differs to what a firm intended, they slow the rate of product introductions. The study then tests their findings under two boundary conditions: stability of quality reputation and high sales revenue. Cole and Mutsumiya (2007) change direction and question if quality be too much of a good thing, serving as an impediment to innovation; linking to Parker *et al.*'s work (2017). A focus on quality is compatible with incremental innovation but not with radical or disruptive innovation. Prieger's (2007) paper classifies delay between feasible technology introduction and submission to regulators as innovation delay. Firms subject to regulation often claim that getting new products approved is expensive and inhibits incentives to innovate with new product introductions. This paper is one of the first to acknowledge different forms of delay as distinct in relation to regulation.

Li, Graves and Rosenfield (2010) study planning production quantities when a new product replaces an old one but there is no replenishment available during the transition in attempt to understand demand-supply mismatches. Therefore, this paper assumes there is an existing

product. Customers may be using similar substitute products or making do with competitors so the effects may be similar in other circumstances, though this needs to be empirically tested in further research. Because of uncertainties, extreme cases of demand and supply mismatches can be encountered. However, papers related on this notion of cannibalisation do not consider the potential pressure of competition and that in some contexts it may be necessary to release products without delay. Few studies in this area have explored this empirically and compared instances of such competition between organisations.

Our review now moves to delays made on purpose for strategic reasons. Putsis (1993) finds there are multiple reasons that may delay, or increase speed, of a new technology in a product to the market. Such as sales performance of existing products and cross-product effects. Bhattacharya, Krishnan and Mahajan (2003) research when is appropriate for organisations to have new product introductions and find that incorporating technology in new products in many technology-based markets is key; previous research found low-end products should not be launched before high-end products to avoid cannibalisation. However, there is a trade-off here as technology improvements can delay the introduction of high-end products. Wang and Hui (2012) find deliberately delaying product introductions can be beneficial to organisations, even when the necessary product technology is available. Li, Graves and Rosenfield (2010) take this further for the context of a new product replaces a previous one. Replacing an existing product with a new one presents many challenges, to address this a new product may be offered when an old one runs out of stock. As product life cycles become shorter, managing product transitions has become a major challenge as the optimal substitution point is time-varying. Substitution reduces the need to hold the old product which can increase profitability. However, that does not help when an old product's stock runs out before a new product is ready. The authors determine the optimal delay in new product introductions based on the inventory of a given existing product. Bilginer and Erhun (2014) then employee this in the context of capacity-constrained organisations. As the holding cost of capacity increases or delay sensitivity decreases, immediate product introduction may be preferred.

Krankel, Duenyas and Kapuscinski (2006) explore organisations deciding to delay product introductions to include further technology improvements. Contrary to cannibalisation, some firms delaying introduction on purpose to include more new technology in their products may inhibit the sales of existing products. However, this can slow sales of existing products. This contrasts the previous findings on cannibalisation. Wang and Hui (2012) that consumers will see that such delays are for new technology to be incorporated and so may hold off purchase until a later date. However, more research is needed to explore under what conditions this is most prevalent. Moorthy and Png (1992) build on cannibalisation where there is multiple product introductions. This paper unrealistically assumes an organisational context where there are two distinct customer segments where demand is static and known and technology is in

place to exist both products.. Boone, Lemon and Staelin (2001) move the discussion forward for what this introduction framed as a strategic choice for organisations means for consumers and therefore future product introductions, finding that consumers may decide to buy a product with new technology based on expected benefits.

Overall, this sub-section has found that pressures on organisations to continually innovate and launch new products can put strain on their operations and sometimes lead to delay. Additionally, highly technological and innovative products can experience more problematic delays. Factors such as complexity and quality can also influence delay. Conversely, even when an organisation makes a conscious decision to delay a new product introduction for strategic purpose the consequences can still sometimes be negative, as with unwanted delays due to poor management for instance.

2.4.2 Effects of delays

There can be a number of, typically negative, effects of new product introduction delays. For instance, financial implications. This sub-section will critically review the literature on the consequences of such delays.

Hendricks and Singhal (1997) focus on the stock market returns when an organisation is late to the market using an event study. This research assumes the efficient market hypothesis and due to the nature of the research design can only analyse PLCs. Consistently developing and launching new products had become more important during the time of publication because of increased competitive pressures; more firms entering markets wanting market share. Therefore, effectively introducing new products is key for maximising shareholder wealth, the primary goal of publicly traded companies. Critically, event study methodologies do not measure the direct impact of stock market returns, they instead use a model, such as the market model, which takes into account confounding events by using an event window. The paper finds significant penalties on being late to market beyond a promised introduction date. The market value decreased by 5.25%. The following factors are statistically significant predictors in the market value changes: competitiveness of industry, firm size and diversification. Additionally, regression analyses were used to identify factors that impact the direction and magnitude of market value changes, common with event study methods. Hendricks and Singhal (2008) later studied the effect of product introduction delays on a different dependent variable to market value: operating performance, in particular profitability, which they measure as return on assets and observe a significant decrease associated with a delay. Chen *et al.* (2007) find that this negative impact spills over from the focal company to competitors. Alternatively, Moorman et al. (2012) research how firms influence their stock market valuations by timing the introduction of innovative new products. These group of papers adopt a signalling theory perspective.

Shapiro (2016) explores the cost of strategic product introduction delays on firms and consumers. This research is based on pharmaceuticals, as with other similar papers, such as Figueiredo and Loiola (2017) and Chambers, Snir and Ata (2009). Because of regulation, in the US new drugs enjoy a period of exclusivity. Therefore, firms have an incentive to delay introductions of new products until the patents of existing products expire. There is significant literature on strategic delay but less is understood about its effects on consumers and firms. This is similar to product introduction delays in general which has significant literature but the effects of which, on particular parties like suppliers, are less explored.

Bayus, Jain and Ambar (2001) coin product introduction delays in the software industries as "vaporware" to investigate the consequences of new product announcements when the product is not finished yet, taking the perspective that a new product announcement is used as a strategic signal. Figueiredo and Loiola (2017) illustrate the impact of product introduction on research and development. Based on a pharmaceutical company, a dynamic model is used to see the impact of innovative product introductions on R&D performance. The key problems are which and how many projects should be undertaken and which should be terminated. The project introduction rate can be improved by using an adequate rule of thumb. In the pharmaceutical industry, value is eroded when introductions are slower. There are also regulatory issues, as with other industries such as aerospace so this has abstraction beyond the pharmaceutical industry.

Overall, this sub-section finds that there is evidence to suggest that new product introduction delays can have a significant impact on the stock returns of their organisations. This means that organisations must take new product introduction delays seriously and attempt to avoid or reduce them, which leads onto the next sub-section.

2.4.3 Managing delays

O'Driscoll (2002) found that 'design for manufacture' is a means of reducing delays. This is because delays can be contributed to by poor product processes because of insufficient reconciliation of process capabilities with design requirements as key processes are often poorly understood. Firms should consider how its manufacturing process will work at an early stage of product development to minimise delays by reducing production issues. However, a major limitation of this research is that the study does not consider how this many apply to service-based products. More attention is needed in studying ways of reducing delays in a service context. In particular, researchers could consider if any aspects of the current approaches to reducing delays in product manufacturing scenarios could apply to services with some tailoring. Standish *et al.* (1994) identify using electronic data transfer to facilitate effective communication between design and manufacturing functions. However, this paper is quite outdated and most

companies are now using some form of electronic data transfer, such as enterprise resource planning. Though, to varying levels and efficiencies; such as enterprise resource planning.

Alhumrani and Qureshi (2016) seek to resolve delays caused by project scheduling issues under multiple resource constraints. The authors find that a genetic algorithm resource-constrained project problem of scheduling can be resolved to allocate resources efficiently. Arnold and Floyd (1997) investigate business process re-engineering. This is the first paper analysed to explicitly use the term reengineering as an important and effective means of speeding up product introductions. Benchmarking and process reengineering within a business unit led to significantly faster product introductions and response to consumer needs.

Özer and Uncu (2013) seek how to optimise decisions on speeding up new product introductions. How much a firm can produce depends on how soon they have decided to go to market. However, this assumes that delays are caused by demand fulfilment issues which is only one part of the picture, as discussed throughout this review. Other key factors, such as supply chair configuration and technological advancement in products are key. Long product introduction delays allow competitors to enter the market which reducers the suppliers' market share. This paper establishes that organisations should not enter a market if they cannot produce enough as per a predetermined threshold and develops a two-stage framework to optimise timing of new product introductions. Chambers, Snir and Ata (2009) explore flexible production but finds that it is expensive so mostly appropriate for large capacity contexts. However, this assumes that in a given context that the delay is caused by production issues. This is only part of the picture, showing delays pertaining to supply chain configuration, customer requirements and technological innovation.

Chirumalla (2018) used semi-structured interviews within a case study research design of heavy-duty vehicles industries. All project managers were interviewed reported that timing the correct resources is a significant issue in new product introductions. They found that issues contributing to delay include poor communication and missing learning opportunities. The authors argue their qualitative approach is important for an in-depth understanding of industry practice with project managers. However, data access can be challenging as organisations often withhold information on new products and avoid discussing delays and setbacks which can spook investors.

Li and Zhu (2009) critically question whether certain products should be introduced at all based on their projected performance. There is a decision organisations must make here on when to pay to acquire information to forecast the product introduction performance. Introduction issues can be expensive so organisations must acquire costly information from various sources to make strategic decisions on new product introductions. Although, this study assumes that such information forecasting is available and that such data will be the 'right' data and accurate. This study finds purchasing forecasts sequentially can lead to a significant profit

advantage based on the mediator variable of cost of information acquisition being moderate and the profit margin of the new product is small.

Overall, this sub-section finds that despite the vast literature on reducing new product introduction delays they still occur in industry. Therefore, more research is needed to continue this debate and increase the knowledge base on new product introduction delays.

In conclusion, we have critically reviewed and synthesised the new product introduction literature. It has been found that the key literature on new product introduction delays shows that new product introduction delays can be caused by very technologically innovative products which take longer to develop. Moreover, organisations sometimes decide to delay products on purpose, for reasons mainly about avoiding cannibalisation and staggering implementation of innovation in new products to maximise profits. Though, this can have unintended consequences similar to unwanted delays. For instance, new product introduction delays can cause significant harm to their organisations, in particular to their stock price which can decrease by over 5%. These key findings and gaps identified from this review is used to inform and generate potential fruitful research directions which will be derived in the following section.

2.5 Future Research

There is potential for fruitful new research on new product introduction delays. Linking back to the problematisation of this research, although the literature may understand causes and attempts to reduce delays, less is known about the impact on other involved parties, such as suppliers.

Research Avenue 1 - The role of firm resources in new product introduction delays

It is known from the literature that new product introduction delays can have a negative impact on market value (Hendriks and Singhal 1997; Chen *et al.*, 2007), alongside key factors relating to the delay announcement, such as if a time length for the delay is given for instance. However, less has been studied on the moderating role of firm resources, such as profitability, operational slack and research and development intensity to name a few. Interaction effects between these variables could also be explored to provide further detail. Research in this area could offer useful insights on bettering our understanding on what factors affect market value when there is a new product introduction delay. This knowledge could then be used to develop more effect ways of managing new product introduction delays.

Research Avenue 2 - The impact of product introduction delays on suppliers

There are very few papers focussing on the consequences of new product introduction delays on market value beyond the focal company. It is known from previous studies by Hendriks and Singhal (1997) that delays can affect stock prices for focal companies and also competitors (Chen *et al.,* 2007) but the effect on suppliers remains uncertain. This is important because the financial viability and performance of suppliers can have an impact on their ability to meet their requirements as a supplier. This is intended to spark further discussion on product introduction delays and how to address them (Ozer and Uncu, 2013). In particular, such research could differentiate between different types of suppliers - for instance, those which are and are not related to the product(s) being delayed. Further analysis could illuminate which types of suppliers experience a more or less negative share price reaction, such as based on their relationship value with the focal company. Other supply chain partners could also be studied, such as customers, and also second tier suppliers.

Research Avenue 3 - The difference between the consequences of product introduction delays when strategic or accidental

Some researchers have focused on delay as a deliberate strategic choice while others have not (Moorthy and Png, 1992; Boone, Lemon and Staelin, 2001; Krankel, Duenyas and Kapuscinski, 2006; Li *et al.,* 2010; Wang and Hui, 2012; Bilginer and Erhun, 2014). However, no authors have compared and contrasted the consequences of the delays stemming from both distinct roots. Such research could help to bridge the understanding of what delays mean for organisations as a holistic issue and what decisions can be made around delays where possible. Furthermore, authors do not seem to investigate potential unintended consequences of deliberate delays as a strategic choice. In other words, even if a decision to delay is made on purpose for potential benefits, there still may be some other negative consequences of delays. This remains empirically unexplored. Authors could differentiate between strategic and accidental in their research, particularly when studying the effects of new product introduction delays, rather than just the causes.

Research Avenue 4 - Managing innovation, research and development on new product delays

Whilst the research find that technologically advanced products can sometimes increase a product's likelihood to be delayed because of the ambitious and new technologies causing unexpected problems that take more time to resolve, not enough is known about how to deal with getting to market quickly with highly innovative products. This is important as such products are key in achieving competitive advantage to maximise sales revenue. Researchers could differentiate between various types of 'new' products.

Research Avenue 5 - Why new product introduction delays happen

Although there have been several studies on the causes of new product introduction delays, the vast majority of these have been quantitative in nature. By using qualitative methods, such as interviews for instance, insight into why delays may happen and how organisations come to delay a new product could provide fruitful knowledge on new product introduction delays.

Ultimately, these identified research avenues are aimed at covering some of the significant gaps in the literature on new product introduction delays as well as stimulating the debate and research on the area. It is hoped that such knowledge creation and understanding can be applied to industry to help organisations better manager their new product introductions.

2.6 Conclusion

Overall, the problematisation of much of the literature seems to follow a similar theme, even as the publications get more recent. That is, that new product introductions and constant and continuous technological innovation is critical in order to remain competitive in the modern business environment. This has key implications for shareholder wealth maximisation. As set out in the opening of this paper, many delays in industry still occur despite the vast literature. This may be because of the focus of the literature to jump to quickly finding way of reducing delays to little effect because they have not yet understood the consequences of delays in sufficient depth, reflected in the relative lack of studies on consequences. Following this literature review, empirical research seeks to address some of these research avenues. Specifically, chapter 3 aims to address research avenue 1 and will investigate the role of firm resources on the market value effects of new product introduction delays for focal companies. Meanwhile, chapter 4 relates to research avenue 2 and will study the market value effects of new product introduction delays for suppliers.

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2.8 Appendix 1

University of Liverpool Management School
PhD Thesis – PhD Structured as Papers

AUTHORSHIP DECLARATION - joint authored papers - Appendix B

1. Candidate

Name of the Candidate	Student Number
Matt Mitchell	200883259
Thesis Title	
Event studies on the market value effects of new product introduction delays for focal companies and suppliers	

2. FORMAT OF THE THESIS

Is the candidate intending to structure their thesis as papers?	Yes	If Yes, please complete Section 3 (sole authored paper) OR 4 (joint paper) **If No, you do not need to complete this form**

3. PAPER INCLUDED IN THE THESIS – JOINT AUTHORED PAPER

Title of the paper	Has this paper been published, presented at a conference or under review with a journal	If Yes, please complete the boxes below. If No, go to section 4
Causes, effects and managing new product introduction delays: A systematic literature review with guidance for future research	Yes - presented at a conference	Completed
If the paper has already been published please refer to the University guidelines on presentation of publications within a PGR Thesis - https://www.liverpool.ac.uk/media/livacuk/tqsd/code-of-practice-on-assessment/annex-7.2-PGR-CoP.pdf		
If the paper is under review with a journal, give details of the journal, including submission dates and the review stage N/A		
If the paper is presented at a conference, give details of the conference International Conference: 1) The 10th International Conference on Systematic Innovation (ICSI) and the 9th Global Competition/Exhibition on Systematic Innovation (Paper ID: 77), Liverpool UK 8th July 2019 Other: 2) HELAM 7th PhD/ECR Workshop, Helsinki Finland 2-4th June 2019 3) Alliance Manchester Business School Doctoral Research Conference, Manchester UK 2019 13th-14th May 2019 4) Faculty of Humanities and Social Sciences Postgraduate Research Showcase, Liverpool UK 12th June 2019		

4. DESCRIPTION OF ALL AUTHOR CONTRIBUTIONS (including the PhD candidate)

Name and affiliation of author	Contribution(s) (for example, conception of the project, design of methodology, data collection, analysis, drafting the manuscript, revising it critically for important intellectual content, etc.)
Matt Mitchell, University of Liverpool	Conception of the project, design of methodology, data collection, analysis, drafting the manuscript, revising it critically for important intellectual content
Prof. Hugo Lam, University of Liverpool	Supervision
Prof. Andrew Lyons, University of Liverpool	Supervision

5. AUTHOR DECLARATIONS (including the PhD candidate)

I agree to be named as one of the authors of this work, and confirm:
i.   *that the description in Section 4 of my contribution(s) to this publication is accurate,*
ii. *that there are no other authors in this paper,*
iii. *that I give consent to the incorporation of this paper/publication in the candidate's PhD thesis submitted to the University of Liverpool*

Name of author	Signature*	Date
Matt Mitchell	*Matt Mitchell*	14th February 2023
Prof. Hugo Lam	*Hugo Lam*	28th March 2023
Prof. Andrew Lyons	*ALyons*	28th March 2023

6. OTHER CONTRIBUTOR DECLARTION

I agree to be named as a non-author contributor to this work.

Name and affiliation of contributor	Contribution	Signature* and date
N/A	N/A	N/A

This consent form (Appendix B) or the sole author consent form (Appendix A) for each paper must be completed and kept by the PhD candidate once the paper is finalised. If the paper is to be included as part of the thesis, a copy of this form must be included in the PhD thesis with each publication.

Appendix 2

Table A1. Overview of Literature

Study	Key Argument	Problematisation	Theory	Method	Findings	Contribution
Category: Causes of new product introduction delays						
Wu *et al.* (2004).	This paper examines how external parties evaluate whether a product will be delayed beyond their 'deadline'.	Preannouncements are key for external parties. However, they must also critically evaluate such preannouncements.	Not explicitly used.	Quantitative - questionnaire (hypothesis-testing). Data collected from managers in computer hardware, software and telecommunication industries.	Delays beyond the deadline can be explained by the following factors: organisations sometimes have motivations to deliberately delay product introductions, constraints and product development abilities. This paper is the first analysed in this review to distinguish between delays beyond a 'deadline' and other delays that may happen in any product development initiative but which are project managed to prevent introduction delay.	This paper contributes to the literature an explanation of factors for why new product introductions are delayed.
Parker *et al.* (2017).	This paper argues that when quality performance is either above or below what a firm intended, they slow the rate of product introductions. two boundary conditions are tested: stability of quality reputation and sales revenue.	Most research in this area has focussed on financial performance so this paper applies this framework to product quality performance.	Behavioural theory and performance feedback theory.	Quantitative - hypothesis-testing. US video game industry from 2006 to 2009. Data analysed using descriptive statistics and correlations.	Firms will intentionally slow the rate of new product introductions in such conditions to either identify and attempt to resolve underperformance or to learn why overperformance has occurred so it can attempt to be replicated.	The literature is moved on by shifting from a focus on financial performance to product quality performance which was lacking research. This is of interest to managers.

| Owens (2007). | This research is focussed on a UK context and SMEs and explores reasons for delays. | The long-term survival of organisations depends on their ability to introduce new products so this knowledge is of profound interest. For example, the Boeing Dreamliner. Customers are demanding more environmentally friendly and economic products which require radical technological innovations, potentially increasing the risk of development delays. | Not explicitly used. | Exploratory (survey)- provides empirical support to a number of propositions derived from innovation management literature on the introduction of new products. | Reasons are found for delays: poor definition of product requirements, technological uncertainties, senior management support, lack of resources and poor project management. | This paper studies why product introduction delays occur, the nature of them and how to avoid them, within the context of UK SMEs. The paper raises major concerns: management and organisational style lack of attention to detail, support for innovation, lack of strategic thinking and poor manufacturing capabilities. However, what this paper does not consider is cost and profit pressures; as the primary goal to maximise shareholder wealth. |

Rosas-Vega and Vokurka (2000).	The reasons for delays in the introduction of products. This research focuses on the computer industry.	Recent research has showed that being first to market is critical, as opposed to quality as the top competitive priority in the 1980s. Therefore, understanding reasons for delays is key.	Trade-off theory.	Qualitative - classification framework (to categorise the reasons which caused delays in a sample of 52).	Quality should be built into the new product development process as an initial step to accelerate the introduction to market.	Quality should come first and then try to increase speed efficiencies by building on a quality foundation rather than treating these as trade-offs.
Vickery *et al.* (2015).	The paper explores the relationship between product and process modularity and new product introduction performances.	Product and process modularity can affect new product performance: delays and lead times, frequency of new product introductions and innovation.	Not explicitly used.	Quantitative - hypotheses-testing: hierarchical regression analyses are used.	Product modularity has a positive effect but not when complexity is high. Process modularity has a positive effect too but the moderator was not statistically significant here.	The paper tries to find an objective product/process complexity measure to see if it moderates the relationships investigated.
Javadi, Bruch and Bellgran (2016).	This research analyses how the characteristics of low-volume manufacturing industries influence and facilitate the new product introduction.	There are increasing pressures on organisations to continually introduce new products successfully: technology and globalisation resulting in shorter product lifecycles.	Not explicitly used.	Qualitative - interviews and multiple-case study of two new product projects in a low-volume firm.	Characteristics: Low number of prototypes, not conventional production ramp-up, low process complexity, disregard for manufacturability, high resource allocation complexity. Facilitator: previous production of similar products.	There is significant literature on product introduction delays in high-volume manufacturers but not low-volume.

Schatzel, Calantone and Droge (2003).	6 antecedents effect propensity to issue introduction or withdrawal announcements: first mover predisposition, reputation building, firm information interactivity, buyer involvement, industry innovativeness and competitive hostility.	Previous research has ignored preannouncements that update the status of new product introductions, e.g. delays and cancellations.	Not explicitly used.	Quantitative - hypothesis-testing (questionnaire).	Firms announce their new product intentions to enhance their position as an industry leader.	Introductions and withdrawals are caused by the same primary drivers: reputation building and buyer involvement
Tavana, Di Caprio and Santos-Arteagra (2016).	Loyal customer bases can be innovation incentives for duopolistic firms using strategic signalling.	Previous models concentrate on costs and expected profits to justify strategic delay but when consumers are introduced to the model they are either perfectly informed or consider a unique characteristic of the product to determine their purchasing decision.	Game theory.	Quantitative - Bayesian analysis modelling (Duopolistic innovation game model).	The existence of a loyal customer base decreases the incentives of firms to introduce the most technologically developed product available.	The model created combines and extends the partial approaches from the economic, management and operations literature.

Bhattacharya, Krishnan and Mahajan (2003).	Incorporating technology in new products in many technology-based markets is key and to do so planning is needed; relevant to operations managers.	Previous research found low-end products should not be launched before high-end products to avoid cannibalisation. However, there is a trade-off here as technology improvements can delay the introduction of high-end products.	Game theory.	Quantitative - modelling (multi-period model of product introduction).	Cannibalisation can be reduced by offering customers an option to upgrade from a low to a high-end product.	Analytical results for product positioning and profit from different introduction sequences and contribution to managerial practice in insights via a conceptual framework.
Li, Graves and Rosenfield (2010).	New product introductions often lead to extreme cases of demand and supply issues.	Replacing an existing product with a new one presents many challenges, to address this a new product may be offered when an old one runs out of stock. As product life cycles become shorter, managing product transitions has become a major challenge.	Not explicitly used.	Quantitative - modelling.	The optimal substitution point is time-varying. Substitution reduces the need to hold the old product which can increase profitability. However, that does not help when an old product's stock runs out before a new product is ready.	The authors determine the optimal delay in new product introductions based on the inventory of a given old product.

Bilginer and Erhun (2014).	Capacity shortages may be intentional. As the holding cost of capacity increases or delay sensitivity decreases, immediate product introduction may be preferred.	Mismanaged product introductions are costly. Striking a balance between lost sales by launching too early and missing out on market opportunities launching too late is key.	Not explicitly used.	Quantitative - modelling (two-period model)	When the holding cot of stock is low and capacity is fairly low, a build-up policy is optimal if consumers are delay sensitive.	This paper combines marketing and operations management decisions in a model to optimise production and sales planning.
Putsis (1993).	Organisations face a difficult and complex decision on when to introduce new products to avoid cannibalising existing product lines.	There are multiple reasons that may delay, or indeed increase speed, of a new technology in a product to the market.	Not explicitly used.	Quantitative - statistical study using specific industry examples.	Sales performance of existing products and cross-product effects are key factors in delay decisions. The authors refer to existing sales growth as product saturation.	The paper details the impact of these two key factors discussed on delay decisions but highlights that there are many more factors also.
Choi (2003).	Informational leverage has implications of sequencing product introductions.	Informational leverage has implications for the timing of new product introduction delays.	Informational leverage theory.	Quantitative - econometrics (modelling).	Sequential introduction of new products enables informational leverage to be utilised. When two products are viable on their own, leveraging can cause delays because of product availability.	This paper provides a theory of informational leverage and critically analyses its implications for product introduction timing.

| Wang and Hui (2012). | The motivation for firms to purposely delay products is cannibalisation. | Sometimes delaying product introductions on purpose is beneficial to organisations; even when the necessary product technology is available. | Not explicitly used. | Quantitative - modelling (3 periods) based on a monopolistic seller: economics. | This decision-dilemma arises because it is assumed that a firm cannot remove old products from the market, worsen durability or pace R&D; at least in the short term according to neoliberal economic theory. The paper finds that products may be delayed despite discount incentives and instead may be more likely to be introduced if they have a bigger improvement in quality and durability rather than very incremental changes. | This paper provides practical recommendations for pricing and policies. |

Krankel, Duenyas, and Kapuscinski (2006).	This paper is about organisations deciding to delay product introductions in order to include further technology improvements.	Contrary to cannibalisation, some firms delaying introduction on purpose to include more new technology in their products may actually inhibit the sales of existing products.	Not explicitly used.	Quantitative - modelling on demand diffusion. This focusses on IBM mainframe computers.	Delaying can slow sales of existing products. This contrasts the previous findings on cannibalisation that releasing products later enables existing products to sell well; instead finding that consumers will see that such delays are for new technology to be incorporated and so may hold off purchase until a later date. For example, iPhones are released every year and consumers often hold out on buying new ones in anticipation of new product introductions. However, more research is needed beyond this paper to see under what conditions this is most prevalent. For example, consumers know to expect a new iPhone every year. However, this effect may be lessened if product introductions involve information asymmetry on their release date.	The model created in the paper explains product introduction behaviours.

Moorthy and Png (1992).	Like similar authors on differentiation and cannibalisation, this author explores if two differentiated products should be introduced simultaneously or not.	Cannibalisation can lower profits via reduced sales. Sometimes organisations have decisions to make across multiple products on when to introduce new products.	Single-person decision theory.	Quantitative - econometrics (modelling).	To reduce cannibalisation in this context, quality of the low-end product could be lowered and lower price of the high-end product. Or the quality of the low-end product could be increased but its introduction delayed. However, both also assumes that the products are of distinctly different quality. Furthermore, delay means profits will be delayed too. Sequential introductions requires the organisations to be able to commit to their new product introductions.	This paper is more specific than the others and assumes an organisational context where there are two distinct customer segments where demand is static and known and technology is in place to exist both products. However, static demand is mostly an unrealistic assumption.
Boone, Lemon and Staelin (2001).	Consumers may decide to buy a product with new technology based on lag and expected performance gain. This also has implications for business to business situations, such as airlines who wish to invest in more economical aircraft but which require a significant capital investment.	Businesses are concerned that while they need to introduce new products to remain competitive, they could erode sales of existing products in doing so. This links to the idea of cannibalisation as discussed earlier.	Not explicitly used.	Quantitative - modelling (consumer purchasing behaviour included with frequency and pattern of product introductions).	The frequency and pattern of product introductions influences consumer's perceptions of future product introductions and their purchasing decisions. This may also have competition aspects if firms can strategically manage consumer expectations of future product introductions.	Firms overlook their pattern of product introductions as a strategic tool. Such strategies ultimately effect profitability and stock price if they are a publicly listed company.

Cole and Mutsumiya (2007).	No distinction is made in the literature between incremental and radical innovation.	The positive relationship between quality and innovation is stressed, however this has not been broken down into different types and speeds of innovation.	Not explicitly used.	Quantitative - hypothesis testing.	A focus on quality is compatible with incremental innovation but not with radical or disruptive innovation.	This paper breaks down innovation into incremental and radical innovation to better understand the impact of quality on a more granular level.
Prieger (2002).	A model is created for regulated product innovation and introduction. In the model, more services were created under price caps than under rate of return regulation.	The price caps literature focuses almost solely on cost reduction, ignoring product innovation in new product introductions.	Not explicitly used.	Quantitative - econometrics (modelling) of US Telecommunications. The authors control for demand and supply factors; such as income and R&D for example.	Price-capped firms have greater incentives to innovative. However, this paper cannot make the leap from correlation to causality.	Few authors had yet attempted to measure the effects of regulation on product innovation. This paper's contribution is methodological in the form of an econometric model.

| Prieger (2007). | Both organisations and regulators contribute to delays. The paper classifies delay between feasible technology introduction and submission to the regulator as innovation delay. Then when seeking approval, it is identified as regulatory delay. | Firms subject to regulation often claim that getting new products approved is expensive and inhibits incentives to innovate with new product introductions. The literature lacked consideration for the relationship between regulation and innovation in new product introductions. Regulation is increasingly relevant to many industries as consumer protection increases, such as food and cosmetics for example. | Game theory. | Quantitative - econometrics (modelling) of telecommunications. | When firms expect regulatory delay, they delay their product introduction. This mirrors a multiple effect observed in economics. By signalling the marginal cost of delay to the regulatory, regulatory delay can be reduced. | This paper is one of the first to acknowledge different forms of delay as distinct in relation to regulation. However, this in part links to the paper on pharmaceuticals mentioned earlier which are also subject to regulation. Although, this paper uses telecommunications regulation to illustrate their argument. |

Cucculelli and Ermini (2009).	This paper investigates at the effects on an organisation's growth in relation to new product introductions, 'product tenure' and innovation.	Some previous studies failed to confirm a statistically significant relationship between product innovation and growth. This is why this study adds in a new variable to further the literature.	Not explicitly used.	Quantitative - hypothesis-testing (Empirical model): Sample of Italian firms from 2000 to 2006.	This research finds that releasing a new product enhances growth opportunities amongst firms with a multiproduct offerings, in industries with high R&D levels, and in industries that absorb patents from external origins.	The paper adds to the recent literature at the time of publication on the relationship between innovation and organisational performance, specifically how product introductions effect growth. Unlike other studies, this research adds in an additional variable which is the number of years since the first introduction of the last product, referred to as product tenure. This captures new characteristics of products' novelty and complexity, providing insights beyond previous studies.

Kalish and Lilien (1986).	A key issue in new product introduction is timing.	Firms must get market introduction timing right or risk launching under-developed products versus sacrificing sales.	Not explicitly used.	Quantitative - econometrics (100-home demonstration program for photovoltaics).	Getting the timing of a new product introduction wrong can incur significant penalties.	The study provides a market diffusion model to help firms make market entry timing decisions.
Kong, Yang and Jin (2022).	Firms must optimise their product introduction strategy.	Based on delayed network effects, firms choose what product to sell and pricing decisions within a period.	Not explicitly used.	Quantitative - econometrics.	When delayed network effects intensity is low, firms choose versioning to maximise profit. When it is high, they chose shelving to capitalise on delayed network effects.	The authors provide empirical evidence for the optimal product introduction strategy.
Kristiansen (1998).	Rivals should agree on new technology introduction before launching a new product.	Firms must introduce new technologies but business environments are competitive. They must decide when to introduce new technologies whilst considering their rivals activities.	Not explicitly used.	Quantitative - econometrics.	R&D costs are increased if rival firms introduction new incompatible technologies early.	This paper identifies that standardisation policy around agreeing with rivals before a new product introduction can help avoid issues.

Dacko (2002).	Organisations have a decision to make on the effective timing of new product introductions.	It is known in the literature that firms must make decisions on the timing of new product introductions. This paper seeks to empirically test that decision-making.	Not explicitly used.	Quantitative - surveys.	The study shows where there is consensus and deviation among decision makers with the academic literature.	The findings enable managers to make more successful decisions on new product introduction timing via reducing ambiguity of internal and external decisions and highlighting potential action biases.
Lexchin (2020).	The time between approval and product launch is important for pharmaceutical companies.	Extant studies on new drugs products typically focus on regulatory review time rather than the time between approval and market launch.	Not explicitly used.	Quantitative - descriptive statistics.	Over 18% of the time between filing for approval of a new drug and market launch is because of decisions made by the focal company. This decision time is smaller for drugs with expedited approval compared to standard approval.	This study investigates pharmaceutical companies specifically to add to the literature on drug approval and time to market.
Krider and Weinberg (1998).	In the context of the motion picture industry, new product introduction timing is imperative due to extremely short life cycles and rapid decay in revenues with high competition.	This investigates new product introduction delays in the motion picture industry which has some unique characteristics.	Not explicitly used.	Quantitative - econometrics (1990 summer season in the US).	The authors find that current movie release timing decisions can be improved, in particular by avoiding competitive issues.	This paper studies new product introduction delays in a specific and unique context, the motion picture industry.

Category: Effects of new product introduction delays

Hendricks and Singhal (2014).	Demand-supply mismatches can have an impact on firm risk.	Demand-supply mismatches can indicate that some of all of supply chain management's subsystems are not working as expected.	Not explicitly used.	Quantitative - event study.	Firm risk increases by when there is a supply-demand mismatch. Those mismatches related to excess inventory carry greater risk. Changes in information asymmetry positively correlated with demand-supply mismatches.	This paper provides empirical evidence on the effect of demand-supply mismatches on firm risk.
Bayus, Jain and Ambar (2001).	This paper takes the perspective that a new product announcement is used as a strategic signal.	Firms are accused of intentionally engaging in "vaporware".	Not explicitly used.	Quantitative - product announcements of 123 software companies. A correlation analysis of the time between the announcement and the product shipment with a stylised model of preannouncements.	Dominant firms may use vaporware to deter entry by signalling product development costs. Firms with very high or low development costs make accurate announcements, whilst moderate ones intentionally engage in vaporware.	Unearthing the beneficial and harmful consequences of the practices discussed around new product announcements and delays.

Figueiredo and Loiola (2017).	Based on a pharmaceutical company, a dynamic model is used to see the impact of innovative product introductions on R&D performance.	The key problems are which and how many projects should be undertaken and which should be terminated.	Not explicitly used.	Dynamic model - a pharmaceutical company.	The project introduction rate can be improved by using an adequate rule of thumb. In the pharmaceutical industry, value is eroded when introductions are slower. There are also regulatory issues, as with other industries such as aerospace. This is due to testing also, such as clinical trials for example.	Solving problems on product introduction rates.
Adaku *et al.* (2018).	The current business environment has competition pressure because customers are demanding manufacturers to provide more value so the capacity to respond is key.	Product life cycles are shortening so delays hit overall says. Products may become obsolete due to rapid changes to customer needs. For example, the Airbus A380. This had a huge R&D and infrastructure investment, as well as operations implications.	Not explicitly used.	Case study - process and participant observations. Two-stage approach interviews the questionnaires) on respondents who work in a project team for a large food processing firm.	The most important causes of delays in new product introduction (particularly in the food processing industry) are: a high number of projects running concurrently, lack of PM process, lack of consistent PM structure, high workload on project teams and delays caused by external parties.	Identifying factors which cause delays of new products and the relative importance of delay factors for informing manager's decisions.
Moorman *et al.* (2012).	Accounting literature shows that firms try to influence stock market returns.	Delaying product introductions may increase stock returns but damage sales performance.	Ratchet effect.	Quantitative - hypothesis-testing: secondary dataset, Compustat (two samples: Ltd and PLC).	Public companies use an innovation ratchet strategy more often than private firms because the stock market rewards them for it. However, this inhibits performance in product markets, for instance when delaying introductions.	Firm and market characteristics influence the likelihood that a firm will engage in an innovation ratchet strategy.

| Chen *et al.* (2007). | Information-signalling effect and the competitive effect interaction are what the economic impact of delays by a firm on its rivals depends upon. | Previous research focuses on the notion that costs of delays in product introductions outweigh potential benefits. But what is not known is the impact of a delay on other firms in the industry. Previous research found one firms' delay could be lucrative for others when customers switch to alternative products; but this paper argues that actually a negative effect is felt across the industry in some instances. | Signalling theory, spillover effects, competitive effects. | Quantitative - event study (A sample of 324 announcements of delayed product introductions in 52 industries from 1989 - 1997). | Competitors experience significantly negative share price responses when an organisation in an industry makes a new product announcement. Delays convey more negative information about competitors in industries most likely to have delays. | The information-signalling effects dominates the competitive effect as a whole. |

Shapiro (2016).	This research is based on pharmaceuticals, as with other similar papers, such as Figueiredo and Loiola (2017) and Chambers, Snir and Ata (2009). Because of regulation, in the US new drugs enjoy a period of exclusivity. Therefore, firms have an incentive to delay introductions of new products until the patents of existing products expire.	There is significant literature on strategic delay but less is understood about its effects on consumers and firms. This is similar to product introduction delays in general which has significant literature but the effects of which, on particular parties like suppliers, are less explored.	Not explicitly used.	Quantitative - econometrics (modelling).	Perceived benefits of new products in marketing can cause adoption of new products rather than product-related benefits themselves.	Policies can be implemented to induce earlier entry of new product introductions. This can be beneficial for customers but also for sales revenue for firms.

| Hendricks and Singhal (1997). | As with Hendricks and Singhal (2003), this paper focuses on the stock market returns when an organisation is late to the market using an event study. As with their previous paper, these authors assume an efficient market hypothesis and due to the nature of the research design can only example PLCs. | Consistently developing and launching new products had become more important during the time of publication because of increased competitive pressures; more firms entering markets wanting market share. Therefore, effectively introducing new products is key for maximising shareholder wealth, the primary goal of publicly traded companies. | Not explicitly used. | Quantitative - event study. These factors form the contribution of such studies. Critically, event study methodologies do not measure the direct impact of stock market returns, they instead use a model (such as the market model commonly) which takes into account confounding events by using an event window. | The paper finds significant penalties on being late to market beyond a promised introduction date. The market value decreased by 5.25%. The following factors are statistically significant predictors in the market value changes: competitiveness of industry, firm size and diversification. | Regression analyses were used to identify factors that impact the direction and magnitude of market value changes, common with event study methods. These factors form the contribution of such studies. |

Hendricks and Singhal (2008).	New product introduction delays can affect operating performance.	Their previous research considered the impact on market value but not operating performance.	Not explicitly used.	Quantitative - event study.	The study finds a decrease in profitability, measured as return on assets (ROA), following a new product introduction delay. They also consider sales over assets and return on sales, which both decreased too. Cross-sectional regression analyses reveal that profitability is more negative for firms that were more profitable before the new product introduction delay as well as for firms which operate in larger and more profitable industries	Empirical evidence is provided for the impact of new product introduction delays on operating performance.
Hendricks and Singhal (2003).	The paper report the effect of supply chain glitch announcements which result in product introduction delays on shareholder wealth.	At the time of publication, supply chain management was said to be the next source of building and sustaining competitive advantage. There was little support to support claims of cost reduction of effective supply chain management and shareholder value.	Not explicitly used.	Event study, econometric modelling and descriptive statistics - Sample of 519 announcements of supply chain 'glitches' between 1989-2000. Shareholder wealth is estimated via abnormal stock returns.	Announcements in this study resulted in a decrease in shareholder value of 10.28%. Larger firms experience a less negative market reaction and those with greater growth prospects have a more negative reaction. Interestingly, the temporal element of the data had no significance on returns, suggesting that the stock market has always perceived glitches undesirably.	This paper seeks to empirically support the effect of supply chain management on shareholder wealth.

Hao and Wang (2016).	Similar to the previous paper mentioned, Hendricks and Singhal (2003), this study measures investors reaction to new product announcements.	New product introductions play a pivotal part in sustaining competitive advantage. Therefore, announcements of such products are key and impact stock returns substantially. A multi-stage model moves the literature forward by avoiding viewing stock market response statically.	Viral dynamics theory.	Quantitative - multi-stage model (differential equations).	When investors take a longer time to consider investment, the effectiveness of preannouncement signals is reduced. Additionally, investors with positive sentiment are more likely to invest. This is a factor distinct to the preannouncement signals.	This paper draws on viral dynamics theory, viewing stock market reactions as 'infection'. This is a methodological contribution by drawing on other fields. The model has practical applications.
Robinson and Fornell (1985).	First-movers typically have significantly higher market share than late entrants.	Firms must get to market fast to benefit from first-mover advantages and to maximise their market share. The authors explore theoretical explanations for this.	Not explicitly used.	Quantitative - econometrics.	High market share for first-movers are derived from firm-based superiority and consumer information advantages. Overall, market entry is a major determinant of market share.	This study examines theoretical sources behind the relationship of market share, timely new product introduction and return on investment.
Urban *et al.* (1986).	Market entry is inversely relate to market share.	Firms benefit from first-mover advantage in terms of their market share.	Not explicitly used.	Quantitative - econometrics.	Market entry, advertising and positioning positively moderate market share.	This study explores factors which affect market share for pioneering brands.

Savin and Terwiesch (2005).	Companies must decide when is most effective to introduce a new product.	The study considers the perspective of competing products, investigating the trade-off between lost revenues and lower unit production cost when there is a delay.	Not explicitly used.	Quantitative - econometrics.	When a competing product's introduction is delayed, a firm can benefit from accelerating its own product launch.	This study provides empirical evidence for optimal product introduction decisions in a competing products situation.
Herm (2013).	Brand trust can be lost due to new product introduction delays.	Consumers perceive preannouncements as credible promises to introduce new products on time. However, a majority of such preannouncements are delayed.	Commitment-trust theory.	Quantitative - regression analyses.	When new product introduction delays occur, there is a loss in brand trust from consumers. High brand commitment does not mitigate this effect, though long-term relationships with the brand does positively mitigate this.	This study provides empirical evidence for the impact of new product introduction delays on erosion of brand trust.

Category: Managing new product introduction delays

O'Driscoll (2002).	'Crisis atmosphere' around launch delays can be contributed to by poor product processes because of insufficient reconciliation of process capabilities with design requirements.	Key processes are often poorly understood. How can this be avoided?	Not explicitly used.	Quantitative - flow chart to review practices in industry of design for manufacture.	Manufacturing costs can be significantly lowered via a design to manufacture approach and delays can be reduced.	Firms should 'design for manufacture'; design products with how its manufacturing process will work in mind at an early stage. This can help to shorten the product development cycle and minimise delays by reducing production issues.
Vanteddu and Chinnam (2014).	This paper focusses on when organisations should chose product differentiation. However, his also has implications for product delays as discussed in the following sentences.	Customers are demanding a greater variety of products, enhanced customer service and lower prices. This is causing supply chains to be needed to be overhauled. Life cycles for products and product families are shrinking so supply chain responsiveness is key.	Not explicitly used.	Quantitative - econometrics (modelling).	To meet increasing customer needs, delaying differentiation of products can be one strategy. Particularly in mass customisation contexts. This can help to limit product introduction delays by standardising products which reduces strain on the supply chain. For example, when the Boeing Dreamliner was introduced, only one variant was available and since a stretched and long-range version have come to market to meet customer needs for long routes or large passenger numbers.	Context-specific and counter-intuitive managerial insights.

Özer and Uncu (2013).	How much a company can produce depends on how soon they have decided to go to market. This paper implies that organisations may be able to prevent being late by producing less or improving manufacturing yield to meet demand. However, this assumes that delays are caused by demand fulfilment issues which is only one part of the picture, as discussed throughout this review. Other key factors, such as supply chair configuration and technological advancement in products are key.	Long product introduction delays allows competitors to enter the market which reducers the suppliers' market share.	Not explicitly used.	Quantitative - econometrics (modelling).	This paper establishes a policy that organisations should not enter a market if they cannot produce enough as per a predetermined threshold.	This paper develops a two-stage framework to optimise timing of new product introductions. This framework could also be used to quantify the effect of market conditions on the time to market. For example; competitor behaviour, price and operating conditions like production costs and learning.

Golhar and Banerjee (2013).	The rapid pace of new product introductions, demanded by customers wanting technology innovation, creates complexity and fragmented supply chains. This is because such products and technology in a globalised world require international sourcing. This research assumes a base product is produced and then in a second stage customised. However, some products require customisation from the outset. Other products are built in a more modular format where some components are customised and others aren't.	This paper introduces the use of third-party managed supply chains which absorb many issues, such as meeting demand. They also must deal with delays.	Not explicitly used.	Quantitative - econometrics (modelling).	This paper tests strategies, such as deciding to postpone customised products to reduce variation. This links to Vanteddu and Chinnam (2014) findings.	Postponing customisation and product variation may not always lead to the best outcome for third-party supply chain managers. However, this research does not consider or explore the implications on the actual organisation so it is unknown whether these will be negative or positive. Further research is needed here, to explore the implication of third-party supply chain managers and whether that makes a difference on product introduction delays.

Chambers, Snir and Ata (2009).	This research focuses on the introduction of pharmaceutical products. This is a risky industry as there are high development costs. This is true of other industries too, such as aerospace for example. Also, there are regulatory issues where requirements and testing must be met before a product can go to market.	Previous research focussed only on demand uncertainty instead of supply issues and production.	Not explicitly used.	Quantitative - linear programming.	This paper argues that if flexible production facilities can be used then they can be configured to produce new products and minimise delay. However, this assumes that in a given context that the delay is caused by production issues. This is only part of the picture, as demonstrated with the other literature analysed here, showing delays pertaining to supply chain configuration, customer requirements and technological innovation.	This paper finds that flexibility can involve substantial costs and so if capacity is large then organisations should seek to construct dedicated facilities soon.
Alhumrani and Qureshi (2016).	This paper is based on the software development industry. The paper also addresses multiple resource constraints on project scheduling.	Late projects come at a highly substantial costs to clients and yet they still occur so finding a better solution for this is key.	Not explicitly used.	Quantitative - algorithm (genetic).	Using genetic algorithm resource-constrained project problem of scheduling can be resolved.	The paper offers a solution to allocate resources efficiently so that a project can e scheduled to finish on time.

Standish *et al.* (1994).	This paper argues that introductions can be shortened via effective communication between design and manufacturing functions enabled by electronic data transfer. However, this paper is quite outdated now and it would be assumed that most companies are now using some form of electronic data transfer. Though, to varying levels and efficiencies; such as enterprise resource planning.	At the time of writing, reducing new product introduction lead times was critical, particularly in the focus of this study which is electronics manufacturing.	Not explicitly used.	Quantitative - mapping the electronic data transfer process in organisations.	Electronic data transfer is so important because increasingly in this industry companies were using external design centres and manufacturers so effective communication between the business and outside partners becomes imperative.	The paper reviews the current state of electronic data transfer in new product introductions, the need for standardising this practice internationally and for manufacturing and supply processes to support this.
Li and Zhu (2009).	Because failure can be expensive, organisations must acquire costly information from various sources to make strategic decisions on new product introductions. Although, this study assumes that such information forecasting is available and that such data will be the 'right' data and accurate. Forecasts are not always available for purchase.	Organisations often experience substantial financial losses from failed (or delayed) new product introductions. Therefore, they like to first seek forecasting information to help predict and avoid such issues.	Not explicitly used.	Quantitative - decision analytical models.	This study finds purchasing forecasts sequentially can lead to a significant profit advantage based on the mediator variable of cost of information acquisition being moderate and the profit margin of the new product is small. Further research is needed to investigate what goes on here when the profit margin is substantial and why this may differ to lower margin products.	Optimal policies for organisations that make decisions on information acquisitions for the performance of new product introductions are provided.

| Arnold and Floyd (1997). | The new product introduction process can be reengineered to increase pace. Though, some earlier authors critically analysed supply chain reconfigurations. Business process reengineering was a particularly popular management initiative at the time of this paper's writing so this does not come at a surprise; though it is not a fad and is an important tool in such contexts. | Product cycle times were being reduced at the time of writing because of fast technological advances, making it of competitive importance. Often, increasing speed requires the need to reengineer processes. This is the first paper analysed to explicitly use the term reengineering as an important and effective means of speeding up product introductions. | Not explicitly used. | Case study research design, focussed on a high-technology business. Benchmarking and process reengineering. | Benchmarking and process reengineering within a business unit led to significantly faster product introductions and response to consumer needs. Lead times to market were reduced by half within a two year period. | This paper's contribution is methodological as it provides a method for future authors to use to further investigate new product introductions. Additionally, best practices for new product introductions is put forward. |

| Chirumalla (2018). | This paper focusses on the heavy-duty vehicles industry. Because of the continuous need to introduce new products, there are implications for organisations' existing production systems and processes. | Due to competitive market environments; organisations continuously need to launch new products and at increasingly short intervals. | Not explicitly used. | Qualitative - semi-structured interviews: Case study research design (heavy-duty vehicles industries). | All project manager interviewed reported that timing the correct resources is a significant issue in new product introductions. Other issues contributing to delay include: poor communication and missing learning opportunities. These can come down to poor project management practices, methodologies and implementation. Interestingly, this is one of the first papers identified to explicitly talk to and discuss the implications of real-life project management challenges and how they impact product introduction delays. | This study takes a qualitative view and argues this as important for an in-depth understanding of industry practice with project managers. Often, organisations want to keep their new technologically innovative products secret and do not like to discuss delays and setbacks. |
| Mahoney and Maynard (1999). | The delay in introducing new vaccine products into developing countries is unacceptable. | There is significant need to reduce delays of introducing new vaccines into developing countries. | Not explicitly used. | Qualitative. | Time to market for new vaccines in developing countries can be decreased by competition, low cost vaccines and retention and strengthening of public sector vaccine manufacturers, | This study examiners ways of reducing time to market for new vaccines in developing countries. |

| Stanko, Molina-Castillo, Munuera-Aleman (2012). | Faster speed to market introduction is related to better quality and lower costs, though it is not necessary to sacrifice one of these. | Research has found there are negative consequences for being late to the market but these authors attempt to better our understanding of the interrelationships of objectives when introducing a new product. | Not explicitly used. | Quantitative - survey (197 managers). | Innovation positively moderates the relationship between speed to market and quality. Innovation negatively moderates the relationship between speed and profit. | This study uncovers knowledge which managers can use to identify when speed to market should be prioritised. |

Chapter 3:

The effects of new product introduction delays on market value: The role of firm resources with evidence from the S&P 500 Index

3.0 Abstract

We conduct an event study on 194 new product introduction delays experienced by S&P 500 Index companies in the US from 1999 to 2018 to investigate the impact of the delays on market value of companies. We also consider how investors react to the preannouncements of new products. Drawing on signalling theory, we find that that investors react to negative delay signals, but not positive preannouncement signals. We also study the role of firm resources on market value when a delay occurs, finding that more profitable firms and those with a higher advertising intensity experience more negative changes in market value. Additionally, we find that operational slack positively moderates the impact of advertising intensity. We explore the implications of these findings to help inspire more effective ways of addressing such delays.

Key words: New product introduction delays, market value, event study, firm resources, preannouncements

3.1 Introduction

Organisations' survival often depends on the ability to successfully introduce new products, which have been described as the 'lifeblood' of an organisation (Owens, 2006), to generate revenue and remain competitive. Firms use preannouncements to send positive signals to investors about upcoming new products which can be investigated through the lens of signalling theory (Lam *et al.*, 2016). They announce these products in the hope of boosting their share prices. Although, previous studies on preannouncements using an event study method find that there is no statistically significant enhancement in share price in the short term, unless under a certain condition - high information quality (Lee, Chen and Hartmann, 2015). However, all-too-often organisations fail to deliver on time and a new product is subsequently delayed. This could be due to being overzealous in announcing new products to try impress investors and an important first-mover competition advantage. In some circumstances, particularly in the

software industry, new products may be announced even before they have been developed, earning the name 'vaporware'. (Bayus, Jain and Ambar, 2001). This could be problematic if any hope of impressing investors is later foiled by delays when certainty of the product's viability has not even yet been established in some instances. Despite the accepted importance of new product introductions and being on time to market for competition reasons and avoiding negative changes in market value, delays are still widespread in industry. Apple's AirPower wireless charging pad was announced in September 2017 with a promised 2018 launch date. However, due to product development issues with overheating due to the amount and density of charging coils needed in the device to deliver intended functionality, the product was delayed and eventually scrapped (Su, 2019). This is an example of a product preannouncement and delay, which in this instance never came to fruition, much like with vaporware. Other products, such as the Boeing Dreamliner, which was delayed in September 2007 due to a shortage of fasteners and incomplete software, went on to become commercially successful products, with the Dreamliner becoming one of the most popular passenger aircraft due to its efficiency (Topham, 2013). This shows how delays can be 'bumps in the road' to commercial success of the product or it can be the end of the product's development, never reaching the market.

As well as preannouncements of new products, new product introduction delays and their consequences for organisations have attracted the attention of researchers and practitioners for many years (Adaku *et al.*, 2018; Moorman *et al.*, 2012; Chen *et al.*, 2007; Shapiro, 2016; Hendricks and Singhal, 2003; Hao and Wang 2015). One previous study, also employing the event study method, investigated the impact of new product introduction delays on firms' market value (Hendricks and Singhal, 1997). However, this study focused on the direct impact of the variables rather than interaction effects. These variables are those related to product development, including: diversification, industry competitiveness, industry growth rate, product life cycle and time delay. However, all of these variables except diversification are measured as dummy variables with their direct impact. In doing this, important potential interaction effects may be missed. In a later paper, Hendricks and Singhal (2008) also investigate the impact of product introduction delays on operating performance. However, our study differs by looking at dimensions; such as profitability, research and development intensity, advertising intensity and operational slack; and how they impact the direction and magnitude of change in market value. We also consider the interaction effect of operational slack and advertising intensity.

Since Hendricks and Singhal's (1997) seminal paper, the importance of new product introductions has only intensified with customers demanding more innovative and technologically demanding products of higher quality and faster than ever. Factors contributing to these changes include the era of the internet, innovative technological development and immediate delivery; as well as increased competition raising customer expectations. Such

expectations can put strain on the new product introduction process as organisations battle to create exciting products before one another. Taken together, this study aims to answer the following questions:

1. Do investors react differently to positive (preannouncements) and negative (delays) signals?

2. Which firm resources moderate market value when there is a delay?

3. Are there interaction effects between firm resources?

Although researchers have independently explored new product preannouncements (Sorescu, Shankar, and Kushwaha, 2007), in the marketing literature and new product introduction delays (Hendricks and Singhal, 1997), in the operations management literature, synthesising these two in one coherent investigation has not been conducted. This is important to ascertain how investors react to organisations who preannounce and go on to later experience a delay. Prior research has only focussed on either preannouncements or new product introduction delays independently. This is problematic because some products which are preannounced may go on to experience a delay further down the line. By utilising delays and their related preannouncements from the S&P 500 companies, we provide an apple-with-apple comparison.

Based on 194 new product introduction delays occurring in the US over a 20-year period from the start of 1999 to the end of 2018 and their related preannouncements, where applicable, our event study results show that investors react to negative signals, new product introduction delays; but not positive signals, preannouncements. In particular, the average stock returns when there is a delay drop by 0.51% over 3 days around the delay, representing substantial market value. Although we find a 0.55% increase in share price for preannouncements, this is not statistically significant. Some researchers only find a significant positive share price reaction for preannouncements over the long run (Sorescu, Shankar, and Kushwaha, 2007), when taking into account information quality (Lee, Chen and Hartmann, 2015). Other researchers, such as Wu, Balasubramanian and Mahajan (2004), try to predict when a preannounced product is likely to be delayed, however they do not quantify the impact on market value. Our research thus demonstrates that investors react to negative signals but not positive ones. Moreover, our regression analysis further shows that the impacts of delays are more negative for firms with greater profitability and advertising intensity. Though, higher research and development intensity can be associated with less negative changes in market value. We do not find that operational slack has an impact on market value, although it does positively moderate the impact of advertising intensity. We do not find that these dimensions have a significant impact for preannouncements, confirming that investors are less interested in positive signals. This

could show that investors take a more conservative approach when dealing with uncertainty (Kadiyala and Rau, 2004).

Our research makes several important contributions. First, we contribute to the literature on signalling theory in operations management. Although prior research has investigated negative signals of delays on market value (Hendricks and Singhal, 1997), this had not been investigated alongside related positive signals, preannouncements, to compare how investors react differently to such events from the same sample firms. Our research based on new product introduction delays and their related preannouncements considers how investors react to both using events from the same pool of the S&P 500 companies. This investigation direction provides a more comprehensive view on signalling of both a positive and negative nature and may inspire researchers to further explore the impacts of preannouncements and new product introduction delays in further ways which will be explored later. The negative effects of new product introduction delays as documented in our research also remind firms of the importance of avoiding delays as well as considering carefully whether it is valuable to preannounce a new product. This is important because discussing a new product can open up an organisation to a vulnerable position of late experiencing a delay. In addition to the direct impacts of preannouncements and new product introduction delays, we further investigate how the impacts of these vary in relation to profitability, research and development intensity, advertising intensity and operational slack. This investigation provides new insights into the roles that these variables play in the context of new product introductions. The findings also provide important implications for firms to better manage the negative effects resulting from delays and where preannouncements have been used and on their decision-making of whether to preannounce a new product. We also consider the moderating role of operational slack on the impact of advertising intensity. Finally, we compare the differences between preannouncements and delays of new product introductions in terms of positive and negative signals. The comparison advances our understanding of how the investors react differently to positive and negative signals in the context of new product introductions.

Signalling theory has been employed in many event studies that measure the impact of an event on market value (Lam *et al.,* 2016). This is because of the principal-agent problem; whereby the agent, the organisation's management, make decisions on behalf of the principal, the investor. Therefore, as investors are external to organisations they rely on signals from the organisation and its management on the financial viability of the organisation. For this reason, signalling theory helps to understand how market value can be affected due to events such as new product introduction delays. Maximising shareholder wealth is the primary goal of public limited companies (Hendricks and Singhal, 1997). This means that avoiding new product introduction delays is of key importance to investors and organisations alike.

3.2 Literature Review and Hypothesis Development

3.2.1 Literature on new product introduction delays

Consistent with the previous study (Hendricks and Singhal, 1997). we define new product introduction delays as when a firm is late to the market with a new product based on a previous pre-announcement, whereby a new product is communicated to the market. New product introduction delays occur in essentially all types of products. To survive, organisations have to continually innovate and release new products, generating sales revenue. This is particularly important in competitive, technology-driven environments (Hendricks and Singhal, 1997; Cucculelli and Ermini, 2012). Organisations' pre-announcements of new products may increase share price. This is sometimes done optimistically, even before the product has been fully developed as mentioned earlier. For example, Apple began advertising its AirPods before delaying the product multiple times. (Prigg, 2016). Organisations nonetheless make these pre-announcements because being first to market and winning consumers with new technologies and innovations can be very lucrative and competitively advantageous (Yang *et al.*, 2018).

The vast majority of research on new product introduction delays is of a quantitative nature with only a few qualitative and mixed-methods papers. The quantitative papers mostly focus on econometrics with some using questionnaires. Only Hendricks and Singhal's (1997) and Chen *et al.*'s (2007) research employs the event study method. It is attractive to utilise the event study method to investigate new product introduction delays as it enables us to appreciate the impact of delays on market value using a relatively large sample. Using the dependent variable of market value is important because maximising shareholder wealth remains the primary goal of public companies.

Hao and Wang (2015) explore how investors react to new product announcement signals. Similar to the work of Hendricks and Singhal (2003), this study measures investors' reaction to new product announcements. New product introductions play a pivotal part in sustaining competitive advantage. Therefore, announcements of such products are key and may impact market value substantially. A multi-stage model moves the literature forward by avoiding viewing stock market response statically. Additionally, investors with positive sentiment are more likely to invest. This is a factor distinct to the pre-announcement signals. This paper draws on viral dynamics theory, viewing stock market reactions as 'infection'. This is a methodological contribution by drawing on other fields and has practical implications. Adaku *et al.* (2018) base their work on the position that products may become obsolete due to rapid changes to customer needs. A two-stage approach using interviews and questionnaires on respondents who work in a project team for a large food processing firm was deployed. If products become obsolete due

to quick-changing customer needs then being quick to market is imperative to avoid delayed products becoming obsolete before or soon after they are released.

Firm resources are key in the context of new product introduction delays because such assets are needed to bring new products to fruition. For instance, financial resources are needed to invest in new product development, R&D is needed to develop new products and innovation, advertising is needed to market the new product and operational slack is needed to create the new product by meeting operational needs with any challenges that may arise. Padgett and Galan (2010) identify R&D intensity as an important intangible resource, forming an asset that can provide firms with competitive advantage for instance. It is logically deduced that such an important asset can also be important in new product introductions as new products require R&D to bring the products to fruition. More specifically from the literature, Lee and Chen (2008) also identify R&D and marketing resources as key firm resources in the context of successful new product introductions. Meanwhile, Slotegraaf, Moorman and Inman (2003) recognise financial resources as important firm resources. Therefore, we consider profitability as a key variable. Vitale, Cupertino and Taticchi identify operational slack as a key firm resource. Taken together, we consider a diverse range of key firm resources from the literature discussed above. Firm resources can enable firms to reduce or minimise the impacts due to delays by being able to better cope with or manage the delay (Lee and Chen, 2008).

3.2.2 Abnormal returns of new product introduction delays

Prior to conducting this study we did an extensive literature search of new product introduction delays. Then focussing on those which employed the event study methodology, we discuss how they are different from our research on new product introduction delays. For instance, Hendricks and Singhal (1997) were first to investigate new product introduction delays using the event study methodology. They focussed on establishing the overall effect of new product introduction delays on the market value of the firm. Hendricks and Singhal's (2008) research the effect of new product introduction delays on operating performance. Other researchers have investigated new product introduction delays using other methodologies. For example, Adaku *et al.* (2018) use a case study methodology to study the causes of new product introduction delays. Wang and Hui (2012) explore why firms might want to delay new product introduction intentionally to avoid cannibalisation of sales. Wu and Mahajan (2001) explore when a new product introduction is likely to be delayed. Ku, Huang and Kuo (2011) explore the determinants of clarity of new product introduction delay duration announcements. Vokura (2006) study the causes of new product introduction delays in the computer industry. Chen *et al.* (2007) explore intra-industry effects of delayed new product introductions.

The previous study has found that new product introduction delays do harm the market value of their firms within their sample, with the average loss being 5.25% (Hendricks and Singhal, 1997). Their study investigated industry-level and firm-level factors via a cross-sectional regression. These factors included: firm diversification, industry competitiveness, industry growth rate, product life cycle and a dummy variable for delay estimation. Our study focuses on firm-specific factors to try to understand what action firms may be able to take. Chen *et al.*, (2007), also undertook research based on 324 delays from 1989 to 1997. The result within this nine-year duration was even more significant, reaching -11.4% with the same (-1, 0) window as Hendricks and Singhal (1997). Chen *et al.* (2007) focussed on industry and competitors' characteristics, including: intra-industry relatedness degree, competition degree, growth opportunities, technological opportunities as well as the firm's size, free cash flow and financial leverage.

Consistent with prior studies (e.g. Hendricks and Singhal, 1997) we expect that new product introduction delays have a negative impact on market value. We include this as a hypothesis because our sample is different to Hendricks and Singhal's (1997) previous study as their sample was from 1984-1991 whereas, our sample of delays is more recent from 1999 to 2018 and has a US focus, enabling a consistent study. It is important to test this hypothesis with recent data as delays still occur in industry. In addition, the increased pace of innovation and increasing customer demands are expected to have impacted new product introduction delays, trends which have raised since Hendricks and Singhal's (1997) original study. We must first calculate the overall effect of new product introduction delays on market value to see if our findings are also negative, consistent with the other studies.

New product introduction delays have a negative impact on market value because a delay in a new product introduction can shorten the product's life cycle. This means that sales revenue can be damaged due to the product being on sale for a shorter length of time before it comes to the end of its life. Further to this, prices can decrease over time so a shorter life cycle can lead to a decrease in profit margin (Hendricks and Singhal, 1997). When a delay occurs, customers may no longer be willing to wait for the product, causing the organisation to lose out to competitors. This loss in market share can be long-lasting, particularly if products have high switching costs (Hendricks and Singhal, 1977). Thirdly, uncertainty can scare investors because they are not sure when the product will eventually be released and what the damage to the organisation will be. Such damage includes lost sales revenue, losing customers to competitors and reputational and brand damage (Hendricks and Singhal, 1977). A delay that is down to development issues can mean an increase in costs due to the additional work required (Clark and Fujimoto, 1991). Investors may not be satisfied with new product introduction delays as they postpone profits and harm dividends (Hendricks and Singhal, 1977). Finally, new product introduction delays can send signals to investors that the organisation does not have the

competence to launch new products on time and could be therefore symptomatic of a deeper organisational malaise (Hendricks and Singhal, 1997). Key in understanding the phenomenon of new product introductions is signalling theory. Signalling theory applies to the situation of asymmetric distribution of information between two parties in which certain underlying capabilities of one party are unobservable to the other party (Connelly *et al.*, 2010). As investors are not working within the business, they rely on signals from the organisation to judge its performance. New product introduction delays can worry investors for the reasons examined here. Therefore, we propose that:

H1. New product introduction delays have a negative impact on the market value of a company.

3.2.3 Firm profitability

Profitability is a relatively common factor to consider in event studies (Flammer 2013; Luo, Zhang and Duan, 2013; Tang, Lai and Cheng, 2016). We expect a negative impact of shareholder value for firms with higher profitability because investors expect firms which are able to generate high profitability have more to lose (Hendricks and Singhal, 1997). Additionally, investors expect firms with high profitability to be operating efficiently in order to generate profit and so they do not expect them to be experiencing a new product introduction delay. We therefore introduce this variable to the research on new product introduction delays to investigate the relationship between new product introduction delays and firms' profitability.

Sharma and Lacey (2004) find that innovative products can make a positive effect on firms' profitability. Girotra, Terwiesch and Ulrich (2007) take this further to find that innovative firms which then introduce more new products are more profitable than non-innovative firms. This helps to hypothesise the role that profitability may have in new product introduction delays in the year leading up to the delay; in other words, the impact that profitability may have on new product introduction delays before they happen, rather than the consequence of new product introduction delays on profitability (Hendricks and Singhal, 2008). Therefore, we propose that:

H2. The impact of new product introduction delays on market value is more negative for highly profitable companies.

3.2.4 R&D intensity

Research and development (R&D) has been regarded as vitally important for growth, productivity and competitiveness for a long time (Schumpeter, 1949; Griliches, 1979; Romer, 1990; Ugur, Trushin, and Solomon, 2016). From this, we can see how important R&D intensity is when it comes to developing new products, announcing new products and getting to market on time. R&D intensive firms may experience more positive change in market value when they experience a delay because they have the financial commitment to resolve such delays swiftly, since R&D measures how much a firm invests in new product development (Chao and Kavadias, 2013). Therefore, we propose that:

> *H3. The impact of new product introduction delays on market value is more positive for companies with high R&D intensity.*

3.2.5 Advertising intensity

Advertising intensity measures how much firms invest in advertising (Rahman, Rodríguez-Serrano and Lambkin, 2017). We expect that firms with high advertising intensity will experience a reduction in market value by new product introduction delays because their high spend in advertising in the hope of creating a positive brand image and brand awareness will be damaged by being seen to be late to market. The capital spent on advertising will be, to some extent, wasted if a subsequent delay damages the brand. Therefore, we expect that a high level of advertising intensity will be not help with market value when there is a delay announced. Therefore, we propose that:

> H4. *The impact of new product introduction delays on market value is more negative for companies with high advertising intensity.*

3.2.6 Operational slack

Operational slack is a measure of efficiency of organisations in their operations management. Having a level of operational slack enables firms to "adjust to gross shifts in the external environment with minimal trauma." (Bourgeois, 1981, p.31). Previous studies find that slack can

enhance firm performance (Daniel *et al.,* 2004; George, 2005). Slack resources allow firms to tactically deploy assets needed to manage new product introduction delay issues. Although firms with a low operational slack may be said to be operating more efficiently, illustrating a trade-off. When glitches happen, such as product introduction delays, firms with low operational slack may not be able to respond to mobilise resources and expedite the product introduction process as effectively as those with higher operational slack (Kovach *et al.,* 2015). Therefore, we purpose that:

H5. *The impact of new product introduction delays on market value is more positively for companies with high operational slack.*

3.2.7 The interaction effect of operational slack and advertising intensity

We hypothesise that advertising intensity amplifies the impact of operational slack on market value reactions to new product introduction delays. Previous studies use advertising intensity as a proxy variable for public awareness of firms (Miller, 1969; Han, Chinta and Palker, 2017). Investors may react more favourably to firms with high advertising intensity and high operational slack because the firms are conveying a desirable company image which they have the resources to do by executing their operations successfully, helping them to overcome new product introduction delay. There is appropriate theory on brand perception that explains the psychological role played in investors' effective evaluations of a firm's brand which influence their investment decisions. Combined with signalling theory, this expands our understanding. We hypothesise that firms send signals using advertising, which high operational slack enables them to back up their advertising with capacity to deliver new products. The interaction effect here attempts to explain advertising intensity as an amplifier to those signals. An industry example is Apple's AirPods. The company was still utilising a high advertising intensity to promote the product and other products as well as their brand in general while managing to achieve a high profit margin (Prigg, 2016).

Previous studies in different contexts find that advertising intensity can act as an amplifier, in particular a positive amplifier. For instance, Rahman, Rodríguez-Serrano and Lambkin (2017) find that advertising intensity positively moderates CSR activities on market share. This logic can be applied to new product introduction delays because organisations with high advertising intensity are able to send more positive signals about other key dimensions, for instance profit margin or CSR activities, which can lead to a boost in share price or market share. Therefore, we propose that:

H6. The impact of new product introduction delays on market value is more positive for companies with high operational slack and high advertising intensity.

3.2.8 The interaction effect of operational slack and R&D intensity

We hypothesise that R&D intensity amplifies the impact of operational slack on market value reactions to new product introduction delays. Firms with R&D intensity can experience greater productivity and long-term competitiveness (Schumpeter, 1949; Griliches, 1979; Romer, 1990; Ugur, Trushin, and Solomon, 2016). High R&D intensity can signal a financial commitment to resolve such delays swiftly, since R&D measures how much a firm invests in new product development (Chao and Kavadias, 2013). However, high R&D intensity can also mean that firms are striving to develop highly innovative products, perhaps developing or including new technologies. This intensive R&D can mean that some challenges arise in the new product development. For instance, Apple's AirPower problems overheating because of an overly-ambitious design including many overlapping wireless charging coils (Su, 2019). These ambitious designs and features, which can be associated with high R&D, need organisational slack as a firm resource to help cope and deal with any setbacks and challenges (Kovach *et al.*, 2015). If the firm were to be running with very little slack then there is not much capacity or scope to absorb such development problems relating to extensive R&D.

Figure 5 below is a conceptual model, visually showing how all of these hypotheses work together in one coherent model.

Figure 1: Conceptual Model
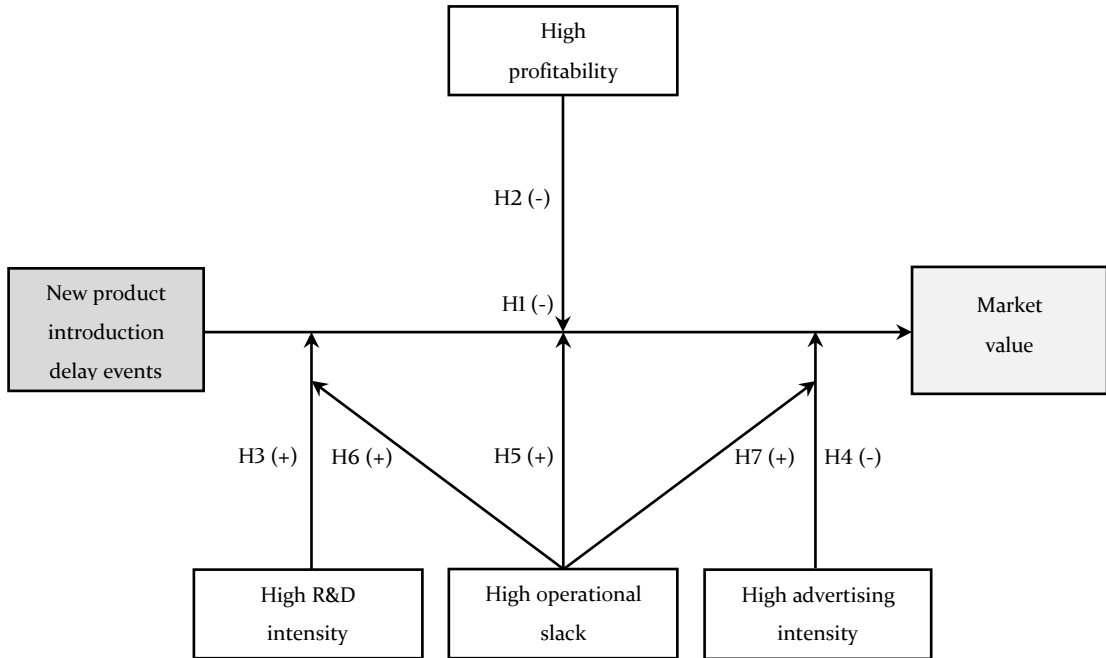
3.3 Methodology

3.3.1 Research context

Our research focussed on the preannouncements and new product introduction delays of publicly listed firms in the US for several reasons. The US is one of the largest economies in the world. The places the US at the forefront of international economic strength, with many large publicly listed companies that announce new products. However, such companies can also experience delays. US companies produce products for customers all over the world, highlighting the relevance and importance they play in the global economy. We were able to identify preannouncements and delays of new products for US firms listed on the S&P 500 Index via LexisNexis News.

Table 6. Industries of Companies Experiencing New Product Introduction Delays.

Industry	Two-digit SIC code	Frequency of new product introduction delays
Materials	15	1
Industrials	20	11
Consumer Discretionary	25	21
Consumer Staples	30	2
Healthcare	35	52
Information Technology	45	87
Communication Services	50	24

Table 7. Descriptive Statistics of Companies Experiencing New Product Introduction Delays.

Firm Characteristics	Unit	Mean	Std. Deviation	Minimum	Maximum
Employees	Thousand	103.23	83.69	4.29	400
Market Capitalisation	Million US$	139250.38	136062.63	1017.59	615336.46
Total Assets	Million US$	79866.15	754575.75	2440.315	321686.00
Sales	Million US$	51261.60	49741.27	1197.70	233715.00
Inventory	Million US$	2884.89055	2915.98	0.00	16933.00
Cost of Goods Sold	Million US$	27232.19	39109.89	48.24	143136.00

3.3.2 Data collection and sample

We collect data for companies from the S&P 500 index of the largest publicly-listed US companies. We searched for any preannouncements and new product introduction delays that these companies experienced by using LexisNexis news database, as mentioned above. Our scope was a 20-year period from the start of 1999 to the end of 2018 to capture all recent events. The S&P 500 list is updated annually so for consistency we use its 1999 list as this is the start of our data period. By using the S&P 500 index of the US' largest public companies we were able to use companies that are widely covered by various news media, reducing bias of the news coverage. Furthermore, this index can be used for the market return in the Market Model discussed later so we could estimate the sample firms' abnormal returns. The LexisNexis News database collects news and business information from over 40,000 online and premium sources, including *The Wall Street Journal, Associated Press* and *The New York* Times and has been widely used in prior studies (Sadovnikova and Pujari, 2017). We restricted our search to English language news only. To ensure we could capture changes in market value based on the efficient market hypothesis we searched for the first published news of a preannouncement and new product introduction delay where multiple news articles were published about a single

event (Markovitch and Steckel 2012). Tables 7 and 8 give an overview of the industries in which the companies in our sample operate and descriptive statistics respectively.

In our data collection process, we first identified the main business scope and product of each company in the S&P 500 index, to discard any companies which were not actually preannouncing or delaying a new product. Secondly, we used a combination of the following keywords: for preannouncements "product name obtained from delay announcement", for delays "company name of each S&P 500 company AND delay OR postpone". This ensured that all new product introduction delays could be found systematically to avoid researcher bias. We then manually read through each of the headlines to check its relevancy by identifying whether the news was actually about a preannouncement or new product introduction delay or a trial for instance, before reading the full news article. This resulted in an initial sample of 224 new product introduction delays from 46 companies and 104 preannouncements. Next we removed some events that happened on the same day, including multiple product preannouncements or delays, because we could not isolate and appropriately measure their effect on market value (Campbell *et al.*, 2003). This gave us a final sample of 197 new product introduction delay events from 43 firms and 97 corresponding preannouncements. However, due to availability of stock return data we end up with a sample of 95 preannouncements and 194 new product introduction delays. The final sample of firms belong to a range of different industries, shown in Table 6, suggesting that delays occur most frequently in healthcare and information technology. Examples of delayed new product introductions from the sample include Microsoft's Windows Vista (Associated Press, 2006) and Sony's Play Station 3 (Associated Press Financial Wire, 2006). For illustrative purposes, examples of news headlines for new products release delays are shown below:

Apple leaves AirPods' buyers up in the air (MailOnline, 26/10/2016)

(Prigg, 2016).

Microsoft delays shipping Windows 2000 in February (The Associated Press, 27/10/1999)
(The Associated Press, 1999).

We acquired the daily stock returns of these sample companies from The Center for Research in Security Prices (CRSP) to analyse their stock price reactions from the preannouncements and new product introduction delays. This data provider maintains some of the largest and most comprehensive proprietary historical databases, and it has been widely used in prior event studies concerning US firms (Chen *et al.*, 2007). CRSP also provides the stock price of the S&P 500 index, which could be used to represent the trend of the whole stock market to calculate the abnormal return. Table 9 summarises the data sources of the key variables used in our research.

Table 8. Key Variable Descriptions

Variable	Description	Measurement	Data Source	Reference
New product preannouncement	A new product announced before its release date	Identify a firm's new product preannouncement based on news articles in LexisNexis News.	LexisNexis	(Sorescu, Shankar, and Kushwaha, 2007)
New product introduction delay	A new product introduction released at a date later to that stated in a pre-announcement	Identify a firm's new product introduction delay based on news articles in LexisNexis News.	LexisNexis	(Hendricks and Singhal, 1997; Chen *et al.*, 2007)
Abnormal returns	The difference between the actual return with the occurrence of the new product introduction delay and the expected return had there been no delay	Abnormal Return = Actual Return - Expected Return	CRSP, Compustat	(McWilliams and Siegel, 1997; MacKinlay, 1997).
Cumulative abnormal returns	Sum of abnormal returns over an event window	Cumulative Abnormal Return = ∑ Abnormal Return	CRSP, Compustat	(McWilliams and Siegel, 1997; MacKinlay, 1997).
Firm size	Proxy for firm size before the new product introduction delay, lagged 1 year before the event date	Natural logarithm of number of employees	Compustat	(Xiong *et al.*, 2021).
Firm liquidity		(Current Assets - Inventory) / Current Liabilities		(Xiong *et al.*, 2021).
Days of inventory	Inventory days, lagged 1 year before the event date	365 / (Inventory / Cost of Goods Sold)		(Xiong *et al.*, 2021).
Profitability	Return on assets, lagged 1 year before the event date	Return on Assets (ROA)	Compustat	(Flammer, 2013; Luo, Zhang and Duan, 2013; Tang, Lai, and Cheng, 2016)
R&D intensity	The amount of R&D undertaken by a firm in proportion to firm size, lagged 1 year before the event date.	Research & development expenditure divided by net sales revenue	Compustat	(Baysinger and Hoskisson, 2017)
Advertising intensity	The amount of advertising undertaken by a firm in proportion to firm size, lagged 1 year before the event date	Advertising expenditure divided by total revenue	Compustat	(Miller, 1969)
Operational slack	Firm's slack across activities with suppliers, manufacturing operations and logistics and sales activities with customers.	Firm's cash-to-cash-cycle	Compustat	(Hendricks, Singhal and Zhang, 2009; Wiengarten *et al.*, 2017; Lam and Zhan, 2021).

3.3.3 Event study method

We used the event study methodology to quantify the impacts of preannouncements and new product introduction delays on market value. The methodology is based on the efficient market hypothesis and so it is able to measure the impact of an event within a short period, i.e. a few days. This methodology has been widely adopted in the operations management literature to explain how a range of events, including outsourcing, affect firms' market value. This methodology qualifies the abnormal returns rather than the actual stock returns, controlling overall stock market movements and providing a more accurate estimation of the impacts due to preannouncements and new product introduction delays. More specifically, abnormal returns (ARs) are the differences between the actual stock returns with the occurrence of preannouncements and new product introduction delay events and the expected stock returns without such events (Sorescu, Shankar, and Kushwaha, 2007). Following prior event studies, such as qualifying stock return to corporate environmental initiatives (Lam *et al.*, 2016), product recall announcement (Zhao, Li and Flynn, 2013) and supply chain finance initiatives (Lam *et al.*, 2019), we employed the Market Model to generate the estimation of expected return if there was not such a new product release delay. As shown in Equation 1, for firm *i*, its stock return on day *t* was regressed as R_{it}. So RM_t represents the stock return of a specific market index on day t. (McWilliams and Siegel, 1997; MacKinlay, 1997).

Market Model Equation (1)

$$R_{it} = \alpha_i + \beta_i RM_t + \varepsilon_{it}.$$

In our research, as the results of the preannouncements and new product introduction delay news were collected from S&P 500 firms, the S&P 500 index is the most suitable market portfolio for our research. We also took 120 trading days as an estimation period, ending 50 days before the event date to ensure that we could generate an accurate stock trend (MacKinlay, 1997). As we could generate the value of $\widehat{\alpha_i}$ and $\widehat{\beta_i}$ in each firm from their estimation period, we could complete the calculation of $E(R)_{it}$, the expected stock return, for those firms if there were no such preannouncements or new product introduction delays, as shown in Equation 2.

Expected Stock Returns (2)

$$E(R_{it}) = \widehat{\alpha_i} + \widehat{\beta_i} RM_t$$

After that, we could measure the difference between R_{it}, the actual stock return, and $E(R)_{it}$, the expected stock return. The calculation was shown in Equation 2, and we calculate the difference as AR_{it}, the abnormal return.

Abnormal Returns (3)

$$AR_{it} = R_{it} - E(R_{it}) = R_{it} - \hat{\alpha}_i - \hat{\beta}_i RM_t$$

We set the event windows to +/- 1 days since according to Mackinlay (1997), the stock return would not only be affected on the event date. The stock price could also react before the event if there was information leakage ahead of the news published. Hence, we included the day (-1) to capture these impacts. In addition, we also contain day (0) because the most significant reflection from the stock market would be exhibited on the event day. So, we introduce CAR, the cumulative abnormal return, to accumulate every day's abnormal returns during event windows, as shown in Equation 4. In addition to ARs on the event day, it is common practice for event studies to calculate cumulative abnormal returns (CARs) around the event day to capture cumulative effects of an event. This is because the effect an event can be dispersed over a few days around the event due to the leakage or gradual availability of information and interpretation. This is especially relevant to our research as new products can create a buzz right before they are announced.

Cumulative Abnormal Returns (4)

$$CAR_i = \sum_{t=-1}^{0} AR_{it}.$$

Some identified events had missing data and so where omitted as explained earlier. Multiple preannouncements and new product introduction delays on the same day in the same firm could result in cross-sectional interaction, and we would be unable to compute their respective CAR (Ding *et al.*, 2018). Fortunately, such events had already been removed in the data collection process as mentioned earlier. Also, we took trading volumes and average daily stock price into consideration. Prior studies (Subramani and Walden, 2001; Dewan and Ren, 2007) suggest only to calculate those firms whose trading volume were more than 50,000 and stock price were more than $1 because such events could have more representativeness. As our research is based on S&P 500 firms in 1999, they all matched this requirement.

Following previous event studies (Gilley *et al.*, 2000; Lam *et al.*, 2019), we apply parametric tests to identify the value of CAARs, AARs and whether they are statistically significant or not. More specifically, we employed the Patell *z*-test (Patell, 1976; Kolari and Pynnönen, 2010). This method could be used as the ARs are distributed across the whole event window.

3.3.4 Event window adjustment

Although for some studies researchers argue that the stock market could produce an immediate reflection on the firm's security when new information is released (MacKinlay,1997). In their research, ideally, one pre-event day (-1) could cover the stock market reaction of possible information leakage; meanwhile, he also argued that it is necessary to include one post-event day (1) which could record almost all stock return reflection after the stock market had been closed (Brown and Warner, 1985).

In our study, the information concerning preannouncements and new products' release delay was collected from LexisNexis, a third-party news and business information collector. Even though we had chosen the first data of the same preannouncements and product delay news respectively as the event data, there was still a relatively high possibility of the date of news published being one or more days later than the information released from other sources or if the first news had not been collected by LexisNexis. In Zhang's (2013) research, they use the websites of Shenzhen and Shanghai Stock Exchange to collect the event information. These two official platforms could list almost all strategic cooperation and strategic alliance announcements. However, in our event, the preannouncements and new products' release delays had a lower priority than other news (Chen *et al.*, 2007; Lin and Chang, 2011).

3.3.5 Cross-sectional regression model

As cross-sectional regression models had been widely applied in previous studies (MacKinlay, 1997; Flammer, 2013; Lam *et al.*, 2019; Xiong *et al.*, 2021). We also construct such a model to analyse the changes of CARs in the event and the factors affecting the CARs. This regression model assists us in examining the roles of firms' profitability (H2), R&D intensity (H3), advertising intensity (H4), operational slack (H5) and the interaction effect of operational slack and advertising intensity (H6). Therefore, we could measure the significance of the impacts of different factors which might influence CARs, as shown below:

Cross-Sectional Regression (5)

$CARs = \beta_0 + \beta_1\ Firm\ Profitability_i + \beta_2 R\&D\ Intensity_i + \beta_3 Advertising\ Intensity_i + \beta_4 Operational\ Slack_i + \beta_5 Advertising\ Intensity\ X\ Operational\ Slack_i + \beta_6 R\&D\ Intensity\ X\ Operational\ Slack_i + \beta_7\ Industry\ Dummies_i + \beta_8 Days\ of\ Inventory + \beta_9 Firm\ Liquidity + \beta_{10} Firm\ Size + \ \varepsilon_i$

According to McWilliams and Siegel (1997), CARs could be used to capture the significant effect of the event. We estimate Equation 7 by applying the ordinary least squares (OLS) approach. Therefore, we could indicate the effects of firms' profitability, R&D intensity, advertising intensity, operational slack, interaction effect of operational slack and advertising intensity and interaction effect of operational slack an R&D intensity, β_1 , β_2 β_3 β_4 β_5 and β_6 for a new product introduction delay. For these variables, we collected data lagged 1 year prior to the event dates so that we could see the impact of these dimensions on market value.

In addition to the hypotheses variables mentioned, we controlled for a number of firm-level variables. These included firm size, firm liquidity, days of inventory and industry. This is because larger firms may experience more delays due to their size meaning they could have more product lines and more new product introductions. We control for liquidity and days of inventory as efficiency measures so that we can take into account the firms' abilities to operate efficiently which could naturally have an impact on delays and preannouncements, with efficiency being an important factor in delivering on time as promised. We control for different industry types using industry dummies based on the firms' industry codes because some industries may experience more delays than others, for instance healthcare, where regulatory approval often slows down the product introduction process.

3.4 Test Results

3.4.1 Event study results

The test results of the market model are shown in Tables 9 and 10. As it applied three-day event windows, from one day before the event (-1) and one day after the event (+1), the table shows every days' results respectively.

First, for preannouncements the results of AARs in this 3-day window are overall insignificant but do show a positive direction on the day before and after the event, with a cumulative abnormal return (CAR) of 0.55%. This result is consistent with some prior studies

which do not find a significant short-term result without taking into account issues such as information quality (Sorescu, Shankar, and Kushwaha, 2007).

For new product introduction delays, in this three-day range are all negative, from -0.04% to 0.33%, with a CAAR of -0.51%, suggesting that new product introduction delays could negatively affect S&P 500 firms' market value, in line with prior studies (Hendricks and Singhal, 1997). This model is statistically significant ($p < 0.05$) and the abnormal returns (AR) on day -1 are also significant ($p < 0.01$) according to the Patell z-test. Therefore, H1 is supported. Moreover, the biggest AARs were on the day (-1), -0.33%, and the event day itself (0). Therefore, the appearance of information leakage may be present before the announcement of new product introduction delays.

Table 9. Event Study Test Results for New Product Preannouncements.

Day	N	CAAR /AAR	Patell z-test
(-1, 1)	95	0.55%	1.00
-1	95	0.23%	1.10
0	95	-0.06%	-0.95
1	95	0.38%	1.58

Notes: *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$ (Two-tailed tests).

Table 10. Event Study Test Results for New Product Introduction Delays.

Day	N	CAAR /AAR	Patell z-test
(-1, 1)	194	-0.51%	2.27**
-1	194	-0.33%	-3.29***
0	194	-0.14%	-0.89
1	194	-0.04%	-0.25

Notes: *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$ (Two-tailed tests).

3.4.2 Cross-sectional regression results

To be consistent, we use the CARs from days -1 to +1 as the dependent variable in our cross-sectional regression analysis.

Table 11 shows the correlations among the variables included in our regression analysis, while Table 12 presents the regression results. In the regression model, model 1 is the basic model including all the control variables. model 2 adds in the profitability hypothesis variable. model

3 adds in R&D intensity, model 4 advertising intensity, model 5 operational slack and model 6 the interaction between advertising intensity and operational slack. We check for multicollinearity issues in our models, with all VIFs being well below the acceptable threshold of 10, with a maximum of 4.061.

The coefficients for the first hypothesised variable, profitability, remains negative and significant ($p < 0.1$) across models 2 to 7, indicating that the impacts of new product introduction delays are more negative for firms with higher levels of profitability. H2 is thus supported. For R&D intensity, we find a non-significant but positive coefficient across models 3 to 6. Therefore, we reject H3. In models 4 to 6, the coefficient for advertising intensity is negative and significant ($p < 0.1$), supporting H4. For operational slack, we do not find statistical significance, though the coefficient is positive in models 5 and 6. We therefore reject H5. In model 6, there is a positive interaction between operational slack and advertising intensity ($p < 0.1$) which is statistically significant. Therefore, H6 is supported. In model 7, although there is a positive interaction effect between operational slack and R&D intensity, this is not statistically significant. Therefore, H7 is rejected. Table 13 summarises an overview of hypotheses support.

Table 11. Correlation Matrix for New Product Introduction Delays.

Variable	1	2	3	4	5	6	7	8
1. CAR (1, 1)	1							
2. Profitability	-0.16**	1						
3. R&D intensity	-0.04	0.23***	1					
4. Advertising intensity	-0.08	0.06	-0.14*	1				
5. Operational slack	-0.03	-0.21***	0.29***	-0.092	1			
6. Days of inventory	0.03	-1.15**	-0.57***	-0.14*	00.28***	1		
7. Firm liquidity	0.00	0.43***	0.50***	0.09	-0.24***	-0.25***	1	
8. Firm size	0.03	-0.17**	-0.54***	-0.18**	0.03	0.26***	-0.57***	
Mean	-0.01	0.09	1.11	-0.00	-0.30	4517.34	4.32	103.230
Standard deviation	0.04	0.09	0.08	0.03	147.25	1.65	0.85	83.690

Notes: *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$ (Two-tailed tests).

Table 12. Cross-Sectional Regression Results for New Product Introduction Delays.

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Profitability		-0.19** (-2.33)	-0.19** (-2.22)	-0.18** (-2.20)	-0.16* (-1.93)	-0.16* (-1.87)	-0.17* (-1.98)
R&D intensity			0.10 (0.74)	0.08 (0.54)	0.06 (0.44)	0.10 (0.71)	0.06 (0.38)
Advertising intensity				-0.16* (-1.85)	-0.16* (-1.86)	-0.20** (-2.24)	-0.20** (-2.23)
Operational slack					0.14 (1.05)	0.21 (1.56)	0.12 (0.69)
Advertising intensity x operational slack						0.15* (1.74)	0.17* (1.92)
R&D intensity x operational slack							1.33 (0.93)
Industry dummies	Included	Included	Included	Included	Included	Included	Included
Days of inventory	-0.02 (-0.22)	-0.02 (-0.30)	-0.01 (0.12)	-0.02 (-0.17)	-0.01 (-0.07)	-0.00 (-0.03)	-0.01 (-0.59)
Firm liquidity	0.02 (0.17)	0.07 (0.63)	0.07 (0.56)	0.13 (1.05)	0.13 (1.08)	0.16 (1.31)	-0.19 (1.51)
Firm size	-0.05 (-0.46)	-0.01 (-0.12)	0.00 (0.00)	0.04 (0.39)	0.01 (-0.10)	-0.02 (-0.19)	-0.01 (-0.06)
Number of observations	192	192	192	192	192	192	192
R-squared	0.04	0.07	0.07	0.09	0.09	0.11	0.12
Adjusted *R*-squared	-0.01	0.01	0.01	0.03	0.03	0.04	0.04

Notes: $*p < 0.1$, $**p < 0.05$, $***p < 0.01$ (Two-tailed tests).

Standardised coefficients are reported. t-statistics are in parentheses.

Table 13. Hypotheses Support Overview.

Hypothesis	Significance	Coefficient	Result
H1. New product introduction delays have a negative impact on the market value of a focal company.	Significant	Negative	Accepted
H2. The impact of new product introduction delays on market value is more negative for highly profitable focal companies.	Significant	Negative	Accepted
H3. The impact of new product introduction delays on market value is more positive for focal companies with high R&D intensity.	Non-significant	Positive	Rejected
H4. The impact of new product introduction delays on market value is more negative for focal companies with high advertising intensity.	Significant	Negative	Accepted
H5. The impact of new product introduction delays on market value is more positively for focal companies with high operational slack.	Non-significant	Positive	Rejected
H6. The impact of new product introduction delays on market value is more positive for focal companies with high operational slack and high advertising intensity.	Significant	Positive	Accepted
H7. The impact of new product introduction delays on market value is more positive for focal companies with high operational slack and high R&D intensity.	Non-significant	Positive	Rejected

Table 14. Robustness Test Results.

Model	Day	N	CAAR	Patell z-test
Expanded event window	(-3, 3)	194	-1.23%	0.00***
Estimation window 180 days	(1, 1)	194	-0.55%	-2.45***

3.4.3 Robustness test results

We conducted numerous robustness tests to check the sensitivity of our findings and to account for alternative expectations. The robustness test results are shown in Table 14 and explained below. Overall, these tests show the robustness of our research.

Frist, we consider a different event window for delays, using a 7-day event window (-3, 3) from 3 days before the event to 3 days after the event. We found consistent results, with the CAAR being statistically significant and negative. Secondly, we select an alternative estimation window

of 180 days and again find consistent results with the CAAR being statistically significant and negative.

3.5 Discussion

In conclusion, our research demonstrates that investors react more to negative signals about new product introduction delays than they do to positive signals of new product preannouncements based on an analysis of 95 preannouncements and 194 delays. This shows consistent findings with prior event studies on new product preannouncements, (Sorescu, Shankar, and Kushwaha, 2007), and new product introduction delays (Hendricks and Singhal, 1997). Although, we find a smaller magnitude in market value erosion. This could be because our sample from the S&P 500 Index are large and successful companies, meaning that just a very small reduction in market value can account for billions of dollars. Additionally, such large companies may have adequate resources and brand power to effectively cope with and address delays. Furthermore, delays are common place and investors may now expect these to occur often. We find that highly profitable firms and those with high advertising intensity fair worse when it comes to their market value if they experience a delay. We also show that operational slack positively moderates advertising intensity. We do not find any significance of these dimensions for preannouncing new products. These findings provide important implications for research and practice which will be explored below.

3.5.1 Implications for research

Researchers have paid much attention to preannouncements and new product introduction delays due to their accepted importance for the survival of organisations (Owens, 2006). Well documented are the impacts of preannouncements and delays in separate studies (Sorescu, Shankar, and Kushwaha, 2007; Hendricks and Singhal, 1997). Other research also investigated the impacts of new product introduction delays on firms' operating performance (Hendricks and Singhal, 2008). Though, it still remained unclear how firms who preannounce and go on to later delay fair with their change in market value. Additionally, few researchers have investigated which dimensions impact, positively or negatively, market value reactions where preannouncements and new product introduction delays are concerned; focussing instead on the impact of such delays (Hendricks and Singhal, 2008). Our research takes a step further by investigating the impact of preannouncements and delays in one study based on the same sample, providing an apple-with-apple comparison. This enables us to see how investors react significantly to negative signals on new products, i.e. delays, but not to positive signals, i.e.

preannouncements. These findings highlight the importance of avoiding negative signals in order to maximise market value.

The signalling perspective adopted in our research may offer a fruitful theoretical foundation for future research on preannouncements and new product introduction delays. Signalling theory is suitable for studying preannouncements new product introduction delays because investors rely on some form of signals from the organisation to see how capable the organisation is in delivering new product introductions and addressing any delays. Investors cannot see from new product introduction delays alone what resources and capabilities the organisation has to deal with its situation. Therefore, investors need to rely on other observable signals to interpret the financial consequences of the announced new product introduction delays. The signalling perspective is particularly useful in this context because organisations do not like to shout about their delay issues, instead it is typically third party news websites which reveal their delays more comprehensively. This contrasts to their propensity to preannounce, with firms often being ambitious in communicating new products before their successful existence and viability is even certain. Drawing on signalling theory, researchers can study other interesting questions beyond those addressed in our research. For instance, while our research focuses on investors' reaction to the signals sent by firms which are announcing new product introduction delays, future research can explore how other stakeholders, such as competitors and suppliers, respond to firms' new product introduction delay signals, in particular Overall, we encourage researchers to adopt the signalling perspective to enrich our understanding of new product introduction delays and preannouncements as these two types of events continue to be essential to all organisations.

We find that organisations with high profitability fair worse with their market value when they delay a product. This is because organisations with high profitability have more to lose (Hendricks and Singhal, 1997). Additionally, organisations with high advertising intensity also fair worse when they encounter a delay. This could be due to brand damage when a delay is announced, this goes against the significant amount of capital spent on advertising. We find that R&D intensity has no significant impact on market value when a delay is experienced, although the direction is positive. This could be because although R&D intensity is vital for remaining competitive and in developing innovative new products successfully (Schumpeter, 1949; Griliches, 1979; Romer, 1990; Ugur, Trushin, and Solomon, 2016), investors may expect highly innovative product development to be more cumbersome in addressing any subsequent delays. Firms with high R&D should be well positioned to deliver new products successfully but this could be counteracted by ambitious new technological innovations for instance. We find that while operational slack alone is not significant in impacting market value when there is a delay, it does positively moderate advertising intensity. When we consider operational slack and advertising together, market value is more positive. This could be explained by firms having

their advertising backed up by the capacity, i.e. operational slack, to cope with new product introduction delays. We do not find a significant impact of the interaction effect between operational slack and R&D intensity, although the moderation is positive. This may be because R&D intensity is less visible than advertising intensity. The consideration of these dimensions explored; profitability, R&D intensity, advertising intensity, operational slack; make some new contributions to the literature on new product introductions because they give insight into which factors may lead to more or less positive market value reactions. This can be useful in understanding which characteristics of organisations have an impact on market value when a delay is experienced.

We do not find significance of these dimensions when it comes to preannouncements. This is expected to be because investors are more interested in protecting themselves from negative signals and events. Consequently, they are less excited by new product preannouncements. This could be explained by the inevitability that organisations have to continue to innovate and develop new products in order to survive by driving revenue (Owens, 2006). In other words, announcing new products is commonplace for essentially all organisations so it does not attract the interest of investors especially. Meanwhile, some of these organisations may go on to later experience a delay which catches the attention of investors more.

Further research could be fruitful in using qualitative methods to gain greater insight into the relationship between preannouncements and subsequent delays at a more granular level in a way that event studies cannot. This could be particularly useful since our sample size for preannouncements and new product introduction delays is not equal. This is due to not all delayed products in our sample being preannounced. This could affect our direct comparison. Utilising other methods, in particular qualitative methods, would help to negate these sample size issues. Additionally, an interesting insight could be on the impact of new product introduction delays on supply chain partners, i.e. suppliers and customers. Since we understand the direct impact of preannouncements and new product introduction delays on focal companies, gaining insight into what this means for supply chain partners and their market value would be interesting (Xiong *et al.,* 2021).

3.5.2 Implications for practice

Publicly listed companies, such as the ones studied in this research, wish to maximise shareholder wealth as their primary goal (Hendricks and Singhal, 1997). To do so, achieving and sustaining high profitability is essential. However, our findings indicate that profitability is in conflict with a more negative impact on market value from new product introduction delays. This tension is difficult for companies to address as both having high profitability and limiting the negative impacts of new product introduction delays are in tension with one another.

Nonetheless, companies with high profitability need to be aware of new product introduction delay issues. To avoid more negative reactions than companies with low profitability, such organisations should first know that having high profitability and experiencing a new product introduction delay can more negatively impact their market value. This can be a reminder and motivator to help avoid new product introduction delays in the first place. Awareness is key as there is already a number of studies on potential methods of helping to avoid, reduce and manage new product introduction delays. For instance, Driscoll (2002) explain how organisations should 'design to manufacture' to enable effective product processes via reconciliation of process capabilities and design requirements, at an early stage of product development. For example, when McDonald's introduced a new limited edition product they did so with existing key ingredients. This meant they were able to avoid production and sourcing issues, as well as staff already being familiar with the ingredients. Further to this, there are researchers who investigate avoiding delays under certain circumstances, such as where delays are caused by a low manufacturing yield (Özer and Uncu, 2013). Although, mitigation strategies for new product introduction delays is beyond the scope of this research. Organisations with a high profit margin should turn to the implications of this literature in avoiding delays. This is key due to the explained inevitability of new products being announced and the rate at which delays still occur, despite the literature on new product introduction issues. Organisations should seek to minimise delays if they are to continue to maximise shareholder wealth.

Additional to profitability, organisations with high advertising intensity can also experience more a negative change in market value. Again, this is a difficult tension to resolve as organisations must invest in advertising to communicate their new products and remain competitive, ultimately attempting to ensure their survival. However, organisations with high advertising intensity must remember that if they experience a delay their market value may fair worse than organisations with lower advertising intensity. Therefore, companies with high profitability and advertising intensity are at risk of significant negative market value reactions when they experience a delay compared to their counterparts. Although, since we find that operational slack positively moderates advertising intensity, this could be one way of addressing the tension presented. Therefore, companies with high advertising intensity should consider increasing their operational slack so that they have spare capacity to deal with delays, backing up their advertising. Though, this is a trade off as high operational slack could be seen as inefficiency.

Avoiding delays is best where possible. However, some delays are inevitable. This means that ability and capacity to cope with and resolve delays in a timely manner is paramount. By better understanding their position according to the explored dimensions, companies can be better prepared to avoid more negative market value reactions. Since our study find that investors react more to negative signals than they do to positive ones, at least in the short-term based on

the efficient market hypotheses, organisations should carefully consider whether to over-ambitiously preannounce a new product, knowing that investors do not pay much attention to such positive signals, when they could later experience a delay. Therefore, an implication for practice here is that managers should only preannounce new products when they have a high degree of certainty that they can avoid delays. Investors reacting more to positive signals than negative ones can be found in other contexts, such as finance, with Kadiyala and Rau (2004) finding this to occur in corporate event announcements. This is useful in applying to preannouncements and new product introduction delays since firms are often eager to announce new products and create buzz but may later experience a delay. By applying signalling theory in this way, it serves as a reminder to organisations to be cautious about being over-zealous in new product preannouncements since they later experience delay which would harm share price more significantly than a preannouncement would benefit it. By studying the impact on market value of new product introduction delays and their related preannouncements from the same sample group, the S&P 500 Index, we are able to better investigate the role of positive and negative signals which investors use on related events, i.e. preannouncements and delays.

3.6 Conclusion

Overall, we believe that by studying changes in market value associated with new product introduction delays we can better understand the impact of delays to the investment community. This will enable researchers and practitioners to gain a better understanding of investor value of preannouncing new products and being late to market, providing important implications for operations management. This can help investors in understanding their cautious approach to negative signals. In doing so, they may wish to increase their reaction to positive signals in order to capitalise on new product preannouncements, which some studies find hold value in the long-run (Sorescu, Shankar, and Kushwaha, 2007).

3.6.1 Limitations

There are some limitations in our research. First, our research focuses on the preannouncements and new product introduction delays of US firms listed on the S&P 500 Index. Although focussing on a single market is consistent with prior studies, (Lam *et al.*, 2016; *Xu et al.*, 2012; 2016), it could miss opportunities to see differences across different markets. As economic development and conditions may vary across different markets it could be interesting to see future research on preannouncements and product introduction delays in other contexts, for instance emerging markets, e.g. China.

As our research employs the event study method, only publicly listed companies can be investigated as their market value data are available. This limitation could restrict the generalisability of our findings to private firms. For example, preannouncements and new product introduction delays may have more impact on large, publicly listed, firms than private ones. This could be due to stronger reputational impacts for publicly listed companies. Additionally, through our research we cannot ascertain whether market value reactions to preannouncements and new product introduction delays are reflected in the long-term since we apply the short-term event study method. We base our research on the assumption of the efficient market hypothesis.

We consider market reactions to new product introduction delays generally across all product types and industries. It is possible that market reactions to certain product types may be different. For instance, many new drugs were delayed by the FDA so investors may respond differently to this as it is very common across new drugs for delays to be experienced due to regulatory approval, although this regulatory delay has somewhat improved over time (Wiggins, 1981). Nonetheless, we attempt to deal with this by controlling for industry type. Despite these limitations, our research provides important fruitful insights into preannouncements and new product introduction delays, quantifying how investors react to these signals and which dimensions lead to more or less negative changes in market value.

3.6.2 Future research

Future research could consider further important dimensions which could have an impact on market value when there is a delay. For instance, management capabilities. Beyond the impact of delays on the focal company and competitors (Hendricks and Singhal, 1997, Chen *et al.*, 2007), it would be insightful to explore the impact of such delays on suppliers. This could be particularly interesting due to the increased importance of supply chain management in recent years.

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3.8 Appendix 1

University of Liverpool Management School
PhD Thesis – PhD Structured as Papers

AUTHORSHIP DECLARATION - joint authored papers - Appendix B

1. Candidate

Name of the Candidate	Student Number
Matt Mitchell	200883259
Thesis Title	
Event studies on the market value effects of new product introduction delays for focal companies and suppliers	

2. FORMAT OF THE THESIS

Is the candidate intending to structure their thesis as papers?	Yes	If Yes, please complete Section 3 (sole authored paper) OR 4 (joint paper) **If No, you do not need to complete this form**

3. PAPER INCLUDED IN THE THESIS – JOINT AUTHORED PAPER

Title of the paper	Has this paper been published, presented at a conference or under review with a journal	If Yes, please complete the boxes below. If No, go to section 4
The effects of new product introduction delays on market value and the role of firm resources: Evidence from the S&P 500 Index	Yes - presented at a conference	Completed

If the paper has already been published please refer to the University guidelines on presentation of publications within a PGR Thesis - https://www.liverpool.ac.uk/media/livacuk/tqsd/code-of-practice-on-assessment/annex-7.2-PGR-CoP.pdf

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If the paper is presented at a conference, give details of the conference International Conference: 1) Production and Operations Management Society (POMS) 32nd Annual Conference 2022 in Orlando, Florida, US, 21st-25th April 2022 (Online) (ID: 111-1748) Other: 2) Alliance Manchester Business School Virtual Doctoral Conference 28th May 2020 (Online) 3) Poster Day 2020 for Postgraduate Researchers, Liverpool UK 31st March 2020

4. DESCRIPTION OF ALL AUTHOR CONTRIBUTIONS (including the PhD candidate)

Name and affiliation of author	Contribution(s) (for example, conception of the project, design of methodology, data collection, analysis, drafting the manuscript, revising it critically for important intellectual content, etc.)
Matt Mitchell, University of Liverpool	Conception of the project, design of methodology, data collection, analysis, drafting the manuscript, revising it critically for important intellectual content
Xiancong Xu, University of Liverpool	Partial collection of data for some of the delay announcements as per the lead author's instructions
Prof. Hugo Lam, University of Liverpool	Supervision
Prof. Andrew Lyons, University of Liverpool	Supervision

5. AUTHOR DECLARATIONS (including the PhD candidate)

I agree to be named as one of the authors of this work, and confirm:
iv.   that the description in Section 4 of my contribution(s) to this publication is accurate,
v.   that there are no other authors in this paper,
vi.   that I give consent to the incorporation of this paper/publication in the candidate's PhD thesis submitted to the University of Liverpool

Name of author	Signature*	Date
Matt Mitchell	*Matt Mitchell*	14th February 2023
Xiancong Xu	*Xiancong Xu*	14th February 2023
Prof. Hugo Lam	*Hugo Lam*	28th March 2023
Prof. Andrew Lyons	*ALyons*	28th March 2023

6. OTHER CONTRIBUTOR DECLARTION

I agree to be named as a non-author contributor to this work.

Name and affiliation of contributor	Contribution	Signature* and date
N/A	N/A	N/A

This consent form (Appendix B) or the sole author consent form (Appendix A) for each paper must be completed and kept by the PhD candidate once the paper is finalised. If the paper is to be included as part of the thesis, a copy of this form must be included in the PhD thesis with each publication.

Chapter 4:

Suffering together? The effects of new product introduction delays on the market value of suppliers: Evidence from the Boeing 787 Dreamliner

4.0 Abstract

We undertake a retrospective study of the Boeing 787 Dreamliner's introduction delays in order to understand their impact on the market value of suppliers. We find that the Dreamliner's introduction delays can be associated with negative financial impacts for both Boeing and its suppliers. We show that these negative effects spillover to suppliers, independent of whether they are involved in the Dreamliner project. We also find that this negative impact is higher for the first delay of the introduction of the Dreamliner than a further delay. We explore the implications of these findings, contextualising contemporary challenges in supply chain management.

Key words: New product introduction delays, suppliers, market value, event study, Boeing 787 Dreamliner

4.1 Introduction

Organisations must continually develop and successfully launch new products to survive and remain competitive via attracting customers and generating revenue. Often there are preannouncements of such new products to tell the market and investors of their anticipated launch (Wu *et al.,* 2004). There can be first-mover advantages in competitive markets and there is also a need to capitalise on new technologies, innovation and meeting customer demands and trends. However, all-too-often delays occur in this new product introduction process. New product introduction delays, defined as being late to the market with a product, occur often (Hendricks and Singhal, 1997; 2008; Kim, Koenigsberg and Ofek, 2023). Recent new product introduction delays include the Tesla Cybertruck which was planned to enter-pre production in late 2021 but has now been pushed back to 2023, suffering from setbacks which Tesla put down to the COVID-19 pandemic (Reuters, 2022). The Boeing 787 Dreamliner's introduction delays, starting in 2007, were partly explained by excessive outsourcing (Elahi, Sheikhzadeh and

Lamba, 2014) and overly-ambitious innovation with composite materials (Marsh, 2009; Mocenco, 2015; Chen *et al.*, 2020). Other new product introduction delays include the Boeing 777X, the launch of which has been postponed until 2025, highlighting that the Dreamliner delay was not a one-off occurrence for Boeing, with delays still affecting the company to this day (Shepardson, 2022). New product introduction delays are found to have a negative impact on stock returns for the company experiencing the delay, i.e. the focal company (Hendricks and Singhal, 1997), and competitors (Chen *et al.*, 2007). However, these delays may also affect external partners beyond the focal company, for instance, suppliers. It is critical that suppliers understand how they could be impacted by new product introduction delays experienced by their customers. This is important for supply chain resistance and transparency (Doorey, 2011). However, this fundamental question remains unanswered.

Delays to the introduction of new products may impact suppliers. It is imperative to understand such impacts particularly with regard to their financial influence (Shih, 2022). Our research investigates whether the impacts of new product introduction delays spillover to supply chain partners. Some researchers have observed a spillover effect of negative events in supply chains. For example, Xiong *et al.* (2021) found a negative spillover effect for supply chain partners, i.e. customers and suppliers, of a focal company which committed an environmental violation, but it is unclear whether such a spillover effect can be found in the context of new product introduction delays. Other researchers have found spillover effects in the operations and supply chain domain, such as Nichols *et al.* (2019). Their study demonstrates that negative supply chain news across all three triple bottom line dimensions reduces consumer perceptions of quality. Investigating such spillover effects beyond the main direct effect is key in developing a more comprehensive understanding of the phenomenon.

To conduct our study, the Dreamliner programme is used to illustrate the impact of delays on suppliers. This is made possible using a single product's delays as we are able to measure the impact on suppliers and can dissect this into suppliers which were and were not involved with the product being delayed. The Dreamliner programme was large and innovative (Aboussalah *et al.*, 2013), not only in terms of the product, which utilised a new material to aircrafts, carbon fibre, enabling the plane to be lighter and therefore more environmentally friendly, whilst allowing for larger windows to enhance the passengers' experience and enable them to reconnect with the 'magic' of flight' but also in terms of the supply chain challenge (Boeing, 2010).

Different to usual and previous aircraft development, on this occasion, Boeing decided to have a number of larger suppliers manufacture various sub-assemblies using parts and components from smaller suppliers across the world which were then put together to create the Dreamliner final assembly at Boeing's plant. However, this radical approach for the company proved problematic. Issues arose concerning quality, delays and differences in standards. These

issues were time-consuming, costly and resource-intensive to resolve. The Dreamliner did go on to become a successful product in respect of sales, despite a number of other setbacks after its initial launch, such as battery fires (Gokhale et al., 2014; Schwartz and Busby, 2014; Song *et al.*, 2014). The challenges Boeing found with its new approach caused a number of delays to the introduction of the new aircraft. Naturally, Boeing's launch customers and those which had made orders for the aircraft were dissatisfied.

We focus on the first two delays which related to the introduction of the aircraft, i.e. its delivery to customers. This is because the greatest impact of the delays is expected to be felt in the initial delays as they are unexpected so it is logical to focus on the first delay and the second delay to test whether a further delay also has a negative impact. We specifically focus on delays which impact the introduction of the new product for our research context, rather than a more general delay to production for instance but which does not actually push back the delivery date of the first aircraft. The programme experienced a number delays, some of which pushed back the delivery date of the aircraft. Some of these issues, forming the focus of this study, are illustrated in Table 15 below:

Table 15. The Boeing 787 Dreamliner Introduction Delay Events

Date	Event
10th October 2007	A further 3-month delay to the first flight plus a 6-month delay to the first deliveries due to problems with the US and foreign supply-chain: ongoing fastener shortage and software issues.
9th April 2008	Fourth delay announced. Maiden flight rescheduled for fourth quarter of 2008; initial deliveries put back 15 months to third quarter of 2009.

(The Telegraph, 2013).

It is logically predicted that a focal company's new product introduction delay would have a negative impact on the stock returns of supply chain partners, e.g. customers and suppliers. Furthermore, suppliers located in the same country as the focal company, which is the US in the case of Boeing, may experience less negative stock returns than firms located in other countries outside of the US. This is rationalised as it is expected to be easier to resolve new product introduction delays within the same country due to shorter lead times owing to quicker shipping times, less complicated logistics and physical distribution, particularly relevant to an aircraft manufacturing research context with its complex sub-assemblies as in the case of the Dreamliner's global production system (Reuters, 2008; Sabat, 2015; Schmuck, 2020). Communication can be easier with relatively close spatial location and the same languages, cultures and standards. The aim of this research is to investigate the impact of the introduction

delays for the 787 Dreamliner on Boeing's suppliers Overall, this research seeks to address the following questions:

1. What is the impact of Boeing's Dreamliner introduction delay on its suppliers?

2. Is there a difference in impact depending on whether suppliers are involved with the Dreamliner?

3. What is the impact of a further delay to the Dreamliner on suppliers?

4. How do the impacts of the Dreamliner introduction delay vary across suppliers based on their location?

5. Is there a difference in impact depending on supplier relationship value?

Our findings make a number of significant contributions. First, we add to the existing literature on new product introduction delays. Although prior research has examined the impact of new product introduction delays on focal companies (Hendricks and Singhal, 1997, 2008), and to some extent competitors (Chen *et al.*, 2007), it remains uncertain how the impact of such delays could also spillover and affect suppliers. This remains a blind spot in the literature. Focal companies do not exist in a vacuum but rely on supply chain partners to help bring their new products to market. Therefore, we move the research on in an important direction with the intention of providing a more comprehensive picture of the impact of new product introduction delays. Based on the Boeing 787 Dreamliner introduction delays in 2007 and 2008 and Boeing's suppliers' details obtained from Bloomberg and Airframer respectively, we find that the delay of the introduction of the Boeing 787 Dreamliner does have a negative impact on not only the focal company, i.e. Boeing, but also its suppliers. We find that the spillover effect is strong, not discriminating if a supplier is directly related to the delayed product or not. Furthermore, our cross-sectional regression analysis and intergroup comparison shows that suppliers experience similarly negative impacts regardless of whether they are from the same country as Boeing, i.e. the US, or not; and irrespective of their relationship value with Boeing. However, we also find that investors react more strongly to an initial new product introduction delay than to a further delay of the same product.

4.2 Literature Review and Hypothesis Development

This literature review section will begin by reviewing a few key research themes: studies on the impact of new product introduction delays on the market value of firms, studies on spillover effects in the operations and supply chain management context, and studies on the introduction delays of the Boeing 787 Dreamliner. This serves as a foundation upon which the subsequent hypotheses are derived.

Hendricks and Singhal (1997) found an erosion of approximately 5.24% in market value of focal companies in their sample experiencing a delay, representing a substantial loss in market value of $1193 million associated with new product introduction delays due to companies being late to the market with new products. They found, via regression analysis, that industry competitiveness, firm size and firm diversification have an impact on the market value of firms experiencing new product introduction delays. The researchers also found that new product introduction delays have a negative impact on profitability, and other financial metrics such as return on assets (ROA). The effect is more negative for smaller firms and for those which are more profitable prior to a delay, as well as for firms operating in larger and more profitable industries. Additionally, they find a positive association between ROA and stock price around the delay (Hendricks and Singhal, 2008).

Besides focal companies, Chen *et al.,* (2007) attempted to measure the impact of new product introduction delays on competitors, finding a negative impact for what they described as intra-industry effects, via information-signalling and competitive effects lenses. Furthermore, they broke down this overall effect by industry, finding that around 60% of industries have a negative response to delays. They found that more negative information is conveyed about competitors in industries that are more likely to experience new product introduction delays. Finally, they showed that competitors' stock price movement is positively related to the announcement effect on the focal company, industry competitiveness, and industry growth while being negatively associated with the relatedness of the focal firm to the industry, and the focal firms' free cash flow level relative to its competitors.

A number of researchers find empirical evidence for spillover effects of various phenomenon in the operations and supply chain management context. Xiong *et al.* (2021) find empirical evidence for a negative market value effect of environmental violations in China for supply chain partners, including both suppliers and customers, demonstrating a spillover effect. Further analysis revealed that environmental transparency and supply chain diversity helped supply chain partners to mitigate the negative market value effects. The mitigating role of environmental transparency was more pronounced for customers than suppliers, while supply chain diversity had a similar mitigating effect across supply chain partners. Meanwhile, Jacobs

and Singhal (2020) study the 2015 Volkswagen diesel emissions scandal. They find a negative that the market value effect of the scandal spills over from Volkswagen to the wider automotive industry. Firms with larger revenue dependence on Volkswagen and suppliers of components for engines and/or emissions systems were associated were more negative market value effects. Volkswagen's customers were also negatively affected but not non-Volkswagen customers. Nichols, Stolze and Kirchoff (2019) study the impact of the news about supply chain operations related to the triple bottom line on consumer's perceptions. They find a negative spillover effect on consumer perceptions of quality across all dimensions of the triple bottom line. Ding *et al.* (2021) study the impact of natural disasters, specifically using data from the 2016 Kumamoto earthquakes, to find evidence of how industry peers located in other companies are also affected by the disaster. They find a negative market value effect for semiconductor manufactures located in China. This effect was more negative for firms with supply chain connections with Japanese firms. On the other hand, Chinese firms with high inventory turnover and customer concentration experienced a less negative market value effect. These studies on spillover effects in the OSCM context demonstrate how OSCM issues can affect supply chain partners and not only the focal company.

There are relatively few studies studying the impact of the Boeing 787 Dreamliner's introduction delays. Marsh (2009) find that the Boeing 787 Dreamliner introduction delays caused discontent for the aircraft's customers, significantly harming Boeing's credibility and leading to $2.5 billion being written off by Boeing, mostly in compensation. The delays also meant changes in members of Boeing's management team. Moreover, Jelaca and Boljevic (2016) also find that the delays loss of loyal customers, business partners and impacted the competitive position of Boeing. Shenhar *et al.* (2016) take a project management perspective, finding that the Dreamliner project delays caused cost overruns. However, there is still a significant gap on the impact of the Boeing 787 Dreamliner introduction delays, particularly for suppliers. No studies have yet examined the market value effects of the Boeing 787 Dreamliner for Boeing's suppliers.

A contingent theoretical lens is adopted within the supply chain management context (Stonebraker and Afifi, 2003). Within this specific research context of examining the market value effects of the Boeing 787 Dreamliner introduction delays for Boeing's suppliers, important supplier and delay variables are considered. These important variables are comprehensive in relation to suppliers and the delays. For instance, supplier involvement is key in understanding whether the impact of the new product introduction delays are associated only with the suppliers involved with the delayed product itself or whether this spillover to all suppliers working with the affected focal company (Hertzel *et al.*, 2008; Herm, 2014; Nichols, Stolze and Kirchoff, 2019; Jacobs and Singhal, 2020; Xiong *et al.*, 2021; Ding *et al.*, 2021). Supplier location is important, particularly in the context of Boeing's global outsourcing model, because suppliers

further away from the focal company with different ways of working, design standards and measurement systems, longer lead times and communication differences may experience different impacts when there is a delay (Melo, Nickel and Saldanha-da-Gama, 2009. It is logically predicted that the first delay will have a greater impact on the market value of suppliers than a second delay in the research context as investors may expect more delays to follow since they know that the complex challenges faced by the Dreamliner programme would not be a quick fix and that getting the product right, for example for safety reasons, was paramount. It is reasonably predicted that suppliers with a larger relationship value with Boeing would experience more negative market value effects when there is a delay as they depend on Boeing for their business to a greater extent (Kumar *et al.,* 2019; Shih, 2022b). These are detailed below in the hypotheses development:

4.2.1 The impact of the Boeing 787 Dreamliner's initial introduction delays on Boeing's market value.

We apply the extant literature on new product introduction delays, reviewed in detail in the previous sub-section, to the case of the Boeing 787 Dreamliner. Notably, Hendricks and Singhal (1997) find a negative market value effect for new product introduction delays. The Dreamliner is a very well-known and pioneering aircraft, demonstrating a substantial use of composite materials (Marsh, 2009). Boeing's investors have a direct interest in the success of the product and it's time to market to generate revenue for the business. Therefore, we propose the following hypothesis:

> *H1. The Boeing 787 Dreamliner's initial introduction delay has a negative impact on the market value of Boeing.*

4.2.2 The impact of the Boeing 787 Dreamliner's initial introduction delays on the market value of Boeing's suppliers.

Thus far, previous research mostly focuses on the returns of focal companies, finding a significant reduction in market value associated with new product introduction delays. (Hendricks and Singhal, 1997). Chen *et al.,*(2007) also found a negative market value effect for competitors, as reviewed in detail earlier. This narrow focus of the literature has mostly focal companies and to some extent competitors. However, the field of Operations and Supply Chain Management (OSCM) is predicated on the interconnected and dependent nature of industries and supply chains.

Since suppliers are closely involved and play an important role in realising new product development and its successful and timely introduction, we expect that investors will also respond negatively to suppliers of Boeing. For other negative operations and supply chain management events, a negative spillover effect has been found by several researchers (Nichols, Stolze and Kirchoff, 2019; Jacobs and Singhal, 2020; Xiong *et al.*, 2021; Ding *et al.*, 2021), as well as beyond operations and supply chain management, including brand co-operation (Herm, 2014) and bankruptcy (Hertzel *et al.*, 2008). These researchers find spillover effects associated with other supply chain phenomena, including environmental violations and negative supply chain news, as well as corporate scandals, as reviewed in detail earlier. Notably, these spillover effects tend to be adverse in their nature. The Dreamliner project was well reported due to its high-profile and highly innovative design. Its manufacturing involves many international suppliers, some of which are large and well-known companies, including Rolls-Royce and 3M. The high cost of the aircraft and novel approach to manufacturing using international suppliers to produce major sub-assemblies led to suppliers being significantly invested in the programme. This close relationship and dependency potentially exposes suppliers to experience a negative spillover effect due to their proximity and heavy investment with Boeing. We propose the following hypothesis:

H2.   The Boeing 787 Dreamliner's initial introduction delay has a negative impact on the market value of suppliers.

4.2.3 Direct involvement with the Boeing 787 Dreamliner delays

Based on the previous hypothesis, we expect that Boeing's suppliers involved in the 787 Dreamliner programme will experience a more negative stock market reaction than those not providing parts and sub-assemblies for the Dreamliner. This is rationalised by an expectation that suppliers directly involved are more likely to experience the repercussions of delays. For example, it is known that delaying new product introductions can shorten product life cycles, reducing potential revenue generated (Hendricks and Singhal, 1997). Additionally, there is more time for competitor reaction, potentially nullifying any first-mover advantage. In the case of the 787 Dreamliner, the supply chain may be regarded as part of the cause of the delays due to Boeing's ambitious outsourcing policy (Mocenco, 2015). Therefore, investors may penalise their supply chains accordingly. Despite this, even suppliers of Boeing which are not involved with the 787 Dreamliner programme may still be penalised in the stock markets because of a strong spillover effect due to their association with Boeing. Investors may not be able to easily and efficiently distinguish between suppliers which are involved and those that are not due to

agency problems of institutional investors (Bebchuk, Cohen and Hirst, 2017). For these reasons, we propose that:

> *H3. The Boeing 787 Dreamliner's suppliers experience a more negative stock market reaction than Boeing's non-Dreamliner suppliers.*

4.2.3 The role of supplier location

Facility location plays an important lead-time role in the design of supply networks (Melo, Nickel and Saldanha-da-Gama, 2009). Due to Boeing's new global manufacturing system for the 787 Dreamliner and the innovative nature of the aircraft such as the use of composite materials for the fuselage in order to reduce fuel burn, running costs and environmental impact, Boeing was not able to easily switch to alternative suppliers (Marsh, 2009). Communication can be more difficult and cultural barriers and differences in standards may be at play. Being able to investigate the case of the Boeing 787 Dreamliner retrospectively is advantageous as it is known that Boeing brought back some of its sub-assembly manufacturing to the US as part of a remedy for the Dreamliner programmes' issues (Oh *et al.*, 2020). This suggests that Boeing identified supplier location as a significant issue. Overall, greater leader times due to suppliers being further away from Boeing, communication challenges and differences in measurement systems and standards could play a role in this context. Therefore, we propose that:

> *H4. The impact of the Boeing 787 Dreamliner introduction delay on market value is more negative for suppliers headquartered outside of the US.*

4.2.4 Multiple delays for suppliers

New product introduction delays continue to be prevalent. Many prior aircraft programmes have been delayed. The initial delay to the 787 Dreamliner sends a message to investors that the programme is facing challenges and we expect them to penalise Boeing and its suppliers in the stock markets. However, when Boeing announced further delays to the programme, investors may be less surprised. This is because investors are aware that large, complex, new product development programmes like the 787 Dreamliner are likely to experience further consequential issues once they have encountered one issue. As explanations for these

problematic issues, including outsourcing, come to light, investors know that this will not be a quick fix. For these reasons, we propose the following hypothesis:

H5. The initial delay to the introduction of the Boeing 787 Dreamliner has a more negative impact on the market value of suppliers.

4.2.5 Relationship value between Boeing and suppliers

We expect suppliers with a higher relationship value with Boeing to suffer a larger reduction in market value as a direct consequence of their higher revenue dependence on Boeing (Kumar *et al.,* 2019; Shih, 2022b). Studies on other issues, such as the 2015 Volkswagen emissions scandal, find that suppliers with a higher revenue dependence on the focal company are associated with a more negative market value effect (Jacobs and Singhal, 2020). Ultimately, suppliers which have a large transaction value with Boeing have more to lose from introduction delays. This is due to the greater dependence that the supplier has on Boeing for their business. Therefore, we propose that:

H6. The impact of the Boeing 787 Dreamliner introduction delay on market value is more negative for suppliers for whom Boeing is a major customer.

Figure 6 below shows a conceptual, consolidated hypotheses model.

Figure 2. Conceptual Model
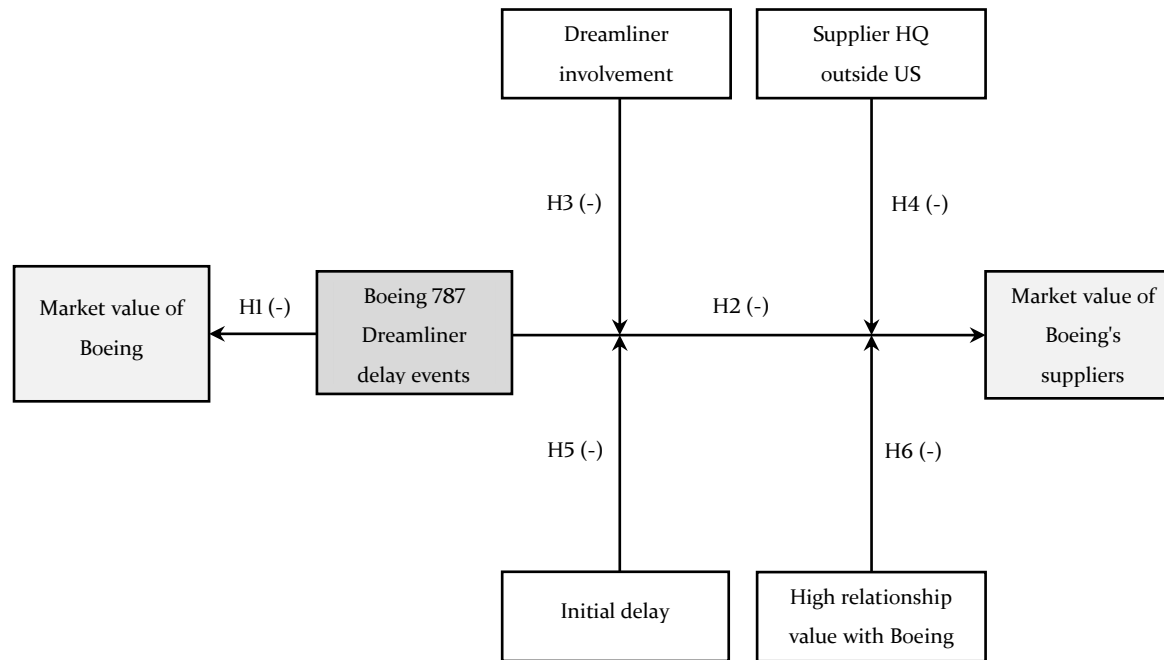
4.3 Methodology

4.3.1 Research context

Our research context is focused on the Boeing Dreamliner. It provides a foundation to answer our research questions by using one new product introduction delay for a focal company and its suppliers. Furthermore, it allows the investigation of the impact of multiple delays on supply chain partners in a consistent manner. The Dreamliner programme began in 2004 and was planned to be introduced in 2009 (The Telegraph, 2013). However, delays first began to the programme in 2007. The programme is of particular interest as it represents a significant innovation on a large scale for a product that has substantial impact on the environment, financial performance and customer experience (Jelača and Boljević, 2016). Therefore, successful and timely introduction of a product of this importance is paramount for key stakeholders such as suppliers, airlines, passengers and society. Despite the case taking place several years ago, other event study researchers find useful contributions in similar retrospective circumstances, such as the event study of the Great East Japan earthquake in 2011 (Hendricks *et al.,* 2020). Such land mark cases are vital to our understanding because these unfavourable events can have dramatic implications for supply chain management and phenomena such as natural disasters and delays which still occur, making such studies relevant and important. In the context of the Dreamliner's supply chain challenges, this is more acute than ever as supply chains are increasingly connected, complex and resilience-dependent (Hosseini, Ivanov and Dolgui, 2019). This can be illustrated with recent global supply chain challenges and shortages. For example, the global chip shortage of semiconductors has caused significant disruption to a wide variety of industries from automotive to white goods (Chandler, 2022).

The Dreamliner 787 remains a landmark case. However, Boeing continues to experience product introduction delays such as to the 777X aircraft (Shepardson, 2022). Therefore, any negative impact for Boeing and its suppliers in relation to market value is still prevalent today. Beyond the Dreamliner 787 case, other new product introduction delays continue, such as the Tesla Cybertruck (Reuters, 2022). Such delays may be causing a negative market value effect for both the focal company and its suppliers. Therefore, first understanding this effect is imperative so that companies, particularly suppliers, can understand the impact of delays prompting them to attempt to uncover strategies for shielding themselves or mitigating any negative consequences.

The Dreamliner programme began in 2004 and was set to launch in 2009. However, delays first began to the programme in 2007. This research will focus on the first two out of the four delays which actually pushed back deliveries of the aircraft as we can legitimately assume that

supply chain partners would remain fairly consistent over this period of less than a year. This enables us to compare market value between the two delay events to understand the impact of multiple delays on supply chain partners. Specifically, we focus on the introduction delays of the base -8 variant of the Dreamliner aircraft, excluding the -9 and -10 as these had different introduction dates (Shi and Yu, 2013).

4.3.2 Data and sample

To identify Boeing's supply chain partners at the time of the event, Bloomberg's SPLC database was used (Bloomberg, 2019). This is a commonly-used source for researchers, such as by Xiong *et al.* (2021) who investigate the impact of environmental violations on the market value of suppliers. To identify suppliers related to the Dreamliner, Airframer was used which provides data on suppliers of the aircraft, which components they supply, their geographic location, contact information and more (Airframer, 2019). This is an expensive resource, valued in industry. It offers an aircraft programme director with analysis of over 1,000 aircraft programmes of various types. There are also index reports and cross-referencing of suppliers to a number of aircraft programmes. This is updated daily and was accessed by the research team in Spring 2019. However, we assume that the vast majority of the Dreamliner's suppliers would remain constant throughout its lifecycle. To test for sensitivity of this, we cross-corroborate these suppliers with those found in Bloomberg's SPLC database as of the event date in 2007 and perform a robustness test of another event study with only these 28 suppliers, which can be cross-matched across the data sources, to check that our results hold.

Once the suppliers were identified via Bloomberg, the second step is to find their market value data. The databases used to retrieve market value data include: Datastream, Yahoo Finance and Wharton Research Data Services (WRDS) CRSP. Datastream was predominantly used, as is common in the finance literature, as it enabled retrieval of the most data for our sample and enhanced consistency. Where data was not available in Datastream in a very small number of circumstances, Yahoo Finance or WRDS were used. Where a supply chain partner was a private company or did not have available market value information, we took the stock price data of its parent company if it had one. Logically, the impact of the delay will be felt by a parent company. We use a global stock market index to conduct our event study, similar to other studies (Xiong et al., 2021). We use the MSCI World Index, which covers twenty-three developed market countries and covering approximately 85% of the free float-adjusted market capitalisation in each country allowing the event study to be conducted in a multi-country setting.

4.3.3 Event study

The short-term event study method in a multi-country setting is used to estimate market value effects of the Dreamliner delay on Boeing's supply chain partners. Event studies in multi-country settings need some additional considerations to those in a single country (Eden *et al.*, 2022). These considerations will be detailed in this sub-section. The event study method, first documented in the finance literature, has been applied widely in Operations Management recently. This is due to its ability to interpret the market value impact of key operations management decisions, actions and issues, such as manufacturing outsourcing, reshoring, and product recalls (Brandon-Jones *et al.*, 2017). More recently, some researchers have attempted to go beyond the impact of events on focal companies to study other key stakeholders, such as competitors and supply chain partners such as in the case of the Volkswagen emissions scandal and environmental violations (Hertzel *et al.*, 2008; Jacobs and Singhal, 2020; Xiong *et al.*, 2021). With regard to the emissions scandal, Jacobs and Singhal (2020) investigate the automotive ecosystem to find that   there is empirical evidence to suggest that supply chain partners, including suppliers and customers, experienced a decrease in market value following the scandal. Other European motor vehicle manufacturers besides Volkswagen also experienced a spillover effect, with market value decreasing by -7.60% due to a loss of trust in the market. This is highly important in a shareholder wealth context. Similarly, Xiong *et al.,* (2021) found a negative impact on market value for supply chain partners of a focal company which committed environmental violations. Ultimately, justifying OSCM decisions and new technologies must rely on generating shareholder wealth. Equally, understanding the impacts of OSCM disruptions is key for organisational learning and avoiding future recurrent mistakes. This relates not only to the focal company but also suppliers.

   We employ the market model, the most commonly used model in the event study literature (Hendricks and Singhal, 2003; Lam *et al.*, 2016), to estimate stock returns. The market model equation is shown below (1). The short event window, selected for the event day and one day after the event, assumes the efficient market hypothesis, i.e. investors react efficiently to new information (Fama, 1970; Ding *et al.*, 2018). We select a short two-day event window from day 0 to day 1, where day 0 is the event date and day 1 is the day after. For the first delay, the event date is the 10th of October 2007, the first known public announcement of the first delay to the Dreamliner's deliveries. The second delay occurred on the 9th April 2008. We check for information leakage prior to the announcement by expanding the event window to a day before the event but find no significant investor reaction on this day. Therefore, it is unnecessary to include pre-event days in our event window. This suggests that we have selected an appropriate event window which captures the effect of the event. We calculate expected stock returns over a 180-day estimation window with a gap of 30 days between the estimation and event windows. This gap avoids the influence of the Dreamliner delay on the estimation of the expected returns.

We report the significance of CARs and ARs using the Patell z-test (Ding *et al.*, 2018). Since we use the event study method in an international context, we select the next trading day in any instance where a market is closed on an observed day (Ding *et al.*, 2018).

Stock returns, i.e. market value, following the Dreamliner delay are observable and measurable whereas, stock returns if the event had not had happened are not observable and therefore must be estimated. Event studies measure abnormal returns, i.e. the proportion of the actual returns that can be attributed to the event. Since we use the event study method in an international context, we select the next trading day in any instance where a market is closed on an observed day (Ding *et al.,* 2018). The event study equation for the Market Model is shown below:

Market Model Equation (1)

$$AR_{it} = R_{it} - E(R_{it})$$

$$E(R_{it}) = \alpha_i + \beta_i R_{mt}$$

4.3.4 t-Tests

To test our hypotheses, we use multiple event studies based on different categorisations of suppliers. This enables us to understand the impact of the Dreamliner's delays on the stock returns of supply chain partners in a detailed fashion, revealing the magnitude for each category. We distinguish between different groupings as follows: 1) the impact on Boeing, i.e. the focal company, to provide a basis of comparison on whether suppliers also suffer when Boeing experiences a delay and to what extent; 2) whether suppliers taken as a whole, i.e. Boeing's suppliers identified from the Bloomberg SPLC database as of 2007 at the time of the delay; 3) whether the impact on suppliers specifically pertaining to the Dreamliner is significantly worse than to those suppliers related to Boeing generally, i.e. is there a spillover effect of the Dreamliner not only to suppliers but to those which were not involved in the delay? We also explore the role of location and relationship value. Based on the various event studies, we then conduct independent sample *t*-tests to compare groups, testing whether there is a statistical significance between them.

Descriptive statistics for suppliers at the time of the first delay are provided in Table 16 below. This is to provide an overview of suppliers at the start of the Dreamliner's delays.

Table 16. Descriptive Statistics for Suppliers.

Firm Characteristics	Unit	Mean	Sd. Deviation	Minimum	Maximum
Employees	People	26266	68402	17	520112
Total assets	Million US$	12560.86	60885.81	0.82	696683.00
Sales	Million US$	6676.66	17980.16	0.51	160854.00
Inventory	Million US$	1070.41	3139.16	0.00	23925.00
Firm liquidity	Ratio	1.80	2.08	0.12	17.41
Return on assets	Ratio	0.92	0.38	0.13	2.20

Table 17. Key Variable Descriptions.

Variable	Description	Measurement	Data Source	Reference
New product introduction delay	Delays to the Dreamliner programme which impact deliveries	The date of the initial delay to the introduction of the Dreamliner and a further delay.	The Telegraph	(Hendricks and Singhal, 1997, 2008; Chen *et al.*, 2007; The Telegraph, 2013)
Abnormal returns	The difference between the actual return with the occurrence of the new product introduction delay and the expected return had there been no delay	Abnormal return = actual return - expected return	eventstudytools.com WRDS US Event Study Tool	(MacKinlay, 1997; McWilliams and Siegel, 1997)
Cumulative abnormal returns	Sum of abnormal returns over an event window	Cumulative abnormal return = $\sum$ abnormal return	eventstudytools.com WRDS US Event Study Tool	(MacKinlay, 1997; McWilliams and Siegel, 1997)
Firm liquidity	Ability to meet current liabilities using current assets, lagged 1 year before the event date	(Current assets - inventory) / current liabilities	Datastream	(Xiong *et al.*, 2021)
Firm profitability	Measured as return on assets, i.e. how profitable a company is from its assets before the new product introduction delay, lagged 1 year before the event date	Sales / total assets	Datastream	(Flammer, 2012; Luo, Zhang and Duan, 2012; Tang, Lai and Cheng, 2016)
Firm size	Measured as total assets, i.e. items of economic value to a company, lagged 1 year before the event date	Log transformation of total assets	Datastream	(Moss and Stine, 1993)
Dreamliner involvement	Whether a supplier provided goods and/or services for the Dreamliner or not	Yes or no	Airframer	(Airframer, 2019)
Country	Measured at the country level, i.e. whether a supplier is headquartered (HQ) in the same country as the focal company, i.e. Boeing - the US, or not	Yes or no	Datastream	
Relationship with Boeing	Whether Boeing is listed as a major customer for a supplier	Yes or no	Datastream	

4.4 Test Results

4.4.1. Event studies and t-test results

Test results are documented in the tables below. Specifically, table 18 shows the abnormal returns of Boeing and their suppliers over a 2-day event window. Table 19 shows test results for independent sample *t*-tests which compare groups detailed earlier in the methodology section.

Table 18. Event Studies Test Results.

Group	Day	N	CAAR /AAR	Patell z-test
Boeing first delay	(0, 1)	1	-4.72%	-3.382***
	0	1	-2.68%	-2.71***
	1	1	-2.04%	-2.071**
All Boeing suppliers both delays	(0, 1)	309	-1.12%	-6.14***
	0	309	-0.62%	-4.45***
	1	307	-0.50%	-4.25***
Dreamliner suppliers both delays	(0, 1)	161	-0.92%	-4.14***
	0	161	-0.50%	-3.12***
	1	161	-0.42%	-2.73***
Non-Dreamliner suppliers both delays	(0, 1)	148	-1.34%	-4.56***
	0	148	-0.74%	-3.18***
	1	146	-0.60%	-3.30***
US Dreamliner suppliers both delays	(0, 1)	84	-1.15%	-4.37***
	0	84	-0.50%	-3.17***
	1	84	-0.64%	-3.01***
Non-US Dreamliner suppliers both delays	(0, 1)	77	-0.67%	-1.42
	0	77	-0.50%	-1.20
	1	77	-0.17%	-0.80
All Boeing suppliers initial delay	(0, 1)	154	-1.56%	-7.36***
	0	154	-0.66%	-4.57***
	1	153	-1.19%	-5.86***
All Boeing suppliers further delay	(0, 1)	155	-0.39%	-1.33
	0	155	-0.58%	-1.73*
	1	154	0.18%	-0.16
Suppliers Boeing is a major customer	(0, 1)	46	-0.95%	-1.66***
	0	46	0.07%	-0.84%
	1	46	-1.00%	-2.92%***
Suppliers Boeing is not a major customer	(0, 1)	263	-1.15%	-5.69***
	0	263	-0.75%	-4.58***
	1	263	-0.41%	-3.51***

Notes: *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$ (Two-tailed tests).

Table 19. Independent Samples *t*-Tests Results.

Group	*t*-Value	Sub-Group	N	Mean	Standard Dev.
Dreamliner suppliers vs non-Dreamliner suppliers	0.71	Suppliers	161	-0.01	0.03
		Non-suppliers	146	-0.01	0.07
US Dreamliner suppliers vs Non-US Dreamliner suppliers	-0.87	US	84	-0.01	0.04
		Non-US	77	-0.01	0.03
All suppliers initial delay vs all suppliers further delay	-2.47**	initial delay	153	-0.01	0.03
		Further delay	154	-0.00	0.06
Boeing is not a major customer of suppliers vs Boeing is a major customer of suppliers	0.24	Not major customer	261	-0.01	-0.05
		Is major customer	46	-0.01	-0.06

Notes: *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$ (Two-tailed tests).

As Table 18 shows, the focal company in this context, Boeing, experienced a reduction in market value of 4.72% across a (0, 1) event window, statistically significant at the $p < 0.01$ level. This short event window suggests that Boeing is immediately punished in terms of market value for the Dreamliner delay, consistent with prior studies (Hendricks and Singhal, 1997). Therefore, H1 is supported.

For Boeing's suppliers overall, the average abnormal return (AAR) is -1.12% over a (0, 1) event window, statistically significant at the $p <0.01$ level for the Patell *z*-test, appearing to confirm a negative spillover effect in relation to H2.

The advantage of using multiple event studies for different classifications of suppliers is that we are able to illustrate the magnitude associated with the delays to the introduction of the Boeing 787 Dreamliner aircraft. Specifically, suppliers which were both involved and not involved experienced a negative stock market reaction of -0.92% and -1.34% respectively, with both being significant at the $p < 0.01$ level for the Patell *z*-test. However, a *t*-test comparing these two groups does not find a significant difference. Therefore, H3 is not supported. This demonstrates that there is a strong spillover effect which has an impact on Boeing's suppliers irrespective of whether they were involved in the 787 Dreamliner programme or not.

Boeing's US Dreamliner suppliers experienced a negative stock market reaction of 1.15%, statistically significant at the $p < 0.01$ level for the Patell *z*-test. Whereas, its non-US Dreamliner suppliers experienced a reduction in market value of -0.67%, which is not statistically significant. Shown in Table 19, a *t*-test comparing the two groups of suppliers did not reveal any significant difference between them, therefore we reject H4. For the second delay to the introduction of the 787 Dreamliner, suppliers experienced a stock market reaction of -0.39%,

however this was not statistically significant for either of our tests. Although, a *t*-test comparing the first and second delay did reveal a significant difference between the two, stock markets react more negatively to the first delay of the 787 Dreamliner's introduction, supporting H5. Suppliers for whom Boeing is a major customer experienced a negative stock market reaction of -0.95%, significant at the $p < 0.05$ level. Suppliers for whom Boeing is not a major supplier also received a negative stock market reaction, significant at the $p < 0.05$ level, but with a magnitude of -1.15%. A t-test comparing the two did not reveal any significant difference between them. Therefore, H6 is not supported. Table 20 summarises hypotheses support below:

Table 20. Hypotheses Support Overview.

Hypothesis	Significance	Coefficient	Result
H1. The Boeing 787 Dreamliner's initial introduction delay has a negative impact on the market value of Boeing.	Significant	Negative	Accepted
H2. The Boeing 787 Dreamliner's initial introduction delay has a negative impact on the market value of suppliers.	Significant	Negative	Accepted
H3. The Boeing 787 Dreamliner's suppliers experience a more negative stock market reaction than Boeing's non-Dreamliner suppliers.	Non-significant	Negative	Rejected
H4. The impact of the Boeing 787 Dreamliner introduction delay on market value is more negative for suppliers headquartered outside of the US.	Non-significant	Negative	Rejected
H5. The initial delay to the introduction of the Boeing 787 Dreamliner has a more negative impact on the market value of suppliers.	Significant	Negative	Accepted
H6. The impact of the Boeing 787 Dreamliner introduction delay on market value is more negative for suppliers for whom Boeing is a major customer.	Non-significant	Negative	Rejected

4.4.2 Robustness test results

We conducted numerous additional tests to check the robustness of our findings. These are detailed in Table 21 below. Table 22 shows a correlation matrix. We expand the event window from -1 to 2 to see if we are capturing the impact of the Boeing 787 Dreamliner's introduction delay, as per the efficient market hypothesis. The returns on the day before the event are not significant which demonstrates that there is no important information leakage preceding the event, which confirms our decision to select an event window which starts on the event day. Additionally, we expand the estimation window to 210 days and find that our results are still

consistent. We also report skewness-corrected *t*-tests for Boeing's suppliers, showing consistency of test results with Patell *z*-tests.

We conduct a further event study on the Dreamliner's suppliers obtained from Airframer which can be cross-referenced with Boeing's suppliers included in the Bloomberg SPLC database as of the initial delay event date, i.e. 10th October 2007. The results are consistent, demonstrating that we have been able to isolate suppliers which are and which are not directly involved with the 787 Dreamliner aircraft.

Similar to some other event study research (Xiong *et al.*, 2021), we check for confounding events which may otherwise have an impact on our findings. We define confounding events as significant occurrences which may affect a supplier's market value such as announcing a partnership, a new chief information officer (CIO) appointment, or a disappointing earnings call. To acquire data on confounding events to enable us to conduct this additional test, we search the Gail OneFile News database, containing over 2,300 world newspapers, to identify any potential confounding events announced in the media. This is undertaken by searching using the suppliers' names within the event window date range. We then remove these events, 21 in total or approximately 6% of the original sample, from our initial sample and run the event study again. There are relatively few confounding events, partly due to the short event window selection of the event day to the day, and partly because some suppliers are not large companies and therefore not of public interest. We employ a cautious approach to remove any events which we doubt could have a confounding impact on our results and we find that our results remain consistent, that is significantly negative for all suppliers across both delays. This actually strengthens our initial results somewhat as the CAAR of -1.27% is slightly larger across the event window.

We construct a cross-sectional regression model used as a robustness test to confirm the findings of the *t*-tests of the event studies, shown in Table 23. The CAR of Boeing's suppliers is the dependent variable in the model. Details of the measures for each variable are explained in Table 17. We control for a number of firm-level variables, including: total assets, return on assets and firm liquidity. We find that our results remain consistent. The VIF for all models is well below the threshold of 10, with the maximum VIF being 4.86. This suggests that there are no substantial multicollinearity issues in our models. The formula for the regression model is shown below:

Regression Model (2)

$$CAR_i = \beta_1 Total\ Assets_i + \beta_2 Return\ On\ Assets_i + \beta_3 Firm\ Liquidity_i + \beta_4 Dreamliner\ Involvement_i + \beta_5 Country_i +$$
$$\beta_6 Delay\ Event\ Date_i + \beta_7 Relationship\ with\ Boeing_i + \beta_8 Dreamliner\ Involvement_i \times \beta_9 Country_i + \varepsilon_i .$$

Table 21. Robustness Test Results.

Group	Day	N	CAAR /AAR	Patell z-test
All Boeing suppliers both delays	-1	309	-0.03%	0.87
expanded event window (-1, 2)	0	309	-0.62%	-4.45***
	1	307	-0.50%	-4.25***
	2	307	0.14%	0.37
All Boeing suppliers both delays	(0, 1)	309	-1.13%	-6.16***
estimation window 210 Days	0	309	-0.62%	-4.50***
	1	307	-0.51%	-4.25***
Dreamliner suppliers both delays	(0, 1)	52	-1.11%	-2.72***
from Bloomberg	0	52	-0.51%	-2.01**
	1	52	-0.60%	-1.84*
All Boeing suppliers both delays	(0, 1)	287	-1.27%	-6.46***
with confounding events removed	0	288	-0.63%	-4.59***
	1	287	-0.64%	-4.57***

				Skewness-corrected *t*-test
All Boeing suppliers both delays	(0, 1)	309	-1.12%	-4.484***
skewness-corrected t-test	0	309	-0.62%	-4.97***
	1	307	-0.50%	-2.15**

Notes: *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$ (Two-tailed tests).

Table 22. Correlation Matrix

Variable	1	2	3	4	5	6	7	8	9
1. CAR (0, 1)	1								
2. Firm liquidity	-0.10	1							
3. Firm profitability	0.04	-0.20***	1						
4. Firm size	0.11*	-0.23***	-0.25***	1					
5. Dreamliner involvement	0.04	-0.24***	-0.06	0.41***	1				
6. Country	-0.01	0.23***	0.20***	-0.13**	-0.29***	1			
7. Delay event date	-0.14**	0.02	0.01	-0.03	-0.00	0.00	1		
8. Relationship with Boeing	-0.09	0.09	0.06	-0.17***	-0.12**	0.26***	0.00	1	
9. Country and involvement interaction	-0.01	-0.09	0.06	0.26***	0.59***	0.44***	0.00	0.94*	1
Mean	1.12	1.76	0.92	6.70	0.52	0.66	0.50	0.15	0.28
Standard Deviation	5.21	1.91	0.37	2.57	0.50	0.47	0.50	0.36	0.44

Notes: $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$ (Two-tailed tests).

Table 23. Cross-Sectional Regression Results.

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Dreamliner involvement		-0.01 (-0.19)	-0.01 (-0.08)	-0.00 (-0.06)	-0.01 (-0.07)	0.11 (1.03)
Location			0.03 (0.41)	-0.03 (0.41)	0.02 (0.23)	0.13 (1.23)
Delay event date				-0.14** (-2.38)	-0.14** (-2.37)	-0.14** (-2.36)
Relationship with Boeing					0.02 (0.34)	0.03 (0.46)
Involvement x location						-0.16 (-1.34)
Firm liquidity	-0.06 (-0.97)	-0.06 (-0.98)	-0.07 (-1.05)	-0.06 (-1.01)	-0.06 (-1.01)	0.08 (-1.18)
Firm profitability	0.06 (0.94)	0.06 (0.94)	0.05 (0.81)	0.05 (0.85)	0.05 (0.86)	0.05 (0.74)
Firm size	0.11* (1.75)	0.11* (1.69)	0.11 (1.65)	0.11 (1.62)	0.11* (1.67)	0.13* (1.69)
Number of observations	303	303	303	303	303	303
R-squared	0.02	0.02	0.02	0.04	0.04	0.05
Adjusted *R*-squared	0.01	0.01	0.00	0.02	0.02	0.02

Notes: $*p < 0.1$, $**p < 0.05$, $***p < 0.01$ (Two-tailed tests).

Standardised coefficients are reported. *t*-statistics are in parentheses.

4.5 Discussion

Our study demonstrates a strong spillover effect of new product introduction delays in the supply chain of the Boeing 787 Dreamliner starting from 2007. Moreover, we show that this spillover effect extends beyond suppliers which are directly involved with the programme. We also find that investors react less strongly to a further new product introduction delay. These findings provide several important implications for research and practice.

4.5.1 Implications for research

This research poses a number of contributions to theory and practice. Firstly, it expands on the literature's understanding of the impact of new product introduction delays on market value, not only for the focal company or competitors, but also for their supply chain partners (Hendricks and Singhal, 1997, 2008; Chen *et al.*, 2007). This uncovers a spillover effect to other companies dealing with the focal company. We take this further to then establish if this spillover effect holds even for companies that are involved with the delayed product, demonstrating a stronger spillover effect than expected. This has significant implications for any supplier doing business with Boeing because as they all felt a negative stock market reaction to the delay. This could be due to association and reputational mechanisms for which suppliers penalise them.

Our findings confirm our expectation that Boeing experiences a more negative reaction from investors than suppliers' experience. By way of explanation, Boeing is the prime and, therefore, more visible than its supply chain partners and so the negative consequences of the delay can be attributed to it more easily by investors. Secondly, despite the 787 Dreamliner programme's supply chain challenges, Boeing is regarded as the culpable party as consequence of its responsibilities as the prime. Therefore, investors may penalise Boeing more than its suppliers. Third, Boeing is a very large company, synonymous with the aerospace manufacturing industry, even amongst consumers, and so it may feel a larger erosion of market value compared to its, typically, smaller suppliers.

In addition to finding an overall spillover effect for Boeing's suppliers, we also offer more insights into the factors which may cause stock market reactions to be more or less negative for suppliers. We find that Boeing's suppliers are penalised in the stock markets similarly, regardless of their involvement with the Dreamliner, their location or their relationship value. This should serve as a strong warning for both focal companies and suppliers. Focal companies should be aware that their actions and decisions do not only affect themselves but also their supply chain partners. Boeing relies on its suppliers to bring the Dreamliner to launch, therefore it has a vested interest in ensuring the economic viability of its suppliers. For suppliers, they should proceed with caution when entering into complex, new product development projects. They

should explore potential mitigation techniques if they are to suffer from the impacts of a delay and consider customer diversity carefully (Shih, 2022b).

Understanding impacts of new product introduction delays beyond a focal company is key in order to be able to develop effective strategies for addressing delays. This is of particular importance in complex contexts +where the supply chain plays a key role in contributing to the delay. Some researchers have explored supply chain resilience and disruption (Krishnan and Ulrich, 2001; Shenhar *et al.*, 2016; Duong and Chong, 2020). Integrating these concepts into managing delays could be beneficial for the literature on new product introduction delays. This would help to move the literature along from focussing on the focal company and stimulate consideration of supply chain partners too.

Beyond the Boeing 787 Dreamliner case, our study uncovers important research implications. Although we focus on a specific research context, finding that Boeing's suppliers are penalised when there is a delay to their customer's product launch regardless of whether they are directly involved with the product, may be significant for other research contexts. It is plausible that the first-tier suppliers may face similar consequences in market value erosion. Identifying such spillover effects is key in building our understanding on the negative effects of new product introduction delays, not only on focal companies but also on suppliers.

4.5.2 Implications for practice

We investigated whether location had an impact on the market value of suppliers as we know that Boeing addressed Dreamliner delay issues by in-shoring some manufacturing to the. However, since we reject this hypothesis it seems that investors do not discriminate against which country the supplier is headquartered. This is explained by, and reflected by, the strong spillover effect which affects all of Boeing's suppliers similarly. Although location may not have had a statistically significant impact on market value effects of suppliers there were likely other impacts beyond market value which are beyond the scope of this research, for instance efficiency, time and cost implications as well as softer dimensions, including communication.

Supply chains can be fragile. For example, the recent difficulties of the Evergiven becoming stranded in the Suez canal caused global disruption to suppliers of certain products and a shortage of heavy goods vehicle (HGV) drivers seen in the UK (Nassauer, 2022), affecting logistics and physical distribution. Also, impacts of the COVID-19 pandemic are still being felt in supply chain management and production (Jie, 2022; Saïah *et al.*, 2022). These issues exemplify the significant problems supply chains can face, even in modern times with risk management policies (Tett, 2022). Therefore, such new product introduction delays, particularly those where the products' manufacturing depends on suppliers, can be at risk of

delay. This could indicate that future new product introductions could be even more problematic in the current climate than at the time of the Dreamliner, due to supply chain challenges. Therefore, understanding negative spillover effects for suppliers is critical. Taking into account the precarious global economic situation, focal companies and suppliers cannot take market value erosion due to new product introduction delays lightly (La Monica, 2022).

New product introduction delays are not uncommon occurrences. For instance, in the aerospace industry. Embraer recently delayed its E175-E2 aircraft due to success of its current version. This illustrates how the literature finds that companies sometimes delay new product introductions intentionally to lengthen current product lifecycles, maximising revenue. With Boeing's more recent aircraft, such as the 777X, delays are already being anticipated by major airlines such as Emirates. Although not a commercial aircraft, Boeing's new Air Force One is also facing production issues (Tangel, 2022). These issues are compounded by regulatory and certification challenges following the problems with the 737 Max and demonstrate how Boeing still faces new product introduction issues (Denning, 2013b). Despite these challenges, they must continue to innovate and successfully introduce new products to survive (Sharma and Lacey, 2004; Owens, 2007; Johnsson, 2022).

Potential delays to future new aircraft introductions could be very costly to customers with rapidly increasing fuel prices due to Russia's invasion of Ukraine (Georgiadis and Chávez, 2022; Simchi-Levi and Haren, 2022). Another impact of the invasion is Boeing's suspension of Russian titanium, adding to its procurement challenges (Nair and Helper, 2022). Furthermore, disruption to flight paths, in many cases dramatically lengthening flight time and therefore fuel burn, means that the timely introduction of new and efficient aircraft is paramount (The Economist, 2022). Utilising successful new product introductions to address environmental concerns has become even more critical since the advent of the 787 Dreamliner aircraft. For example, Rolls-Royce is developing powerplants for electric planes to be launched in 2025. Learning from Boeing's 787 Dreamliner development challenges and its impact on suppliers is critical in informing the successful introduction of these future aircraft innovations (Kotoky and Park, 2022). Highly innovative and radical products will be critical for the aerospace industry to remain economically viable, competitive and accepted by an increasingly environmentally-concerned society (McGrath, 2022; Pfeifer, 2022). This is critical as climate shocks are expected to potentially hurt supply chains even more than the COVID-19 pandemic (Rockeman, 2022).

4.6 Conclusion

Overall, we find empirical evidence for a spillover effect to suppliers of an erosion in market value when a new product introduction delay occurs. Outsourcing is leading to more complex

supply chains. Due to the common use of such outsourcing models, our findings may apply elsewhere (Denning, 2013a; Kotha and Srikanth, 2013; Cantone *et al.*, 2019; Wieteska, 2020; Shih, 2022). Some companies are now starting to question whether the risks of global outsourcing are beginning to outweigh potential rewards (Shih, 2022). We encourage further research to empirically test this. Future research could analyse new product introduction delays by focusing on one company and its impact on related companies such as rivals. Other new product introduction examples, their timelines and contexts may have idiosyncrasies and structures different to those of the Dreamliner.

4.6.1 Limitations

This study has some limitations which may provide potentially productive as future research opportunities. Boeing acquired some companies which were proving to be bottlenecks in the Dreamliner's production, e.g. Vought (Tang *et al.*, 2009). This adds to cost which may not necessarily be directly reflected in Boeing's market value. Another limitation is that due to the nature of event studies where the dependent variable is market value, we are not able to derive the impact of new product introduction delays on suppliers which are private limited companies. Thirdly, we use a single world market index, consistent with some other event studies in multi-country settings (Xiong et al., 2021). For our study, we use the MSCI All World Index to calculate the expected returns of Boeing's suppliers since they are from different countries. However, using a single market index might have implications for calculating abnormal returns because there could be variation in different stock markets across the globe.

A critical point is that the assumption of maximising market wealth is not uncontroversial. In the current economic climate business growth is not perpetually sustainable (Dudley, 2022). Furthermore, some companies, such as Apple, have huge cash reserves which could be put to better use. Interestingly, Apple's supply chain mastery is often cited as a major contributor to its financial successes, highlighting the importance of supply chain management both in this research context and beyond (Kovach, 2022).

There may be some minor changes in Boeing's supplier list between delays but this is expected to be minimal due to the relative short time frame and the bureaucracy and expertise required in the aircraft manufacturing industry. Suppliers must meet quality requirements and have the skills and capacity necessary to work with Boeing. Nonetheless, we still find a negative stock market reaction for the initial new product introduction delay and for a further delay. Future research could attempt to investigate changing suppliers and do so in different contexts. Although, there are some practical challenges in doing so, such as the validity in comparing findings across multiple delays where suppliers are different, and time-constraints in collecting large amounts of data where there are changing suppliers.

4.6.2 Future research

Future research could investigate the impact of new product introduction delays on other partners along the supply chain, such as customers. It may be insightful to understand how customers are affected by delays since they have an explicit stake in the venture. Researchers could differentiate between B2B and B2C new product introductions here. For instance, in the case of the Boeing 787 Dreamliner, customers, i.e. airlines, needed the new aircraft as soon as possible to fly to new routes based on the aircraft's range and passenger offering, as well as to benefit from its cost savings due to lower fuel burn from use of lightweight composite materials and more efficient engines (Marsh, 2009). Therefore, it could logically be derived that such customers may experience a negative impact when the product is delayed. Still employing the event study method, we encourage researchers to continue this important and under-researched aspect of new product introduction delays. Future research could use operating performance, such as profitability measures, as the dependent variable. This would illuminate further impacts of such delays beyond stock market performance. That kind of research design would also allow for the study of private companies as stock market data is not required.

Unlike some of the initial new product introduction delay literature, such as Hendricks and Singhal (1997), we focus on a specific context within the aerospace engineering industry, which allows us to gain a deep understanding into the impacts of such delays for various suppliers. To empirically test the generalisability of this study's findings, researchers could take a larger and diverse sample of multiple different product introduction delays and investigate the impact on their major few supply chain partners. Although we do not claim generalisability of our findings to contexts different to that of the Boeing 787 Dreamliner case, further research could test this. Overall, our research provides empirical evidence for a spillover effect of the market value effects of new product introduction delays for suppliers. However, additional research is needed on mitigating the impacts of new product introduction delays on supply chain partners.

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4.8 Appendix 1

University of Liverpool Management School
PhD Thesis – PhD Structured as Papers

AUTHORSHIP DECLARATION – joint authored papers - Appendix B

1. Candidate

Name of the Candidate	Student Number
Matt Mitchell	200883259

Thesis Title
Event studies on the market value effects of new product introduction delays for focal companies and suppliers

2. FORMAT OF THE THESIS

Is the candidate intending to structure their thesis as papers?	Yes	If Yes, please complete Section 3 (sole authored paper) OR 4 (joint paper) **If No, you do not need to complete this form**

3. PAPER INCLUDED IN THE THESIS – JOINT AUTHORED PAPER

Title of the paper	Has this paper been published, presented at a conference or under review with a journal	If Yes, please complete the boxes below. If No, go to section 4
Suffering together? The effects of new product introduction delays on the market value of suppliers: Evidence from the Boeing 787 Dreamliner	Yes - presented at a conference	Completed

If the paper has already been published please refer to the University guidelines on presentation of publications within a PGR Thesis - https://www.liverpool.ac.uk/media/livacuk/tqsd/code-of-practice-on-assessment/annex-7.2-PGR-CoP.pdf

If the paper is under review with a journal, give details of the journal, including submission dates and the review stage N/A

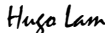| If the paper is presented at a conference, give details of the conference

International Conference:
1) 29th International EurOMA Conference 2022, Berlin Germany 1st-6th July 2022 (ID: 313)

Other:
2) NARTI Annual Doctoral Conference 'Dream, Plan, Achieve: Researching to Make a Difference', 27th-28th June Liverpool UK 2022
3) NARTI Conference: Crafting World-Leading Outputs, 4th-5th April 2022 |
|---|

4. DESCRIPTION OF ALL AUTHOR CONTRIBUTIONS (including the PhD candidate)

Name and affiliation of author	Contribution(s) (for example, conception of the project, design of methodology, data collection, analysis, drafting the manuscript, revising it critically for important intellectual content, etc.)
Matt Mitchell, University of Liverpool	Conception of the project, design of methodology, data collection, analysis, drafting the manuscript, revising it critically for important intellectual content
Prof. Hugo Lam, University of Liverpool	Supervision
Prof. Andrew Lyons, University of Liverpool	Supervision

5. AUTHOR DECLARATIONS (including the PhD candidate)

I agree to be named as one of the authors of this work, and confirm:
vii.   that the description in Section 4 of my contribution(s) to this publication is accurate,
viii. that there are no other authors in this paper,
ix.   that I give consent to the incorporation of this paper/publication in the candidate's PhD thesis submitted to the University of Liverpool

Name of author	Signature*	Date
Matt Mitchell	*Matt Mitchell*	14th February 2023
Prof. Hugo Lam	*Hugo Lam*	28th March 2023
Prof. Andrew Lyons	*ALyons*	28th March 2023

6. OTHER CONTRIBUTOR DECLARTION

I agree to be named as a non-author contributor to this work.

Name and affiliation of contributor	Contribution	Signature* and date
N/A	N/A	N/A

This consent form (Appendix B) or the sole author consent form (Appendix A) for each paper must be completed and kept by the PhD candidate once the paper is finalised. If the paper is to be included as part of the thesis, a copy of this form must be included in the PhD thesis with each publication.

Appendix 2

Table A2. The Boeing 787 Dreamliner Programme Timeline.

Date	Event
26th April 2004	ANA is announced as the launch customer for the Dreamliner with 50 planes to be delivered in 2008. 237 total orders by the end of the year. The first flight scheduled for Autumn 2007.
8th August 2007	First plane unveiled, 677 orders. Initial plan to enter commercial service in May 2008.
5th September 2007	3 month delay to the first flight announced due to a shortage of fasteners and incomplete software.
10th October 2007	**A further 3 month delay to the first flight plus a 6 month delay to the first deliveries due to problems with the US and foreign supply-chain: ongoing fastener shortage and software issues.**
16th January 2008	Third three-month delay to first flight.
9th April 2008	**Fourth delay announced. Maiden flight rescheduled for fourth quarter of 2008, initial deliveries put back 15 months to third quarter of 2009.**
4th November 2008	Fifth delay, due to incorrect fastener installation and strike by Boeing staff. First flight rescheduled for second quarter of 2009. Several airlines state intention to seek compensation for delays.
15th June 2009	At the Paris Air Show, Boeing claims the 787's maiden flight will take place within two weeks. Eight days later it is postponed "due to a need to reinforce an area within the side-of-body section of the aircraft". First flight rescheduled for end of 2009.

12th December 2009	Dreamliner completes high-speed taxi tests and three days later makes its maiden flight, more than two years behind schedule. Originally to last four hours, it landed an hour early due to bad weather. Nine-month test programme announced.
June 2010	Problems found on horizontal stabilisers of test aircraft. All planes inspected and repaired.
2nd August 2010	Trent 1000 engine suffers blowout at Rolls-Royce facility during ground testing. Failure causes further delays with the first delivery to ANA put back to early 2011.
9th November 2010	The 787 makes emergency landing after electrical fire during test flight above Texas. Flight testing suspended the following day with tests resuming on the 23rd of December.
January 2011	First delivery rescheduled for third quarter of 2011, due to software and electrical updates following in-flight fire.
26th August 2011	US Federal Aviation Administration (FAA) and European Air Safety Agency certify the 787, clearing the way for deliveries.
25th September 2011	The first Dreamliner delivered to ANA, more than three years behind schedule.
26th October 2011	The first commercial flight, from Narita to Hong Kong. Tickets sold in an online auction, with the highest bidder paying $34,000 for a seat.

(The Telegraph, 2013).

Chapter 5:

Discussion and Conclusion

5.1 Discussion

This chapter will form a discussion which brings together the findings of the various chapters into a coherent overall narrative as well as discussing the findings in relation to each other. First, the key findings of the research are summarised before implications for research and practice are discussed. This will situate the research findings in the existing body of knowledge. Following this, a conclusion is presented, alongside limitations of the research and future research directions are put forward. Additionally, the overall contribution of this research will be highlighted in relation to the problem addressed and overarching research aim.

This research set out to improve understanding of the market value effects of new product introduction delays. This is motivated by the continued prevalence of such delays which can have negative consequences on organisations (Hendricks and Singhal, 1997; Chen *et al.,* 2007). For instance, the Boeing 777x delays demonstrate that Boeing still experiences new product introduction delays following the 787 Dreamliner challenges (Shepardson, 2022). Extant literature did not consider key factors such as the role of operating performance in the relationship of new product introduction delays and market value. Furthermore, existing studies mostly focussed on the impact of new product introduction delays on focal companies, i.e. the one's experiencing a delayed product introduction. However, organisations exist in environments involving other partners, including suppliers. By focussing on the impact for focal companies, a large part of understanding is missed. This represents substantial blind spots in the literature. Therefore, this research's over-arching aim was:

Overarching aim: To improve understanding of the market value effects of new product introduction delays for focal companies and suppliers.

The second chapter was a systematic literature review on the causes, consequences and ways of managing new product introduction delays. Potential future directions for research were also developed. This formed a solid foundation upon which the subsequent empirical studies are based. The review found that new product introduction delays can occur for a number of reasons, including ambitious technological advancements for new products, such as in the case of the Boeing 787 Dreamliner. In other circumstances, organisations sometimes choose to deliberately delay new product introductions for strategic reasons, like avoiding cannibalisation

of existing products (Moorthy and Png, 1992; Boone, Lemon and Staelin, 2001; Krankel, Duenyas and Kapuscinski, 2006; Li *et al.*, 2010; Wang and Hui, 2012; Bilginer and Erhun, 2014). Critically, the literature finds that new product introduction delays can have significant negative consequences. For instance, a reduction in market share (Robinson and Fornell, 1985; Urban *et al.*, 1986), operating performance (Hendricks and Singhal, 2008) and market value (Hendricks and Singhal 1997). Although, attention was not given to the role of firm resources of focal companies experiencing a new product introduction delay. One study attempted to move beyond the focal company and found that such delays can also have a negative market value effect for competitors (Chen *et al.*, 2007). However, other important parties, such as suppliers, were considered. This review of the literature highlights a number of key gaps in understanding of new product introduction delays. The literature does attempt to identify some ways of managing new product introduction delays, such as designing to manufacture in a hope of preventing or limiting potential delays. However, delays continue to be a challenge for organisations. Therefore, first developing a better understanding of the impact of such delays is imperative to deriving more effective ways of manging and potentially avoiding new product introduction delays. Many extant studies adopt a quantitative approach, favouring econometrics as their method. There is little use of qualitative studies in this area. Furthermore, much of the literature does not explicitly adopt a theoretical lens within their studies.

The third chapter empirically studied the role of firm resources in the market value effects of new product introduction delays for focal companies via the lens of signalling theory. An event study of S&P 500 companies confirms a negative stock market reaction for focal companies, but finds no significant reaction to new product preannouncements. Cross-sectional regression analysis provides further insight on the role of firm resources on market value when a delay occurs. These results show that more profitable firms and those with a higher advertising intensity experience more negative changes in market value when they experience a new product introduction delay. Additionally, an interaction effect is uncovered, showing that operational slack positively moderates the impact of advertising intensity. This sheds light on how companies with various firm resources experience differing market value effects should they experience a new product introduction delay.

Building on the third chapter, the fourth chapter empirically studied the market value effects of new product introduction delays for suppliers from a spillover effects perspective. To enable this important study, the Boeing 787 Dreamliner introduction delays were used. Via a number of event studies, evidence is shown for the negative market value effects of both suppliers and the focal company when a new product introduction delay occurs, irrespective of whether or not those suppliers were directly involved with the delayed product itself. This compliments the third chapter's empirical evidence on the market value effects of such delays for focal companies and provides a more comprehensive view. Further analysis using *t*-tests to compare the statistical significance in the difference of the market value effects of the first delay to the Boeing

787 Dreamliner introduction and a further delay reveal that the first delay has a more negative effect. The findings observe a negative market value effect for both focal companies and suppliers, contributing to the existing literature on new product introduction delays.

In summary, there were three key aspects of this research, a systematic literature review and two empirical studies, to address the research problem. Individually, each component has answered it's research questions detailed in Chapter 1. These various strands come together to form a collective which achieves the over-arching research aim. Taken together, the findings show that the market value effects of new product introduction delays for focal companies and suppliers is nuanced and multi-faceted, with various dimensions at play which are detailed within the respective chapters. Ultimately, new product introduction delays can have negative consequences for both focal companies and suppliers, identifying a spillover effect. Firm resources play a role in the magnitude and direction of such effects. Table 24 summarises hypotheses support across the thesis to provide an overview of the key findings discussed so far in this section. Meanwhile, Figure 7 visually shows how these findings of the various chapters fit together in one coherent conceptual model. The subsequent sections, implications for research and practice, will discuss the significant contributions to knowledge made by this research overall.

Figure 3: Conceptual Model
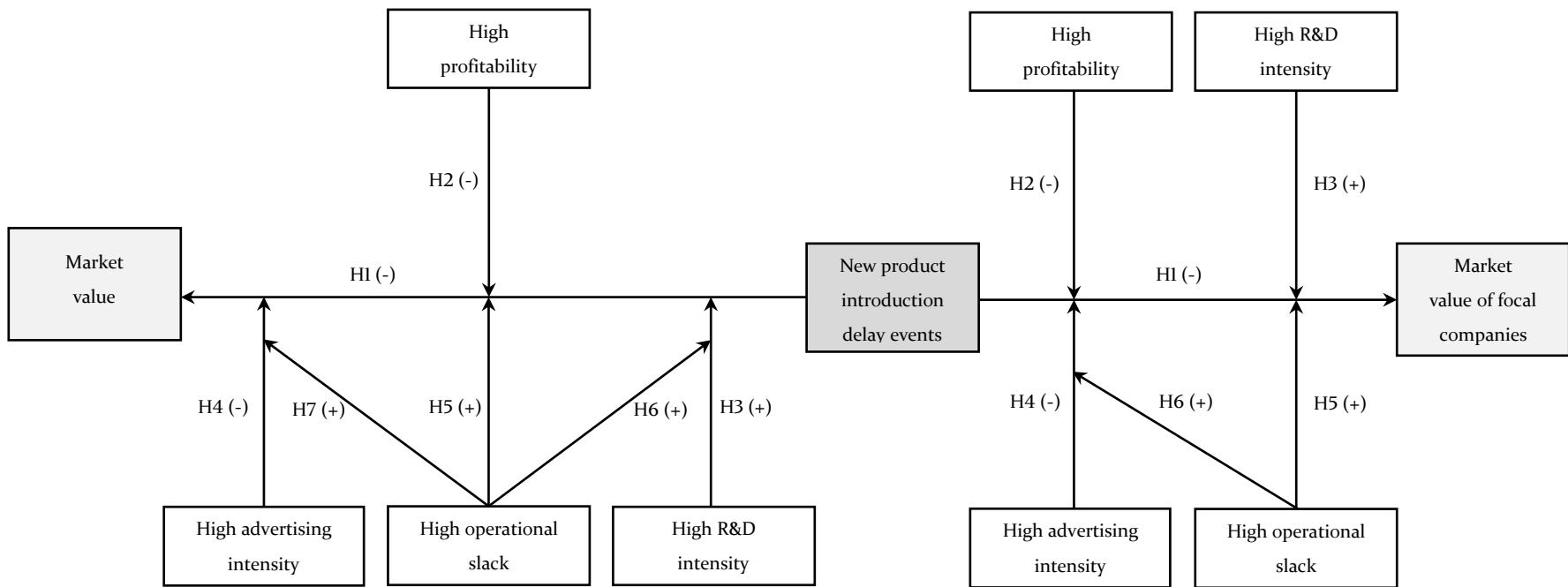
Table 24. Hypotheses Support Overview.

Hypothesis	Significance	Coefficient	Result
Chapter 3: The effects of new product introduction delays on market value: The role of firm resources with evidence from the S&P 500 Index			
H1. New product introduction delays have a negative impact on the market value of a focal company.	Significant	Negative	Accepted
H2. The impact of new product introduction delays on market value is more negative for highly profitable focal companies.	Significant	Negative	Accepted
H3. The impact of new product introduction delays on market value is more positive for focal companies with high R&D intensity.	Non-significant	Positive	Rejected
H4. The impact of new product introduction delays on market value is more negative for focal companies with high advertising intensity.	Significant	Negative	Accepted
H5. The impact of new product introduction delays on market value is more positively for focal companies with high operational slack.	Non-significant	Positive	Rejected
H6. The impact of new product introduction delays on market value is more positive for focal companies with high operational slack and high advertising intensity.	Significant	Positive	Accepted
H7. The impact of new product introduction delays on market value is more positive for focal companies with high operational slack and high R&D intensity.	Non-significant	Positive	Rejected
Chapter 4: Suffering together? The effects of new product introduction delays on the market value of suppliers: Evidence from the Boeing 787 Dreamliner			
H1. The Boeing 787 Dreamliner's initial introduction delay has a negative impact on the market value of Boeing.	Significant	Negative	Accepted
H2. The Boeing 787 Dreamliner's initial introduction delay has a negative impact on the market value of suppliers.	Significant	Negative	Accepted
H3. The Boeing 787 Dreamliner's suppliers experience a more negative stock market reaction than Boeing's non-Dreamliner suppliers.	Non-significant	Negative	Rejected
H4. The impact of the Boeing 787 Dreamliner introduction delay on market value is more negative for suppliers headquartered outside of the US.	Non-significant	Negative	Rejected
H5. The initial delay to the introduction of the Boeing 787 Dreamliner has a more negative impact on the market value of suppliers.	Significant	Negative	Accepted
H6. The impact of the Boeing 787 Dreamliner introduction delay on market value is more negative for suppliers for whom Boeing is a major customer.	Non-significant	Negative	Rejected

5.2 Implications for Research

This research has studied the market value effects of new product introduction delays for both focal companies in terms of the role of firm resources and suppliers, impacts found to be missing in the existing body of literature. This research was imperative because new product introduction delays can have a negative consequence on organisations, such as market share, market value operating performance, and they continue to occur (Robinson and Fornell, 1985; Urban *et al.*, 1986; Hendricks and Singhal 1997; Hendricks and Singhal, 2008). The systematic literature review critically analysed the causes and effects of new product introduction delays, as well as how they may be managed. Ultimately, this research finds that new product introduction delays can have a negative impact on the market value of both focal companies and suppliers.

As discovered in the systematic literature review paper, sometimes organisations delay the introduction of new products on purpose for strategic reasons, such as avoiding cannibalisation of existing products, thus extending the product life cycle (Moorthy and Png, 1992; Boone, Lemon and Staelin, 2001; Krankel, Duenyas and Kapuscinski, 2006; Li *et al.*, 2010; Wang and Hui, 2012; Bilginer and Erhun, 2014). Drawing on the context of the aerospace industry, empirically investigated using the case of the Boeing 787 Dreamliner in Chapter 4, this can be demonstrated with a relevant, recent, example. Aerospace manufacturer Embraer delayed their E175-E2 aircraft until at least 2027, despite making its first flight in 2019. Embraer claimed this is due, in part, to the E175 aircraft's current success (AirFramer, 2022). This shows that companies sometimes delay new products in an attempt to maximise profit. However, this could be criticised as a putting a positive spin on new product introduction delays for key stakeholders, for instance investors and customers, by claiming that it is intentional or due to the success of current products. Notably, Embraer claimed that current product success is *one* of the factors in their decision to delay. Investigation into the other factors would help to form a more complete picture on a organisations' propensity and motivation to delay.

Besides delaying on purpose, other causes of delays identified in the systematic literature review include overly ambitious technological advancements. For instance, the Boeing 787 Dreamliner uses composite materials to reduce weight and therefore lessen fuel burn, increasing efficiency and reducing operating costs for customers. Other innovative features include lower cabin pressure for enhanced passenger comfort, larger windows and fresher air innovation with composite materials (Marsh, 2009). As well as internal decisions and challenges, there can also be external factors that could affect a timely new product introduction which could be out of a company's control. For example, global supply chain issues; as seen in recent times with the COVID-19 global pandemic and the invasion in Ukraine.

The literature finds a negative market value effect associated with new product introduction delays for focal companies. Hendricks and Singhal's (1997) found that market value decreased

by 5.25% on average. This research, in particular Chapter 3, confirms their statistically significant and negative market value effect of new product introduction delays for focal companies. However, this research finds a smaller magnitude of reaction of a decrease of 0.51%, although this still represents a substantial erosion of value for these S&P 500 contexts. This difference in observed magnitude could be due to a number of factors, including time of the studies and sample. Furthermore, delays continue to be experienced by organisations so it is possible that organisations are coming to expect them. Additionally, many of these delayed new products go on to later perform successfully, such as in the case of the Boeing 787 Dreamliner. Chapter 3 also studies the role of firm resources, contributing to the literature. Building on the impact for focal companies, Chapter 4 finds that this negative market value effect associated with new product introduction delays also spills over to suppliers. In the case of the Boeing 787 Dreamliner delays, Boeing's suppliers experience a mean market value erosion of 1.12% across an initial delay and a further delay. Understanding impacts of new product introduction delays beyond a focal company is key in order to be able to develop more effective strategies of addressing for delays, i.e. which do not only consider the focal firm but also supply chain partners. This is key in relation to supply chain disruption. (Sodhi and Tang, 2012; Sawik, 2020). Consideration of suppliers builds on Hendricks and Singhal's (1997) work by offering a unique contribution to show empirical evidence for such delays beyond the focal company. Although Chen *et al.* (2007) look at the impact for competitors, they do not consider suppliers. Interestingly, no significant effect of preannouncements on market value is observed. This could be due because investors pay more attention to negative signals than positive ones and because they know that organisations must continually introduce new products to remain competitive. Taken together, the empirical studies of this research provide evidence of the overall effect for the negative market value effects of new product introduction delays for both focal companies and suppliers, representing a key contribution. In the subsequent paragraphs of this sub-section, further discussion will be made about particular dimensions affecting the relationship of market value and new product introduction delays for both focal companies and suppliers.

This research adds to the literature on the market value effects of new product introduction delays by providing empirical evidence for the role of firm resources for focal companies. The study finds that organisations with high profitability fair worse with their market value when they delay a product. This is likely because organisations with high profitability have more to lose (Hendricks and Singhal, 1997). Additionally, organisations with high advertising intensity also fair worse when they encounter a delay. This could be due to brand damage when a delay is announced, this goes against the significant amount of capital spent on advertising. This explanation is put forward as it is known from the systematic literature review that delays can erode brand trust (Hern, 2003). The research finds that R&D intensity has no significant impact on market value when a delay is experienced, although the direction is positive. This could be because although R&D intensity is vital for remaining competitive and in developing innovative

new products successfully (Schumpeter, 1949; Griliches, 1979; Romer, 1990; Ugur, Trushin, and Solomon, 2016), investors may expect highly innovative product development to be more cumbersome in addressing any subsequent delays. For instance, the ambitious Boeing 787 Dreamliner introduction was fraught with challenges. Firms with high R&D should be well positioned to deliver new products successfully but this could be counteracted by ambitious new technological innovations for instance. It is found that while operational slack alone is not significant in impacting market value when there is a delay, it does positively moderate advertising intensity. When considering operational slack and advertising together, market value is more positive. This could be explained by firms having their advertising backed up by the capacity, i.e. operational slack, to cope with new product introduction delays. Taken together, the consideration of these dimensions explored; profitability, R&D intensity, advertising intensity, operational slack; make some new contributions to the literature on new product introductions because they give insight into which factors may lead to more or less positive market value reactions. This can be useful in understanding which characteristics of organisations have an impact on market value when a delay is experienced.

Further insight reveals greater understanding as to the market value effects for suppliers based on a number of dimensions. The research finds that Boeing's suppliers are penalised in the stock markets similarly, regardless of their involvement with the Dreamliner, their location or their relationship value. This should serve as a strong warning for both focal companies and suppliers. For focal companies like Boeing in this context, they should be aware that their actions and decisions can not only affect themselves but also their supply chain. Boeing relies on their suppliers to bring the Dreamliner into being, therefore they have a vested interest in ensuring the economic viability of their suppliers. For suppliers, they should be careful about their involvement with high-risk new product development projects. They should explore potential mitigation techniques if they are to suffer from the impacts of a delay and consider customer diversity carefully (Shih, 2022).

To summarise, the research contributes to knowledge in a few key ways. The systematic literature review synthesis studies on the causes and effects of new product introduction delays, as well as ways of attempting to manage them. From this, potentially fruitful research directions are derived which represent key important gamps in knowledge on such delays. This forms a foundation for the subsequent empirical research. The research contribution is also achieved by providing empirical evidence for the market value effects of new product introduction delays for both focal companies, particularly the role of firm resources, and suppliers. It is intended that this research stimulates further study of new product introduction delays in an attempt to develop more effective ways of managing them. Due to the direct relevance for organisations, this research also has a number of important implications for practice which will be discussed in the next session.

5.3 Implications for Practice

As well as important contributions to research discussed in the previous sub-section, the research provides practical implications too. The systematic literature review reveals that new product introduction delays can have significant negative consequences for organisations. For instance, a reduction in market share, market value and operating performance (Robinson and Fornell, 1985; Urban *et al.,* 1986; Hendricks and Singhal 1997; Hendricks and Singhal, 2008). Therefore, it is vital that organisations are aware of how they may be affected by such delays. Further to this, they should also be aware that such delays can have a negative impact on their suppliers to, as per this research's findings. In doing so, it is hoped that this improved understanding and awareness may enable organisations to attempt to shield themselves from such delays more effectively and provoke discovery of better ways of managing new product introduction delays.

New product introduction delays still occur in practice, therefore understanding and manging them becomes paramount. With Boeing's more recent aircraft, such as the 777X, delays are already being anticipated by major airlines like Emirates. Although not a commercial aircraft, Boeing's new air Force One is also facing production issues (Tangel, 2022). These issues are compounded by regulatory and certification challenges following the problems with the 737 Max and demonstrate how Boeing still faces new product introduction issues in current times (Denning, 2013). Despite these challenges, they must continue to innovate and successfully introduce new products to survive (Sharma and Lacey, 2004; Johnsson, 2022).

The research find that investors react more to negative signals than they do to positive ones, at least in the short-term based on the efficient market hypotheses. Therefore, organisations should carefully consider whether to over-ambitiously preannounce a new product, knowing that investors do not pay much attention to such positive signals, when they could later experience a delay. Therefore, an implication for practice here is that managers should only preannounce new products when they have a high degree of certainty that they can avoid delays. Investors reacting more to positive signals than negative ones can be found in other contexts, such as finance, with Kadiyala and Rau (2004) finding this to occur in corporate event announcements. This is useful in applying to preannouncements and new product introduction delays since firms are often eager to announce new products and create buzz but may later experience a delay. By applying signalling theory in this way, it serves as a reminder to organisations to be cautious about being over-zealous in new product preannouncements since they later experience delay which would harm share price more significantly than a preannouncement would benefit it. By studying the impact on market value of new product introduction delays and their related preannouncements from S&P 500 companies we are able to better investigate the role of positive and negative signals which investors use on related events, i.e. preannouncements and delays.

Publicly listed companies, studied in this research, have the primary goal to maximise shareholder wealth as their primary goal (Hendricks and Singhal, 1997). To do so, achieving and sustaining high profitability is essential. However, our findings indicate that profitability is in conflict with a more negative impact on market value from new product introduction delays. This tension is difficult for companies to address as both having high profitability and limiting the negative impacts of new product introduction delays are in tension with one another. Nonetheless, companies with high profitability need to be aware of new product introduction delay issues. To avoid more negative reactions than companies with low profitability, such organisations should first know that having high profitability and experiencing a new product introduction delay can more negatively impact their market value. This serve as a message and motivator to help avoid new product introduction delays in the first place. Awareness is key as there is already a number of studies on potential methods of helping to avoid, reduce and manage new product introduction delays. For instance, Driscoll (2002) explain how organisations should 'design to manufacture' to enable effective product processes via reconciliation of process capabilities and design requirements, at an early stage of product development. Further to this, there are researchers who investigate avoiding delays under certain circumstances, such as where delays are caused by a low manufacturing yield (Özer and Uncu, 2013). Although, the effectiveness of such approaches requires further investigation. Organisations with a high profit margin should turn to the implications of this literature in avoiding delays. This is key due to the explained inevitability of new products being announced and the rate at which delays still occur, despite the literature on new product introduction issues. Organisations should seek to minimise delays if they are to continue to maximise shareholder wealth.

Additional to profitability, organisations with high advertising intensity can also experience more a negative change in market value. This is again a difficult tension to resolve as organisations must invest in advertising to communicate their new products and remain competitive, ultimately attempting to ensure their survival. However, organisations with high advertising intensity must remember that if they experience a delay their market value may fair worse than organisations with lower advertising intensity. Therefore, companies with high profitability and advertising intensity are at risk of significant negative market value reactions when they experience a delay compared to their counterparts. Although, since we find that operational slack positively moderates advertising intensity, this could be one way of addressing the tension presented. Therefore, companies with high advertising intensity should consider increasing their operational slack so that they have spare capacity to deal with delays, backing up their advertising. Though, this is a trade off as high operational slack could be seen as inefficiency.

Beyond the focal company, the research observes negative market value effects for suppliers in the case of the Boeing 787 Dreamliner introduction delays. The spillover effect observed shown that not only do suppliers of the affected product experience a negative market value effect but so do those not directly involved. This should serve as a warning to all suppliers of the company that they may suffer negative consequences even if they are not related to the delay itself. Additionally, the research finds that an initial delay is more negative than a further delay. This could show that Boeing should focus on getting the product to the right standard rather than rushing it to the market in an unsatisfactory condition once they have already announced a delay.

The research investigated whether location had an impact on market value of suppliers because we know that Boeing addressed Dreamliner delay issues by bringing some manufacturing to the US so evidently they see location and spatial distance from them as the focal company to be a challenge in the supply and manufacturing of the Dreamliner's sub-assemblies (Brandon-Jones *et al.*, 2017). However, since we reject this hypothesis it seems that investors do not discriminate against which country the supplier is headquarted. This is explained by and reflected by the strong spillover effect which affects all of Boeing's suppliers similarly. There was no difference found in suppliers which have a high or low relationship value with Boeing. Therefore, this indicates to Boeing's suppliers that they can all be similarly affected by delays to the introduction of the Boeing 787 Dreamliner. This should heighten awareness of such delays even for suppliers which do not depend on Boeing for a large amount of their business.

Supply-chains can be fragile. For instance, the recent difficulties of the Evergiven becoming stranded in the Suez Canal caused global disruption to suppliers of certain products and a shortage of heavy goods vehicle (HGV) drivers seen in the UK (Nassauer, 2022), affecting logistics and physical distribution. These issues exemplify the significant issues supply chains can face, even in modern times with risk management (Tett, 2022). Therefore, such new product introduction delays, particularly those whereby the products' manufacturing depends on suppliers. Recent supply chain issues seem here to stay, at least in the near future, with companies even placing orders for Christmas due to long lead times (Debter, 2022). Therefore, such supply chain issues could contribute to delays of current new product introductions. Impacts of the COVID-19 pandemic are still being felt in supply chain management and production (Jie, 2022; Saïah *et al.*, 2022). This could indicate that future new product introductions could be even more problematic in the current climate. Taking into account the precarious global economic situation, market value erosion due to new product introduction delays is not something that focal companies or suppliers can take lightly (La Monica, 2022).

An impact of the invasion of Ukraine is Boeing's suspension of buying Russian titanium which also adds to their procurement challenges (Nair and Helper, 2022). Furthermore,

disruption to flight paths, in many cases dramatically lengthening flight time and therefore fuel burn, means that the timely introduction of new and efficient aircraft is paramount (The Economist, 2022). Utilising successful new product introductions to address environmental concerns has become even more critical since the advent of the 787 Dreamliner aircraft. For instance, Rolls-Royce are developing powerplants for electric planes to be launched in 2025. Learning from Boeing's 787 Dreamliner development challenges and their impact on suppliers is critical in informing the successful introduction of these future aircraft innovations (Kotoky and Park, 2022). Highly innovative and radical products will be critical for the aerospace industry to remain economically viable, competitive and accepted by an increasingly environmentally-concerned society (McGrath, 2022; Pfeifer, 2022). This is critical as climate shocks are expected to potentially hurt supply chains even more than the COVID-19 pandemic (Rockeman, 2022).

Avoiding delays is best where possible for both focal companies and suppliers, since this research finds that such delays can have negative market value effects. However, some delays are inevitable. This means that ability and capacity to cope with and resolve delays in a timely manner is paramount. By better understanding their position according to the explored dimensions, companies can be better prepared to avoid more negative market value reactions. It has never been more important for organisations to avoid delays because in current times there are already global supply chain disturbances which are unlikely to ease soon and these issues could work together to cause significant problems for focal companies and their supplier chain (Murray, 2022).

5.4 Limitations

The research has been undertaken with care and due diligence from a positivist perspective. Every effort has been made to conduct the research with integrity in a high-quality manner to provide significant contribution to knowledge. Despite this, due to the messy and complicated nature of research in this discipline, as with any study, there are some research limitations that this section will reflect on. The intention is to provide transparency and ways in which future research could address remaining challenges. Although specific limitations relating to each paper are discussed within the relevant chapters, an overview of the key limitations of the thesis as a whole are discussed here.

Firstly, the event study method assumes the efficient market hypothesis (Fama, 1970; Ding *et al.*, 2018). However, this may not always be the case and testing this is difficult to impossible. Despite this, the event study approach has attracted the attention of researchers for its potential robustness and ability to provide important understandings of the impact of phenomenon like

new product introduction delays on the market value of organisations. Several of these papers have been discussed within the thesis, for instance Hendricks and Singhal (1997; 2008), Xiong *et al.* (2021) and Jacobs and Singhal (2020). The event study approach used in this research to study market value effects assumes that the primary goal of organisations is to maximise shareholder wealth. However, increasingly there are other concerns for companies and society beyond market value. Organisations should also be considered with contributing to society, fostering a positive working environment for employees and the climate crisis for instance.

The empirical studies within this research use data from particular contexts. To study the role of firm resources on the market value effects of new product introduction delays, US S&P 500 companies experiencing delays are used. It could be interesting for future research to test these findings in other contexts, such as emerging markets. Although this part of the study focuses on a particular country, this is consistent with prior studies published in top journals in the field (Xu *et al.*, 2012; 2016; Lam *et al.*, 2016). To study the market value effects of new product introduction delays for suppliers, the Boeing 787 Dreamliner was used. This could potentially reduce the generalisability of the related findings to similar contexts. However, this research decision was made to provide greater detail and in-depth look at a particular supply chain which gave interesting findings about various classifications of suppliers and their market value effects. Future research could explore the generalisability of the market value effects of suppliers by studying additional research contexts.

As with other research, there are a few methodological and practical challenges in achieving the research aim. Specifically, Chapter 4 uses the event study method in an international context as Boeing's suppliers are located around the world. This provides some difficulties to the event study method which must be navigated. In doing so, the MSCI All World Index was used to calculate the expected returns of Boeing and their suppliers. Using a single market index could be a limitation because there could be variation in different stock markets across the globe. To reduce this issue, we select an index which covers a variety of stock markets. Additionally, Boeing's supplier list between the initial delay and a further delay could vary slightly. However, no major chance is anticipated due to the nature of the research context. There is a relatively short time frame between the first delay and a further delay; and it is not quick or easy for aerospace manufacturers to switch suppliers.

This research uses the event study method to investigate the market value effects of new product introduction delays for focal companies and suppliers. However, measuring market value means that only public limited companies (PLC) can be studied here. Therefore, it remains unknown as to the market value effects of new product introduction delays for private companies, i.e. those not listed on a stock market.

5.5 Future Research

This research has addressed a couple of major gaps in the literature on new product introduction delays. More specifically, this includes the role of firm resources in the market value effects of new product introduction delays and the impact on suppliers. From this research, several other potential future research directions are identified. These potentially fruitful research avenues would help to further understanding of new product introduction delays and to move toward more effective means of managing such delays. Overall, future studies could adopt a stronger theoretical lens than past studies, as identified in chapter 2. Broadly, researchers could study the impact of new product introduction delays on other key factors beyond market value, i.e. a different dependent variable. For instance, development team morale and ambitiousness of future innovation. Specific potential research directions are discussed below:

Research Avenue 1: The role of management capabilities
This research found that firm resources play an important role in the relationship between new product introduction delays and market value. However, there are other relevant dimensions too that have so far escaped the attention of researchers. For instance, management capabilities, including board experience and diversity factors. Anecdotally, capabilities of senior management in a company could play an important role in the impact of new product introduction delays on market value. Future studies could use the short-term event study method to empirically investigate how various key management capability factors affect market value when there is a new product introduction delay.

Research Avenue 2: Technologically new product introduction delays
Extant studies have not differentiated between different types of new products, for instance technologically new products. Different types of new products could be associated with different market value effects when their introduction is delayed. Therefore, it could be useful for researchers to classify new product types to provide greater insight.

Research Avenue 3: Consideration of the new product introduction delay cause
So far, studies on the market value effects of new product introduction delays have not considered whether the delay occurred due to some unintended consequence, such as problems in product development stages, or whether the company decided to delay the new product on purpose for strategi reasons, such as avoiding cannibalisation of existing products. This research would provide important insight into whether or not companies experience negative market value effects of new product introduction delays irrespective of whether it is on purpose or accidental. This could help to better inform companies on their new product introduction decisions by enabling them to be aware of the consequences of their actions.

Research Avenue 4: Market value effects for second tier suppliers
This research finds empirical evidence for the negative impact of new product introduction delays on the market value of suppliers. Due to the increased importance of supply chain viability and transparency, it could be interesting to research the market value effects of new product introduction delays on second tier suppliers.

Research Avenue 5: The market value effects of new product introduction delays on customers.
Prior research has largely focused on the impact of new product introduction delays for focal companies. This research has also gone beyond the focal company and found empirical evidence for the market value effects of such delays for suppliers. However, there are other partners which remain unstudied. For instance, new product introduction delays could also have an impact on customers. Such research could provide potentially fruitful insight into how customers are affected by new product introduction delays.

Research Avenue 6: The financial impact of product introduction delays for private companies
Existing studies on the consequences of new product introduction delays on market value have so far only been able to consider the impact on PLCs using the event study method. However, this misses part of the picture of the consequences of such delays. Therefore, future studies could strive to consider the impact of new product introduction delays on financial metrics of private limited companies. Although, practical issues persist, with data access potentially being somewhat more challenging. There is scope for more primary data research in this area.

Research Avenue 7: How new product introduction delays happen for organisations
As revealed in Chapter 2, many of the existing studies on new product introduction delays adopt quantitative methods, such as econometrics. Little effort has been made in studying such delays from a qualitative perspective. Due to the difference in potential research questions fitting quantitative and qualitative studies, key insights could be missed. Therefore, more qualitative studies could be attempted to better understand how and why new product introduction delays happen for organisations. For instance, using interview methods. This could provide greater detail and nuanced insight into how new product introduction delays happen for organisations and they understand and make sense of such delays.

5.6 Conclusion

This research has contributed to the understanding of the market value effects of new product introduction delays for both focal companies and suppliers. It has added to the awareness of such delays beyond the focal company, finding empirical evidence for a spillover effect.

Additionally, the research has found that firm resources play a role in the relationship of market value and new product introduction delays. New product introduction delays continue to be a major challenge for organisations. Therefore, this research aspires to stimulate further research on what new product introduction delays mean for organisations, including beyond the focal company, in the hope of developing more effective ways of dealing with such delays. With current supply chain challenges, as well as social, political, economic and environmental problems that organisations face, organisations must navigate introducing new products in increasingly difficult circumstances. They cannot escape the need to continually introduce new products to the market.

5.7 References

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