VAASAN AMMATTIKORKEAKOULU
UNIVERSITY OF APPLIED SCIENCES

MD HASIB AHMED

HOW HIGH-TECH INDUSTRIES CAN REDUCE UNCERTAINTY ON TECHNOLOGICAL AND MARKET RISK

International Business Management
2025

VAASAN AMMATTIKORKEAKOULU
UNIVERSITY OF APPLIED SCIENCES
International Business Management

ABSTRACT

Author : MD HASIB AHMED
Title : HOW HIGH-TECH INDUSTRIES CAN REDUCE UNCERTAINTY ON TECHNOLOGICAL AND MARKET RISK
Year : 2025
Language : English
Pages : 52 + Appendices
Name of Supervisor: Binod Timilsina

This study assesses the external cooperation, market intelligence, and innovation competencies of Finnish high-tech companies that reduces technology and market risks. It will also explore how these companies, especially Nokia Corporation, manage general uncertainty along with market risks. The objective of this research is to evaluate uncertainty reduction in relation to strategic practices alongside examining high-tech strategies in Finland.

The research was carried out using a descriptive design and both qualitative and secondary sources: academic journals, industry reports, and primary data from a survey. The survey was comprised of 5-point Likert questions aimed at 55 professionals working in R&D, innovation management, and strategic planning within the Finnish high-tech sector.

The study found that that while strategic planning and innovation capability clearly helped to enhance organizational adaptability, market intelligence greatly enabled the reduction of uncertainty. Uncertainty reduction was demonstrated through proactive mitigation of technological market risks. The flexibility and external collaboration were found to be less effective in strengthening organizational adaptability.

The discussion has led to the conclusion that innovation, strategic foresight, and market intelligence are essentially or critically needed tools in managing uncertainties and risks within the high-tech industry. The above insights, together with the recommendations given, are intended to boost these firms' sustained global competitiveness and sustainability levels, thus enriching academic and practical knowledge regarding uncertainty reduction strategies.

Keywords: uncertainty reduction, innovation capability, strategic planning, market intelligence, high-tech industries

CONTENTS

FIGURES

TABLES

ABBREVIATIONS

EC : External Collaboration
FLEX : Flexibility
IC : Innovation Capability
MI : Market Intelligence
SP : Strategic Planning
UR : Uncertainty Reduction

1 INTRODUCTION

This chapter provides a background and motivation of the topic being studied that is the position of high-tech industries as the engines of economic growth and innovativeness, on the world and regional level. It also outlines the nature and significance of technological and market uncertainties and examines strategic practices that firms in this sector adopt in an effort to curtail these forms of uncertainty. This chapter includes the background, research aims, and scope of the study followed by a brief introduction on the organization of the thesis.

1.1 Background of the Study

High-tech industries feature cyclical technology and markets that are volatile and have a lot of uncertainty. It is the Industry lead, So companies have to apply such a strategy with which the currency to tech disturb and market- Business of scour can be decreased, even in potency they help in being so, it is the Innovation capability, strategic and tactical planning Component that has a part to play now, External collaboration became part of in way out from all such uncertainty. The study seeks to explore the connection between these strategic actions and the decrease in uncertainty in the high-tech zone the example of Nokia Corporation (Finland).

In a study by Yang et al. 2024), stressing that the streamlining of environmental regulation is inextricably linked with the growing technological complexity and international competitiveness of high-tech industries. They say the scrutiny being levelled by regulators in China is putting a “U-shaped” structure in the technological sophistication of high-tech exports. It highlights programming world domination the “high tech” sector which has to contend with regulatory pressures alongside those in the market. There's a high level of external collaboration with this stage, typically involving engagements with regulatory institutions and various other partners to mitigate against

such regulatory risks. However, also a significant rise in investment in R&D and human capital were highlighted as what was needed to boost the firms' ability to innovate for the sake of change in the environment and the market.

Singh and Sharma (2024) argue high-tech professional practitioners rely on strategic practices for uncertainty reduction. Much of it comes from the quality of technology development, the design, and the attractiveness to the market- and end-users, as they highlighted in their study, but how do all of these various factors shape the studied high-tech products performance? Such high-level strategic activity (e.g., market intelligence, strategizing) is imperative to win in a constantly evolving, competitive tech landscape. Therefore, this study practises a collective Multi-Criteria Decision-Making (MCDM) method to recognise and confirm the key factors that impact the success of high-tech products in the global market. This aligns with the aim of present paper as it concentrated on strategic practices such as market intelligence and flexibility, which can mitigate uncertainty for high-tech companies.

Popkova et al. (2024) integrate the examination of strategic practices for financial risk management in high-tech sectors. It is suggested that innovations when applied wisely can make a huge difference to mitigate financial risk, especially in high-risk market environments. These initiatives intend to foster sustainable development by reducing technological and market uncertainties. High-tech firms are susceptible to diverse financial risks, particularly in IT, threatening their competitive advantage per the authors. The article provides a transformative sense of foresight as well for the ongoing study since it interrelates the strategic planning as well as external engagements with the idea of risk management. Responsible innovations that help to mitigate the risk of the market and technology and with the integration of high-tech strategies will enhance their long-term sustainability.

Huang and Hou (2023) provide a new perspective on the impact of economic resilience on high-tech industry innovation capabilities. Their research, based on the provinces data of 30 China, can give us a view on tech talent & economy are the primary elements which drive high-tech industries innovation. They detect that economic resilience with technological and talent resilience creates the basis for a stronger innovation capacity which serves a differentiated capacity for firms to cope with market and technological uncertainties. It is therefore especially related to the objectives of the present study, which is to understand the effect of innovation capability and strategic practices on uncertainty reduction in high technology domains. Characteristics such as external collaboration and flexibility form an important part of creating the economic resilience required for high-tech firms to engage in successful innovation while minimizing exposure to risk, the findings of the study indicated.

Based on this empirical review, it is concluded that, in a rapidly changing environment involving several dynamic variables like technology, regulation, and market, high-tech firms operate under the conditions of a dynamic environment. These sectors must innovate, emulate, and partner with outsiders to remain competitive and at the same time bring down uncertainty. In particular, innovation capability is very important in this process. Firms with effective innovation processes are more capable of adjusting to the threats of novel technologies, fluctuating market conditions, and regulatory burdens (Yang et al., 2024). External collaboration also contributes to this respect, since several firms require partnerships with their suppliers, research institutions, and even competitors to reinforce their knowledge and resources needed for innovation (Singh & Sharma, 2024).

Uncertainty reduction is not only based on sound practices like strategic planning, market intelligence, and flexibility. The firms can look out into the market and also the technological events, with the help of strategic planning, and therefore it can prepare long-term decisions. This helps

firms to get the data about what consumers actually need, and what the market dynamics are (Popkova et al., 2024), while making flexibility in operations one of the keys to success, since any company needs to pivot as soon as there are any changes within the environment. Such strategic practices that mitigate ambiguity can also contribute to the competitiveness of high-tech firms helping them anticipate new threats.

The reduction of uncertainty in high-tech industries relies heavily on having a mix of innovation capability, strategic planning, external collaboration, flexibility, and market intelligence. This research examines the ways in which such practices are implemented at Nokia Corporation in Finland and how they serve as mechanisms for obscuring technology and market risks. So, they would be a good source of increasing their resilience, innovation capability, managing uncertainties, and guaranteeing sustainable and competitive enterprises any international market in a constantly shifting scenario.

1.2 The Scope of the research

A set out to analyze the link between strategic practices and uncertainty alleviation in high-tech industries. The role of Nokia Corporation in Finland. This study proposes that innovation capability, external collaboration for innovation, flexibility, market intelligence, and strategic planning are the constructs which could be utilized to deal with the uncertainties at technology and market levels. This quantitative research design is to validate how far these strategic practices are followed by Nokia and how effectively these strategic practices reduce uncertainty. A structured questionnaire was used and purposively given to Nokia employees who are in managerial and strategic positions directly involved in innovation management, planning and risk management activities for this research scope. It will also investigate the relationship between these practices and their capacity for building resilience against external and internal shocks in the firm.

The secondary data collected from industry reports, peer-reviewed articles and company documents will also be used in order to triangulate the findings and to provide a contextual relevance to the study. Second, this research targets on one organization only, Nokia Corporation, which gives us a kinds of case study for a better insight on how a leading high-tech firm in Finland deals with uncertainty. If the research focuses primarily on Nokia, expect the results to be of sufficient generality to benefit not just Nokia but other high-tech firms in Finland and elsewhere, too. This analysis will focus on two main goals: the first objective is to investigate whether the relationship between strategic practices and uncertainty reduction and the second is to describe the adoption level of strategic practices at Nokia. This scope guarantees a well-rounded comprehension of the manner in which high-tech industries can systematically lower uncertainty through a strategic set of practices.

1.3 Research Questions

These research questions are formulated from the purpose that aims to explore the relationship between strategic practices and the reduction of uncertainty in high-tech industries. In particular, the first question addresses how innovation capability, collaboration with external partners, operational flexibility, market intelligence and strategic planning can help firms reduce levels of technological and market uncertainty. The second question assesses the degree to which high-tech firms in Finland such as Nokia Corporation employs these uncertainty reduction strategies.

- How do high-tech industries use strategic practices, such as innovation capability, external collaboration, flexibility, market intelligence, and strategic planning to manage uncertainty?
- What uncertainty reduction strategies are adopted by high-tech firms in Finland?

1.4 Research Objectives

The main goal of this dissertation is to explore how high-tech industries can reduce uncertainty related to technological and market risks by examining the strategic practices, such as innovation capability, external collaboration, and market intelligence, adopted by firms in Finland, with a focus on Nokia Corporation.

Specific Goals:

- To analyze the relationship between uncertainty reduction and the strategic practices in high-tech industries.
- To examine regarding the uncertainty reduction strategies adopted by high-tech firms in Finland.

1.5 Structure of the Thesis

Chapter One: Introduction
It explores the research topic, gives the context, objectives and questions followed by the journal article. It provides Background for the investigation to explain the research scope and research objective to contribute to the understanding of reduction of uncertainty in field of high-tech industries.

Chapter Two: Literature Review
The purpose of the literature review is to provide a critical evaluation of the relevant literature between strategic practices, and the uncertainty reduction within high-tech industries. The paper addresses theoretical frameworks, real-world results, and the significance of innovation in handling technology and market uncertainties. This encouraging review forms the basis for this study while highlighting the existing gaps in literature.

Chapter Three: Methodology
This chapter describes the research design which details the methods and approaches engaged for collecting and analyzing data. It relates to

the sampling technique, the selection of appropriate respondents, and data collection instruments such as the structured questionnaires. It also discusses the logic behind the research methodology concerning the aims and questions of the research.

Chapter Four: Data Analysis

Chapter four includes a data analysis result which describes the results of the data collected from the descriptive statistics to the correlation analysis. This conceptual paper analyses how the selected strategic practices (innovation, collaboration, flexibility etc.) are related with uncertainty reduction and uses statistical tools to give meaning and predict the results of the data.

Chapter Five: Discussion

This chapter discusses the research findings in connection with the literature. The results are discussed with regards to their implications and how strategic practices that reduce uncertainty in high-tech industries. This chapter also highlights the study's contributions by discussing how these contributions differed from those of the other studies.

Chapter Six: Conclusion

The last chapter discusses the main conclusions from the findings of the research and the limitations of the study also discussed. It gives hints on future research related to the handling of uncertainty in highly technological sectors. Finally, the chapter offers suggestions for practitioners and researchers regarding the findings of the study.

1.6 Use of AI in This Thesis

In the study there is use of AI for getting better and meaningful data analysis reporting. AI tools like ChatGPT were utilized to get idea how to report the data analysis in efficiently way, however there is no issue of AI detection as it was just used for idea purpose. Similarly, for paraphrasing purpose, the help of Quillbot was undertaken.

2 LITERATURE REVIEW

This section consists of the literature review that systematically reviews relevant studies of strategic practices that reduce uncertainty in high-tech industries. It contains three cluster conceptual review, empirical review and research gap. Through the anthropological theory we define some key variables related to technological and market uncertainties in high-tech industries (i.e. innovation capability, external collaboration, market intelligence, flexibility, and strategic planning). This empirical review elaborates on the existing literature on these variables, especially in terms of their operationalization in different settings with a predominant focus on high-tech industries, and their implications for practice. Third, research gap indicating there are not enough current literature to understand the nature and the relation of strategic practices on uncertainty reduction in a firm, such as Nokia Corporation. This review provides the background for investigation in the study by underscoring theoretical relevance, empirical evidence and knowledge gaps in the literature.

2.1 Conceptual Review

This conceptual review proposes the key variables that influence the ability of high-tech firms to cope with technology- and market-related uncertainties. These are innovation capability, external collaboration, insight, operational flexibility, and strategic forecasting. Innovation enables technological advancement and allows companies to remain competitive in ever-changing markets. This sort of engagement serves as a positive externality for firms by enhancing the resources and capacity to cope with uncertainty. Finally, firms with market intelligence capabilities will reap the rewards of predicting the changes and needs of the market and each customer segment, and firms that have a high degree of flexibility will be able to respond quickly to any obstacles. Therefore, we can say that to carry out planning strategically is the key

to fitting the objectives of the organization with the long-term dynamic of the market, so that it manages to survive in times of uncertainty.

Innovation Capability

Innovation capability is the strategic capability of the firm to manage radical innovation (RI) projects which are characterized by high uncertainty. It is the capability to recognize, inspect, and take on technical, market, organizational, and resource risks while trying to introduce new products or enter new markets. This capacity is needed to maintain a long-term competitive advantage and involves managerial practices different from those used during everyday practices (O'Connor & Rice, 2013).

Considerable research argues that to retain competitive advantage (even to establish some for the first time), firms need to look toward innovation; a new product or target market like Web 2.0 technologies is simply not sustainable for a mature firm reliant on cost-cutting, quality-enhancement and market increment. But that radical innovation (RI) capability is crucial when trying to monopolize new markets, and cope with long horizon ambiguity. The high level of uncertainty in RI projects makes them very different from the innovation projects and, hence, the conventional management practices do not only tend to fail to deliver the desired results but over time turn out to be negative. O'Connor and Rice (2013) in a qualitative longitudinal study of 12 RI projects in 10 large U.S. firms identify that the multiple types of uncertainty (technical, market, organizational and resource) pose challenges to innovation initiatives. These uncertainties are also further categorized by their criticality and latency that represent a broader model of managing uncertainty. The need to identify these uncertainties and what they mean is critical for building innovation capability in markets that are complex and continually changing. Management practices need a redesign to suit the specific challenges posed by RI projects.

Use of External Collaboration

The use of sources from outside of the company to access outside ideas, knowledge or technologies to feed into the company's own process of innovation. 6 This strategy, often referred to as open innovation, allows companies to develop faster and go to market more broadly through partnerships, alliances, and licensing. It is contrary to traditional closed R&D model and which could be more flexible in complex and information rich environments (Chesbrough, 2003).

External collaboration is the fuel for innovation in modern organizations. The closed innovation paradigm whereby firms rely solely on in-house R & D is finding it increasingly difficult to resist the twin-mounted forces of the opening global knowledge commons and the rising speed of technological change. Open innovation (Chesbrough, 2003), which has as assumption both internal and external sources of innovation, as well as several ways of commercialization. It enables firms to optimize their IP commercialization, provide returns on their R&D investments, and participate in a more extensive innovation network. An Open Innovation presentation describes the strategic benefits to be gained by extending reach and flexibility, optimizing used technologies and instruments for maximizing both, and aligning the R&D and business processes based on examples of leading companies (IBM, Intel, and Merck). It allows companies to improve their innovation pipeline, but also to manage technology risks and operations schedules through complex competitive landscapes.

Flexibility in Operations

Operational flexibility is the ability of a firm to reshape internal competences and resources to meet changes in its environment. It is about sensing the opportunities, acting in a strategic manner to take advantage of them, and changing organizational processes as a result. As these capabilities form the basis of sustained performance in an

increasingly globalized market requiring innovation and nimbleness as the key to a competitive operation (Teece, 2007).

Dynamic Capabilities, for example, imbues firms with operational flexibility that is crucial for firms to establish sustainable performance in the landscape of rapid innovation and global competition. According to Teece (2007), dynamic capabilities refer to the capacity of an organization to strategically sense, seize and transform resources in order to achieve a long-term sustainable value generation. They are actually embedded in micro foundations related to particular skills, organizational structures, routines, and decision-making processes. Besides the ability to adapt through their well-functioning dynamic capabilities, firms actively build and modify these ecosystems through strategic innovations and collaborations. Entrepreneurial orientation helps a firm to escape the "zero-profit condition" common to perfectly competitive markets. Dynamic capabilities enable organizations to anticipate change, react to it involuntarily, and sustain competitive advantage by fostering internal responsiveness and cross-functional agility. This has made operational flexibility the critical backbone to survive and thrive through tech disruption and market headwinds.

Market Intelligence

Market intelligence is the organized collection of data into business information so that it can be used by management in strategic decision making. Rather, it’s about pulling massive, diverse, real-time data sources—like social media, sensors, transactional data—and placing pattern-hunting algorithms over the raw data to search out and predict trends. This allow companies to move from hunch based decision-making to evidence-based decision making, which makes them more agile and more competitive (McAfee et al., 2012).

Big data analytics has turned market intelligence to be an essential tool to mitigate uncertainty and help the organizations to respond better. McAfee et al. (2012) persuades that big data far exceeds conventional

analytics in forming driving evidence based decision-making. Institutions are able to process large amounts of both structured and unstructured data from various sources such as social media, sensors and online activities to make accurate real time business decisions. Such functionality not only enhances forecasting accuracy, but also allows for more personalized interaction with customers, nimble operations and the ability to make strategic calls at the right time. Sears Holdings and PASSUR Aerospace are two examples of companies using insights from data to make better decisions on promotions and flight timing as a way to boost performance, but there are far more examples. Nevertheless, to capitalize on big data, firms must build in-house data science skills, develop leadership aligned to evidence and integrate various data streams. Thus, big data-driven market intelligence is not only about leveraging technology but also shifting the organizational posture from technology to being a data-centric strategy-driven enterprise.

Strategic Planning

Strategic planning infers a deliberate use of technology road mapping to ensure that business aspirations are matched with technology over time. The planning framework allows a company to plot how market trends, product evolution, and technology trajectories relate to one another. Offering both intra and inter-organizational views of the future, it helps in decision making, enabling long-term innovation strategies to be pursued in a fast moving environment (Phaal et al., 2004).

The method of technology road mapping is well-established to support the long-term competitive relevance of organizations in times of technological change through strategic planning. According to Phaal et al. (2004), Technology road mapping is a process that attempts to integrate the typically fugu active and oftentimes far reaching evolutions of markets, technology and the product technology strategy in a flexible yet systematic planning orientation. Such concepts help businesses

direct the technological innovation towards the businesses objectives enabling firms to make use of emerging disruptions and adapt to them. Roadmaps have two functions: at the strategic level of firms, they redirect R&D and investment decisions, and at the multi-organizational level, they assist stakeholders in environmental scanning, risk assessment, and seizing technology opportunities. The fast-start approach described in the study is a streamlined way of developing a roadmap resulting in a more user-friendly approach over a range of organizational settings. Road mapping builds a common language and clear dialogue across stakeholders, enabling better choices through effective group decisions, and helping organizations to learn strategically. In that sense, technology road mapping reinforces the strategic thinking and planning power and the ability of a firm to plan and arrange for the managerial aspects of evolutionary and revolutionary technological changes both in a more suitable way.

Uncertainty Reduction

Uncertainty reduction is the ability of organizations to control uncertainty in a volatile business environment by augmenting artificial intelligence (AI) and more developed data analytics. AI-enabled learning capabilities help organizations to recognize, understand and respond to fast change with a newly achieved level of precision and agility. This allows to have a resilient and future-pattern insight and especially in a volatile and complex sector (Bughin et al., 2019).

In the current dynamic and dynamic business environments, different AI and organizational learning are essential for minimization of uncertainty. According to Ghadge et al. (2019), AI visualization based learning enables organizations to adapt to unforeseen scenario by analyzing huge volume data and providing actionable insights. In this related study fielded among 3,461 executives worldwide and supplemented with additional interviews, we demonstrate how artificial intelligence is helping companies learn to outpace their virtually learned

advantages and make decisions quickly and safely. When AI is combined with strong learning agility, organization are better suited to cope with uncertainty when it comes to strategic planning, market changes and disruption, and technology innovation. It will not only entail investment in AI technologies but also leadership commitment to practicing evidence-based approaches and cross-functional collaboration. The vagueness is no more hazard but an opportunity because of AI possible expediency to predict trends, replicate results, and learn and optimize through feedback loops. Thus, the nascent, now-so-obvious argument for holistic AI-infused ecosystem approach to smoothly managing uncertainty becomes a strategic imperative for sustainable enterprise growth.

Innovation Capability and Uncertainty Reduction

Innovation capability is one of the key strategic practices for high-tech type industries to cope with both technology and market environment uncertainties over time. Since adopting an appropriate innovation practice plays an important role in dealing with the uncertainties in the markets, Yang et al. (2024) suggest that the relationship between environmental regulation practices and export technological complexity is mediated by innovation (NIM). Companies that are purpose aligned for innovation, are better equipped to deal with technological shocks and changing market demands. It is a little less reliant on existing technologies finding ways to facilitate the development of new products and services which if done correctly gives firms the potential to distinguish themselves on the global market. Huang and Hou (2023) demonstrate that innovation capacity can act as a mediator to stimulate economic resilience, which in turn gives a further impetus to the ability of high-tech industries to cope with technological rivalry and market fluctuations. This reduces uncertainty, helping the firms remain competitive even in their extreme volatility-prone environment making it a pivotal innovation strategy of various firms.

External Collaboration as a Strategic Practice

External Cooperation as a Strategic Practice The strategic practice of cooperation with external organizations (universities, research and development institutes, other firms) is a clear attempt to lower economic and technological uncertainties, increase durability, and access the required complementary skills for innovation and adaptability in high-tech industries (Popkova et al., 2024).

Internally, one is also significant with large effects, Strategy External Collaboration, the high-tech industry University Industry Collaboration which integrates both. According to Popkova et al. (2024), partnerships for Responsible Innovation The reduced economic risks and increased sustainability of high-tech projects as a result of these partnerships with external entities built around responsible innovations. Filling the gap of market or technological uncertainty via cooperating with other organizations, such as R&D institutes, universities and other firms in high-tech sector can allow high-tech firms to tap diverse knowledge, technologies and resources under one roof. Firms can use collaboration to leverage complementary capabilities and skills so that they can adapt to rapid technological advances and changes in demand (Singh & Sharma, 2024). Industry partnerships with other technology companies, vendors, and academia must be initiated by Nokia as well to support knowledge transfer, technology risks, and innovation.

Market Intelligence for Competitive Advantage

Market intelligence for competitive advantage refers to the collection and analysis of market information in order to understand customers' needs, industry trends and risk factors, which allows the high-tech businesses to make decision, to address the changes in the environment and to keep in the lead in fluctuant markets (Yang et al., 2024).

Market intelligence is crucial for high-tech companies seeking to lower uncertainties associated with market situational variables.

Environmental policies not only shape the technological sophistication of high-tech industry exports (Yang et al., 2024), ultimately affecting market performance. Companies that use market intelligence can know the patterns of the market and the preferences of customers, as well as the risks they may find, from which they can make informed decisions. Utilizing market intelligence helps firms adapt, remain in line with the market and at the same time cushion the competition. According to Singh and Sharma (2024), market intelligence improves various decision-making processes in high-tech industries, including product development, pricing, and introduction into new markets. In a fast-improving market, firms such as Nokia get to have a competitive edge by having immediate data and insights, that would include where to change or adjust strategies from and therefore reducing uncertainty and paving the way for long-term success.

Strategic Planning and Flexibility

Farsighted strategies and organizational flexibility are cited as two forms of strategy-structure fit capturing how hi-tech firms combine forward looking strategies with flexible organizations that support their ability to cope with technological and market uncertainties. Adaptive planning increases the ability of firms to be resilient and responsibly innovative, sustaining the competitive edge of firms in a fast-changing environment (Hou & Huang, 2023).

The strategic planning and dynamic capability are robust constructs that have added value towards managing uncertainty in high-tech industries. Huang and Hou (2023) also point out that ideal high-tech firms should possess rigid but flexible strategic planning and organizational structure to adapt to variations in technological as well as market environments. A firm's strategic foresight is represented by its strategic planning process whereas its resilience denotes its ability to smoothen unseen shocks. Popkova et al. (2024) contend that responsible innovation facilitates the high-tech companies to navigate

the risks as pursuit of strategic plans and sustain the development in environments of uncertainty. In addition to this, Singh and Sharma (2024) highlight flexible planning, especially in high-tech industries with rapidly changing market conditions and technology advancements. Companies can mitigate the adverse effects of changing market conditions and technological disruptions by being flexible in their strategic planning, which would allow them to stay ahead of the competition in the industry.

2.2 Empirical Review

Technological risk, market uncertainty, and the level of project complexity have long been accepted to impact the success of new technology ventures (Sadeh & Dvir, 2020). Using structural equation modeling, the present study assessed the relationship between the innovation dimensions novelty, complexity, and technological risk and different types of measures of venture performance. The findings of the research suggest that the development of technological infrastructure and improvement in organizational knowledge plays a key role in making innovation successful. As opposed what held true in traditional assumptions, higher risk and uncertainty did not prevent business from setting down success route but more often than not came along higher innovation outcomes. Seasoned entrepreneurs may face more complicated and innovative projects, the report said but urged that the mere fact that challenges of a technological sort are expected to confer greater durability of revenues. The results stressed that big-innovation success is fueled less by operational ends than the nurturing of capabilities, making the case for strategy-delivery and de-emphasizing risk-averse behavior in the early folds of a venture.

Tsai et al. (2009) analyzed the investment choices in high-tech sectors influenced by uncertainty and proposed a product innovation model consisting of three phases. They also highlighted the role of market structures, the market power of the firms and the costs of adjustment

in the investment decisions of firms. The Emerging Economies showed their R&D ambitions and the study illustrated that the EEs should try for better research & development capacity to close the gap with advanced economies. The model provided specific insight into the investment choice of firms with high volatility like in semiconductors and information technology type markets, that such firms face investment decisions under demand uncertainty. Those insights provide significant implications for policymakers in emerging economies who seek to formulate successful industrial strategies to foster from innovation. Customized policy frameworks are needed for strategic industries in uncertain market conditions, which improves innovation performance in dynamic environments, the researchers stated.

High-tech sectors cannot be treated as a single process of innovation (Moensted, 2013) and organizational structure has been shown to be significant in this context, as high-tech innovation occurs under conditions of uncertainty. Efficient R&D is not a matter of size, but rather related to particular organizational capabilities, the study concluded. By analyzing the processes of learning and knowledge creation, they arrived at the conclusion that in very uncertain and complex environments, small firms can possess intrinsic advantages. In conclusion, these findings indicated that dynamic structures and non-by-the-book methods would be particularly effective for smaller firms operating in high-tech sectors, as they help reduce uncertainty and increase innovation efficiency. The findings provide support for the notion that because of its dynamic, high-tech context, entrepreneurial ventures can achieve success by using agility of organization and specialized competencies.

Junshu et al. (2020) used fuzzy evaluation method to build a model for technological innovation risk evaluation in the high-tech enterprises. They realized that there were eight major dimensions of risk; technology, capital, patents, talent, management, policy, industry and market risks. Based on a fuzzy logic model, this research provided an

empirical analysis of the risk out-turn process on a technology innovation project of a petrochemical company, and concluded that the model is able to quantify and measure the risks as well as risks' out-turn. The results stressed that risk assessment in innovation should utilize both objective proxies and subjective expert judgments. The model was shown to be usable and valid, enabling innovation risk-handlers gain hands-on insights into using its outputs for practical decisions. Using this method, it allows high-tech enterprises to make informed decisions during innovation processes and gain the capacity to develop better strategies against the multidimensional risks that are inherently part of high returns in technological innovation.

Zhu et al. (2021) found that economic policy uncertainty could play a moderating role in these relationships, which could strengthen the inverted U-shaped effect in market-based regulation, but negatively moderated the relationship between voluntary regulations. These results emphasized that firms innovation behavior are complexly linked to regulatory pressures and macroeconomic uncertainty. It recommends that environmental policies should take into consideration the volatility of economic policy, so that innovation in high-tech sectors, including green technologies, can be sustained. Amidst uncertain economic times, it offered insights for regulators to weigh the appropriate mix of regulatory instruments with innovation-related incentives.

Qu et al. (2023) support, that risk-taking play a trivial effect regarding the innovation of green technology on high-tech enterprise in China, and financial mismatch partly restrains this association. Notably, the results show that system risk-taking negatively impacted the east on the granting of invention patents. However, the study underlined the importance of regional and ownership heterogeneity in this relationship, and recommended enhancing investment environment and financing structure, to facilitate an enabling environment for innovation-driven growth under uncertainty.

Huang et al. (2021) found that during the COVID-19 period, one biggest challenge facing survival is reflected in the which is that source is that the risk management strategies in high-tech software in small to medium-sized enterprises are still in the weak stage, especially the system of risk management has deteriorated during the COVID-19 period. This study also rediscovers through a case borne awaiting the cloud of job reduction, salary reduction and business suspension, and reiterated that it is a critical piece by both a full risk mitigation framework and a best practice to strategies flexibility indispensable to competitiveness and sustainability.

Jin et al. (2022) on the other hand, were the first to measure the impact of the COVID-19 pandemic on state-owned listed companies in China, finding a notable detriment on firm performance in high-tech industries, measured by return on equity (ROE), return on assets (ROA), and asset turnover. However, R&D investment mitigated such adverse consequences, reinforcing its strategic importance, especially during crises. According to the study, the mechanism of R&D should be clearly prioritized in high-tech companies as resilience for long-term strategy in the face of disruptive events.

Huang et al. (2022) found that founder-entrepreneurs were key players with regard to navigating market risks induced by COVID-19 in Chinese high-tech SMEs. Analysis of longitudinal interviews suggests that these entrepreneurs were proactive in adapting to changes in the market, making intuitive and strategic decisions to seize growth opportunities while also managing uncertainties brought about by the pandemic to ensure business continuity.

Huang and Hou (2023) have found significant positive effects of economic resilience on the industrial innovation mechanism of high-tech industries in China. The results of an analysis based on a configurational approach indicated that improvement in innovation performance is a result of the simultaneous presence of technological talent, high quality

development and agglomeration dynamics together with high levels of government competition. Yet, resilience in low competitive contexts led to a decline in innovative ability.

Research indicates that economic policy uncertainty negatively affects innovation globally, across all industries, with weaker patent output, quality and originality (William & Fengrong, 2022). The decline was attributed to three mechanisms (risk tolerance, financial constraints, and information asymmetry) that had been identified in the study itself. However, strong institutional set ups such as transparency, liberalized finance and strong intellectual property rights can alleviate these adverse effects and support innovation.

Yang et al. (2024) find an "U-shaped" effect between environmental regulations and technological complexity of high-tech industry exports in China. Based on provincial-panel data in 30 provinces, the results revealed that regulatory intensity has an initial inhibiting effect, however, an enhancing effect on complexity thereafter. Indirect effects through foreign direct investment and R&D as well as regional variations were also shown.

Popkova et al. (2024) suggested that responsible innovations with projects especially oriented towards environmental, social, and governance (ESG) criteria are an effective tool for managing financial risks of high-tech companies, including of the Russian IT sector. The study, based on a SEM for the study of market data, concluded on the need to incorporate sustainability into innovation strategies of resilient organizations for have a positive impact on financial longevity in high-risk environments.

Yang et al. (2024) explored the impact of environmental regulation on the technological sophistication of exports in China's high-tech manufacturing sector. Between 2006 and 2021, they discovered increasing degrees of environmental regulation intensity and export technology complexity. What they found was a "U-shaped" relationship

in which the tightness of environmental regulations had an early negative effect on technological complexity that eventually showed progress. What you receive is regional factor affected by foreign direct investment, R&D, etc. Agents defined that bespoke policies are prerequisites to unlocking innovation and maintaining global competitiveness.

Singh and Sharma (2024), faming the performance of the high-tech industry with high-tech products (HTPs) They used fuzzy Multi-Criteria Decision-Making MCDM methods for ranking these variables while giving the main characteristics of HTPs and their relation with technology development, quality design and market trends. The study presented an analytical framework that would be useful for designers, manufacturers, and analysts for improving product competitiveness and performance of industries at global levels.

Popkova et al. It was reported in (2024) that responsible innovations are able to succeed in high-tech companies in the field of IT in Russia to mitigate financial risks. The acknowledgment showed that the presentation of responsible innovations, particularly those regularly pointed toward the Environmental, Social, and Governance (ESG), alleviated the monetary dangers and adding to maintainable advancement of high-tech firms. It pointed out that the different challenges faced by the companies based on sectors and markets, which further explain their financial risk management strategies in future.

Huang and Hou (2023) showed that technological skills and economic development are important for innovation. They also identified that economic resilience bolsters innovation in the face of high-intensity competition, but in the presence of low-intensity competition, economic resilience is detrimental for innovation. The paper may also enhance our understanding of the complex interaction of high-tech innovation and economic resilience.

Table 1. Summary of Empirical Review

Author(s)	Research Method	Key Findings	Recommendations for Future Research
Sadeh & Dvir (2020)	Structural Equation Modeling	High technological risk on the project does not necessarily result in low degrees of innovation; it is the development of competences and knowledge instead of risk aversion that indicates the success.	High levels of innovation can be achieved in the presence of high risk, it is capabilities and learning rather than risk that is important for success.
Tsai et al. (2009)	Product Innovation Model Analysis	Market structure and uncertainty determine investment in high-technology industries; demand uncertainty affects decisions on innovation.	Investment in high-tech sectors is determined by market structure and uncertainty: demand volatility has an impact on innovative decisions.
Moensted (2013)	Qualitative Organizational Analysis	Specialized competences and dynamic structures may allow small firms to excel under uncertainty.	Small firms can excel under uncertainty because of their dynamic structures and specific competences.
Junshu et al. (2020)	Fuzzy Evaluation Model	Distilled the 8 risk dimensions involved in high-tech innovation; backed model for more evidenced based decision	Designed eight risk categories on high tech innovation, model contributes to the rational judgment

		making and risk quantification.	and assessment of risks.
Zhu et al. (2021)	Quantitative Regulatory Impact Analysis	Economic policy uncertainty attenuates the impact of regulation on firms' innovation behavior.	The influence of regulations on innovation behavior among firms is moderated by economic policy uncertainty.
Qu et al. (2023)	Empirical Study in Chinese High-Tech Sector	Misporting and regional differences are the same; that other impact the quality of green innovation.	Capital misallocation and regional disparity influence willingness to take risk; Green innovation.
Huang et al. (2021)	Case Study during COVID-19	It was concluded that poor risk management within the SME sector resulted in business interruption and that there was a requirement for risk mitigation structures.	Poor risk management on the part of SMEs resulted in business interruption; call for enterprise risk management frameworks.
Jin et al. (2022)	Quantitative Panel Study	COVID-19 had an adverse impact on company performance; R&D investment reduced the adverse impact.	COVID-19 had a negative impact on firm performance; R&D investment offset such negative effects.
Huang et al. (2022)	Longitudinal Interview-Based Study	Founder-entrepreneurs reacted face adversity in the	Founder-entrepreneurs took market risks in response to the

		market during Covid-19 and provided business continuity.	pandemic (not the other way around) and they steadfastly supported organizations to persist.
Huang & Hou (2023)	Configurational Approach	Innovation flourishes with economic strength, talent and competition, weak environments drag down results.	When it comes to innovation, performance flourishes when it has the underpinning of economic resilience, talent and competition igniting the fuse; while weak settings impede performance.
William & Fengrong (2022)	Global Data Analysis	Economic policy uncertainty dampens innovation output; strong institutions act to attenuate this impact.	Economic policy uncertainty attenuates the output of innovation, strong institutions can alleviate the effects.
Yang et al. (2024)	Provincial Panel Data Analysis	U-curve relationship between environmental rules and tech complexity; moderated by FDI and R&D.	U-curve of environmental regulations influence on tech complexity; moderated by FDI and R&D.
Popkova et al. (2024)	SEM of Market Data in Russian IT Sector	Responsible ESG-driven innovations mitigate financial risks and sustain	Responsible innovations driven by ESG prevent financial risks and

		ace in extreme risk areas.	make high-risk environments sustainable.
Singh and Sharma (2024)	Fuzzy MCDM Approach	Analyzing high-tech products on the basis of design, technology, and market fit and offering a competitive rating tool.	The impact of capability-building in start-ups under different complexity conditions was investigated.

2.3 Conceptual Framework

The Figure 1 describes the theoretical model, which involves five exogenous variables (Innovation Capability, Use of External Collaboration, Flexibility of Operations, Market Intelligence, and Strategic Planning) and one endogenous variable, Uncertainty Reduction. This model is an example how the strategic conduct in high-tech sectors may help to alleviate uncertainties from dynamic markets and technological environment.

Every one of the independent variables plays a different role to enable firms to manage risk and to reduce resistance to the change. The framework emphasizes that building from internal strength and partnership with external resources help increase the firm's capacity to responding proactively to different sources of uncertainty that result in resilience and sustained competitive advantage.

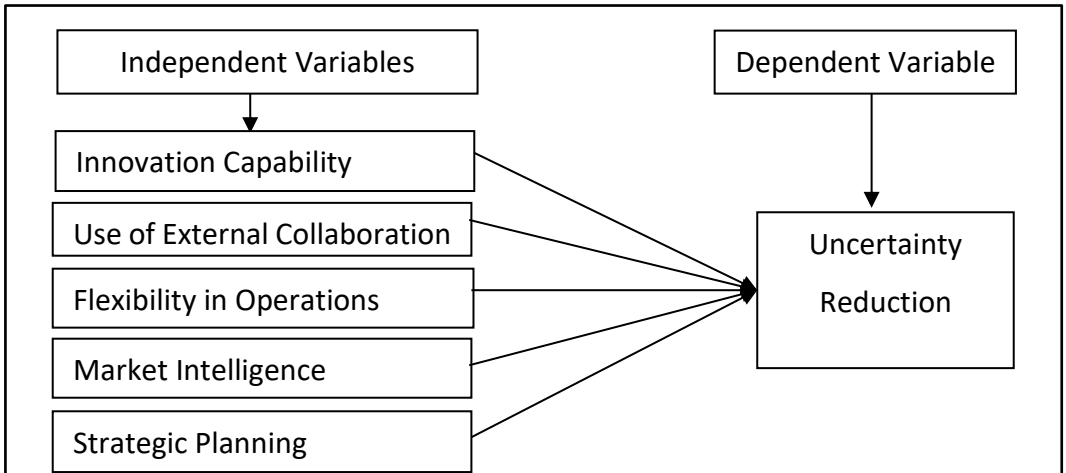

Figure 1. Conceptual Framework

2.4 Research Gap

Although high-tech industries have received considerable attention in technology and market uncertainties, little is known about the exact role strategic practices play, such as innovation capability, external collaboration, flexibility, market intelligence and strategic planning, in ultimate uncertainty reduction for peoples' firms with some specific examples (e.g., Nokia) in Finnish environment. Existing research has examined multiple aspects of uncertainty management focusing, for example, on impact of open innovation (Chesbrough, 2003) and dynamic capabilities (Teece, 2007), but there are few empirical studies on how high-tech firms in Finland practically utilize such strategies. Furthermore, empirical research on the relationship between strategic management practices and the technological and market uncertainty alleviation is also lacking in the high-tech sector even if some theoretical models of radical innovation uncertainty have been already established (Moensted, 2013; O'Connor & Rice, 2013).

Lastly, although a great deal of studies (Sadeh & Dvir, 2020; Junshu et al., 2020) intrigue high-tech firms as areas of high risk-taking and innovation, we lack research of the specific managerial practices that firm like Nokia employ to cope with level of uncertainty in technological and market arenas. Such gap can be especially seen in the limited research using quantitative data from high-tech firm in Finland, which offer specific market contexts and regulatory burdens. Therefore, the current study seeks to address this gap by examining its focus on Nokia Corporation as a case study to analyze how strategic practices – such

as innovation capability and external collaboration – mitigate uncertainty in high-tech industries (Bughin et al., 2019). This research helps fill in this gap by providing insights on how strategic management practices can improve the stability and viability of companies in dynamic high-tech environments.

3 RESEARCH METHODOLOGY

Research methodology is the step by step approach for achieving the research objectives and solving research problems. This study implements a descriptive research design and a quantitative method to observe how high-technology firms, particularly Nokia Corporation in Finland, practice planned actions to decrease technological and market uncertainty.

Responses were obtained via structured online surveys that were sent to current Nokia Corporation's employees via different social media platforms constructed through Google Forms. The questionnaire was constructed in 5-point Likert scales indicating 1 as strongly disagree, 2 as disagree, 3 as neutral, 4 as agree and 5 as strongly agree. The close-ended questions were developed to capture the constructs of strategic practices and perceived uncertainty reduction. The data analysis was performed with the help of SPSS software.

3.1 Research Design

The study incorporates descriptive research design. A descriptive design is suitable when the objective is to provide a systematic description of characteristics, patterns or relationships without the manipulations or interventions of the variables (Bughin et al., 2019). It allows for an in-depth exploration of how strategic practices (e.g., innovation capability, external collaboration, market intelligence, strategic planning) are related to uncertainty reduction. Because the study is situated in the real-world organizational context of Nokia Corporation, this design enables to collect rich, structured data from a particular population.

3.2 Data Collection Methods

Data for this research were gathered through primary data sources. A structured questionnaire designed using Google forms was employed for the collection of the main data which was administered online through

the various social media (such as LinkedIn, WhatsApp and e-mail). The questionnaire were based on a 5-point Likert scale questionnaire, whereby respondents could express their level of agreement with statements about strategic practices and managing uncertainty. Closed ended questions were used, to have a uniform data and for ease to do quantitative analysis. The survey was sent to a total of 82 employees, including innovation managers and strategists, in the Finnish high-tech industry. Out of these, 55 responses were received, making the sample size for the study 55.

3.2.1 Primary Data (Surveys)

An online survey was employed to gather primary data for this study to measure perceptions and experiences of implementation of strategies for reducing uncertainty in the high-tech sector. The questionnaire was conducted using Google Forms and was made available in online-software format to reach respondents through online means, with a focus on anyone who worked in or with Nokia Corporation. Participants were included because they worked as R&D, innovation management, strategic planning person. The questionnaire were based on 5-point Likert scale, closed-ended items for assessing the constructs such as innovation capability, market intelligence, flexibility and external collaboration (Strongly disagree =1, Strongly Agree = 5). This approach, permitted to converge responses and perform statistical analysis by SPSS. Anonymity and voluntary nature of participation made information more dependable and eliminated response bias.

3.2.2 Secondary Data (Articles and Journals)

Secondary data was obtained from academic articles, books, industry white papers and an empirical work on uncertainty reduction, strategic management, and high-tech innovation. These sources supplied theoretical bases and contributed to the generation of research variables and hypotheses. Lots of literature from databases including ScienceDirect, JSTOR, Springer, Google Scholar etc were scanned in the

light of the most recent trends in the subject of technological and market risks management in high- tech firms. Furthermore, papers presenting the innovation history and strategic shifts of Nokia within Finland provided useful information. These secondary sources helped confirm the initial findings and perform a comparison between the already known information and the new evidence.

3.3 Data Analysis Techniques

Data was analyzed with the help of SPSS software. The descriptive analysis was performed incorporating, descriptive statistical tools such as weighted mean, and standard and correlation analysis. Correlation analysis was performed to explore the relationship among the independent variables (innovation capability, market intelligence, strategic planning, external collaboration and flexibility) and the dependent variable (uncertainty reduction). This quantitative method allowed the researcher to determine if and to what degree strategic practices correlate with the reduction of uncertainty.

3.3.1 Quantitative Analysis

Because this is a quantitative research, analysis is basically limited to descriptive analysis and correlation analysis. Descriptive statistical tools like mean, standard deviation, percent and correlation were used to describe and explain the structured survey data. These descriptive statistics were used to observe perception of employees towards the strategic practices and the reduction of uncertainty.

Furthermore, the magnitude and direction of the association between independent variables, innovation capability, market intelligence, external collaboration, flexibility, strategic planning and the dependent variable, uncertainty reduction were investigated using the correlation analysis. The purpose of the examination was to test if strategic practices significantly correlate with the degree to which they are

effective in addressing technology and market risks and to provide empirical evidence supporting the research questions.

3.4 Ethical Considerations

This study is in full compliance with ethical guidelines for academic studies with human subjects. The purpose of the research was explained to all participants, and electronic informed consent was required before entering the survey. All participants were guaranteed confidentiality and anonymity and no personal information was collected. The participation was purely voluntary, and they were free to withdraw at any stage without any prejudice. Information collected was safely kept and was exclusively for academic use with regard to the study. It was properly referenced with obligatory secondary sources to avoid plagiarism and the violation of academic integrity (Huang et al., 2022).

4 FINDINGS AND DISCUSSION

The results and discussion section reports the results obtained from the data collected and analysed throughout the study. First involves an overview of the respondents that describes the demographic background. Next, reliability analysis is performed to verify the internal consistency of the measurement scales.

Essential data features can be summarized using descriptive statistics, which describe key aspects of variables. The correction analysis used for the relationship examination between dependent and independent variables. To examine if there is issue of Multicollinearity among independent variables, the Multicollinearity was also diagnosed. Such integration of these individual analyses provides a holistic view of the dataset to facilitate interpretability and thereby contribute to the purpose of the research to reduce uncertainty, which is prevalent in the high-tech domain.

4.1 Respondents' Profile Analysis

A detailed analysis of the respondent profile shows us that out of the 55 people, a variety of gender, age, education, department, experience and job position exists. Respondents were largely male, well-educated and senior representatives, assuring asymmetrical insights through all organizational verticals within all departments of the high-tech space.

Table 1 overview of background of 55 participants who participate in the study, the first chart shows the gender of the respondents. The majority of participants were men 40 (72.7%) and 15 (27.3%) were female; next, the age of participants in three categories. The largest group were aged 46 and over with around 24 people (43.6%). Followed by the next largest group 31 to 45 years age group 18 (32.7%). The others were younger, aged 18 to 30 were 13 (23.6 percent). The majority of respondents were well-educated, with nearly half (49.1%)

holding a master's degree. 27.3% held a doctorate degree, and 23.6% held a bachelor's degree.

Table 1. Respondent's Profile Analysis

Variables	Category	Frequency	Percent
Gender	Male	40	72.7
	Female	15	27.3
Age	18-30 years	13	23.6
	31-45 years	18	32.7
	46 years and above	24	43.6
Educational Qualification	Bachelor's Degree	13	23.6
	Master's Degree	27	49.1
	Doctoral Degree	15	27.3
Department	Research & Development (R&D)	7	12.7
	Operations	8	14.5
	Marketing	11	20
	Information Technology (IT)	11	20
	Strategy & Planning	8	14.5
	Other	10	18.2
Working Experience	Less than 1 year	4	7.3
	1-3 years	11	20
	4-6 years	15	27.3
	7-10 years	16	29.1
	More than 10 years	9	16.4
Job Position	Entry Level	6	10.9
	Mid-Level Management	18	32.7
	Senior Management	26	47.3
	Director/Executive	5	9.1
Total		55	100

The largest number of respondents were in the Marketing and IT departments (11 each; 20%). Operations and Strategy & Planning (14.5% each), R&D (12.7%), other belonging department with 18.2% of total employees. Most of the people had worked for 4 to 10 years, with 15 people in the 4-6 year group and 16 in the 7-10 year group. This means most of them had enough work experience. The job level also varied. The biggest group was in senior management (47.3%), followed by mid-level managers (32.7%). A few were directors or entry-

level staff. This shows the study included people from different job levels, giving a good mix of views from across the organization.

4.2 Reliability Analysis

Table 2 details the reliability test results based on the method of Cronbach's Alpha, which is a popular approach for measuring the internal consistency of scale items. Cronbach's Alpha is a popular measure of reliability which ranges from 0 to 1, and a general rule of thumb is that values of >0.7 provide evidence of an acceptable reliability value, indicating that the items are measuring the same construct reliably (Tavakol & Dennick, 2011).

Table 2. Reliability Test

Variables	Chronbach's Alpha
Innovation Capability (IC)	.831
External Collaboration (EC)	.751
Flexibility (FLEX)	.859
Market Intelligence (MI)	.860
Strategic Planning (SP)	.775
Uncertainty Reduction (UR)	.888

Uncertainty Reduction has got highest score around 0.888. Basically, it means the questions used to assess how firms cope with uncertainty were highly consistent and yielded robust results. Likewise, our scores for Market Intelligence and Flexibility are also strong, 0.860 and 0.859, respectively, indicating that the survey questions related to the ideas of understanding the market were equally robust and reliable.

This indicates that the information obtained from the survey is reliable and can support conclusions related to how these factors play a role in decreasing uncertainty in high-tech firms.

The minimum acceptable level for this question is 0.70 with external collaboration scoring the lowest at 0.751, this still represents an acceptable score. That means questions on things like how companies

work with external partners whether universities or other businesses continue to be valid. So, all six variables employed in the study are reliable.

This matters because if the survey questions were not reliable then you could not trust the results of the study. The high value (all > 0.70) of this study gives a strong base to how individual strategies are able to reduce uncertainty in high-tech industries.

4.3 Validity Test

The KMO measure is a classical statistical test to measure sample adequacy for conducting factor analysis. That reflects the percentage of variance amongst the variable that may be common variance, where 1 means that the data is highly appropriate for factor analysis. As a rule of thumb, the KMO value should be higher than 0.50, and lower values indicate that the data need to be refined further (Hair et al. This step ensures that the structure of your data is ready for factor analysis of the underlying constructs.

Table 3. KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.539
Bartlett's Test of Sphericity	Approx. Chi-Square	1346.329
	df	435
	Sig.	.000

Results of the KMO and Bartlett’s Test are given in Table 3. The Kaiser-Meyer-Olkin (KMO) value of 0.539 suggests that the sampling adequacy for the dataset is mediocre indicating that the dataset may yields a marginal case to try to check for factor analysis. Bartlett's Test of Sphericity is significant (Chi-Square = 1346.329, df = 435, p <000), which confirm adequate intercorrelations between variables to warrant the use of factor analysis. These results offered evidence which was

sufficient for the application of factor analysis to be used, albeit, the sampling adequacy was moderate.

4.4 Descriptive Analysis

Descriptive statistics extracting the mean and standard deviation (SD) of the answers each topic have received (mean and SD), from the descriptive analysis. The questions covered six main topics and 55 people responded. Innovation capability, external collaboration, flexibility, market intelligence, strategic planning, and uncertainty reduction mean measures how much respondents agreed with the items and standard deviation indicates how close or spread their answers were from one another.

Table 4. Descriptive Analysis

Variables	N	Mean	SD
Innovation Capability (IC)	55	4.23	0.68
External Collaboration (EC)	55	3.87	0.69
Flexibility (FLEX)	55	3.93	0.76
Market Intelligence (MI)	55	3.80	0.76
Strategic Planning (SP)	55	3.96	0.60
Uncertainty Reduction (UR)	55	3.98	0.61

Innovation capability was represented by the mean level (high = 4.23, low = 0.68) of the variable scoring, the maximum score being 4.23) and, out of all the variables scored the highest and lowest. The outcome shows consensus that respondents were indeed able to come up with and implement real and creative ideas for their firms, and responses were fairly consistent. The variable represents the average for the enterprise organizational culture where a high mean indicates that in the enterprise exists a stronger organizational culture in innovation significantly, and this is vital in high-tech and dynamism environments.

Uncertainty reduction (mean = 3.98, SD = 0.61) and strategic planning (mean = 3.96, SD = 0.60) also scored highly; this suggests that organizations see risk mitigation and planning to face future challenges

as high priorities. However, these factors are essential for high uncertainty situations, implying that businesses are doing some bottom work to ensure that operations are set in place and that goals are aligned.

By comparison, Flexibility (mean = 3.93, SD = 0.76); External Collaboration (mean = 3.87, SD = 0.69), and Market Intelligence (mean = 3.80, SD = 0.76), each received average scores nearer the mean as only a couple of points away higher than moderately high, and all other variables were rated moderately high to high.

This finding suggests that though organizations are comparatively reactive to changes in the market space, response to market driven trends and external partnerships still require substantial improvement. The other areas are linked by having standard deviations that are a bit higher than average, meaning that, at some level, people who are answering these questions are experiencing a wider range of responses perhaps by departments/roles.

In short, innovation, preparation, and handling uncertainty is viewed positively overall, but there is more to be done around collaboration and market knowledge. But shaking those relatively weak practices might give organizations an even greater resilience to adverse market conditions while reducing their exposure.

4.5 Multicollinearity Diagnosis

The below Table 5 imply a multicollinearity test. This test is used to confirm whether the variables in a study are too closely related to one another. If some variables are in the same component, the study do not know which one is influencing the results. The table lists 2 numbers each for the variable: Tolerance and VIF (Variance Inflation Factor). These assist in finding out if there is any issue.

Table 5. Multicollinearity Test

Variables	Tolerance	VIF
Innovation Capability (IC)	0.609	1.643
External Collaboration (EC)	0.529	1.890
Flexibility (FLEX)	0.688	1.453
Market Intelligence (MI)	0.711	1.407
Strategic Planning (SP)	0.718	1.393

All Tolerance values > 0.1 and all VIF value <10. If this is good, then there will not be any multicollinearity problem. That is, Tolerance for innovation capability = 0.609, and its VIFT = 1.643. That is an indication that this variable is not very correlated with the others. External collaboration, flexibility, market Intelligence and strategic planning are other variables that exhibit the same truth. Notice that all the VIF go from 1.393 up to 1.890 which are the safe limits.

This is an indication that each variable is providing different information in the study due to all of the values being within a suitable range. This is crucial to ensure that the researcher is observing only the true effect of the treatment (i.e. the true effect of the exposure) on the outcome. This also adds trust to the results of the study. A model analysis will gain stability and improve accuracy when the variables are not too similar. Hence, this test proves that this data is good data to perform further analysis with no such major issues related to similarity between the variables.

4.6 Correlation Analysis

The Table 6 shows correlation tests between the independent and dependent variables. Correlation test is to see how two things are related to each other. In this research, the test examines the connections among various IC, EC, FLEX, MI, and SP in terms of UR. If the number is positive and very high, it means that strong connection between these two things. A low number means they are not very connected. The * indicates that the result is relevant or statistically

"significant" at p<0.05 level and * indicates that it is more relevant at p<0.01 level.

Table 6. Correlation Analysis

Variables	IC	EC	FLEX	MI	SP	UR
IC	1					
EC	.584**	1				
	0.000					
FLEX	.422**	.413**	1			
	0.001	0.002				
MI	0.255	.451**	.361**	1		
	0.060	0.001	0.007			
SP	0.191	.387**	.406**	.420**	1	
	0.163	0.004	0.002	0.001		
UR	.280*	0.237	0.117	.409**	0.262	1
	0.038	0.081	0.393	0.002	0.054	

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

The results show relationship between independent and dependent variables. At 0.01 level (2-tailed), the correlation value (r) is 0.409**, indicating that the strongest relationship is observed between market intelligence (MI) and uncertainty reduction (UR) but this also indicates that companies which with strong market intelligence capabilities tend to experience lower levels of uncertainty.

Market intelligence, or the systematic collection, analysis and use of information about market trends, consumer behaviour and competitor strategies, helps firms make better decisions and facilitates improved forecasting and reduced uncertainty regarding market shifts. With such consideration, market-oriented capabilities are critical for firms wishing to succeed in the complex adaptive landscape of many markets today, particularly the high-tech market where change occurs rapidly.

The second strongest relationship was between innovation capability (IC) and Uncertainty Reduction; the value was 0.280*, which is significant at the 0.05 level. Innovation capability describes a firm's capacity to achieve a continuous stream of new ideas, and new products and processes that have the potential for differentiation from competitors. This ability to innovate is essential to mitigate uncertainty since the force of innovation allows firms to adapt to the changing environment and technological progress, working as an advantage in the face of uncertain environments. As these industries are characterized by rapidly changing technologies and markets, innovation represents a strategic instrument determining risk and uncertainty reduction.

The relationship between uncertainty reduction and strategic planning (SP) is also positive but weaker (r = 0.262). It's not the strongest relationship but this is one the study thought was worth sharing, as it may suggest that organisations that do strategic planning may be better placed to deal with uncertainty. Strategic planning can better align an organization or company to their long-term goals it allows one to align resource, capabilities and actions by providing a framework to consider obstacles and opportunities.

Conversely, external collaboration (EC) and flexibility (FLEX) show relatively weaker association with uncertainty reduction, with correlation coefficients of 0.237 and 0.117, respectively. It blooms the hypothesis that external organization flexibility and external collaboration alone may reduce uncertainty but not as much as market intelligence, innovation capability, or strategic-related knowledge.

External collaboration partnerships or alliances with other organizations offer companies access to valuable information and resources. Nonetheless, the specifics about how these partnerships may alleviate uncertainty may vary on the quality of partnerships. Innovation explains a larger proportion of uncertainty reduction followed by

strategic adaptability, while flexibility, that is the ability to respond quickly to the needs of the moment, goes hand in hand with uncertainty reduction but it is less strong.

In summary, these findings suggest that high-tech firms pursuing uncertainty alleviation should be focused on cultivating robust market intelligence systems, developing innovation competencies, and involving in strategy making methodology. This process helps a company gear up its business actions considering the challenges and nuances of changing business scenarios and lead to informed decision making and strengthened business continuity. High-tech sector leaders would do well to attend to these matters as strengthening competitive advantage and lowering market volatility risk.

4.7 Discussion

The findings of this study corroborate a number of key findings from the prior literature on uncertainty reduction in high-tech industries, specifically about the roles of market intelligence and innovation capability.

An example is that the association between market intelligence (MI) and uncertainty reduction (UR) (0.409) is quite high, and confirms the study of Tsai et al. (2009) called attention on the importance of market structure and uncertainty in investment decisions. Both studies highlight the point that if firms have strong sense of market trends and competitor movements, they are able to predict trends, reduce risks and make better decisions, particularly in the high-tech industry, which are constantly changing. This supports the idea that good decision-making in uncertain environments largely depends on the correctly obtained market intelligence (Sadeh & Dvir, 2020).

In line with earlier research, the study found that innovation capability (IC) was positively influenced on the relationship of uncertainty reduction with 0.280*, which again, confirmed the argument of

Moensted (2013) that small firms have a high capability of innovation under dynamic structures with specialized competencies that outplays the competition under uncertainty. With constant innovation, firms mitigate technological risk and sensitive to market demand changes and thereby, gain competitive advantage. This is consistent with literature cantered around the firm value of innovation as a market stabilization option to help reduce variability of high-tech market returns (Junshu et al., 2020).

On the contrary, the statistical results of our study suggest that strategic planning (SP) is attached to a relatively weak linear relationship with uncertainty reduction (0.262), which is contrary the more major role of planning implied by Huang et al. (2022a), and Sadiqa et al. (2021), identified it as one of the major importance that helps SMEs (small and medium enterprises) in high-tech industries to manage risks. Volumes of research suggest that strategic planning can improve firm performance slightly (Bromiley, 2005), however, there are reasons to suspect that this small divergence, at least in part is attributable differences in organizational context in larger, functional-structure firms which may likely gain more from strategic planning than smaller or more nimble firms.

In particular, the study indicates a weak relationship between external collaboration (EC) and flexibility (FLEX) and uncertainty reduction, which is weaker than other determinants. Our finding is not completely consistent with those of Qu et al. 2023), Regional variation and financial structures affect risk-taking and green innovation: implications for the externality of collaborations, implying that external collaborations in certain geographical areas in certain institutional settings are always more pronounced (2023).

Also, flexibility, as one of the most important themes, was not the key factor in this study, which is inconsistent with Huang and Hou (2023), who found economic resilience and talent are necessary to encourage

innovations in high-tech innovation. Our findings indicate that, although beneficial, flexibility and collaboration are subordinate to capabilities such as market intelligence and innovation, which to a greater extent and in the context of high-tech industries, still mitigate uncertainty.

5 CONCLUSION AND RECOMMENDATIONS

This study focuses on minimizing the uncertainty involved in technological and market risks associated with high-tech industry more specifically on the high-tech industries of Finland. The study investigates strategic practices including innovation capability, strategic planning, market intelligence, external collaboration, and flexibility mitigating uncertainty. The study find that innovation, strategic planning and market intelligence are key determinants of organizational resilience. It also proposed recommendations to industry stakeholders for bolstering such practices, while laying out avenues for future academic- and industry-based research on enhancing long-run competitiveness.

5.1 Summary of Findings

The study offers the following findings based on the major data analysis such as descriptive and correction of the study.

- Innovation capability (IC) had the highest mean score (4.23), which denotes firm prevails strong belief regarding innovation capability, which enables them adapting to the fast-changing technology and market parameters.
- Uncertainty reduction (UR) (mean = 3.98), which indicates firms being highly directed to reduce uncertainty and stabilize during uncertain environments.
- Strategic planning (SP) (mean = 3.96) was also an important factor, indicating that firms leverage strategic planning to be proactive and prepare for shocks.
- Flexibility (FLEX) (mean = 3.93) received an average rating suggesting that the firms are reasonably flexible, but there is a scope of improvement in the organizational flexibility.

- External collaboration (EC) (mean = 3.87) indicates that some firms do engage in EC; however, this practice could be enhanced to improve uncertainty reduction capabilities.
- Market intelligence (MI) (mean = 3.80) was rated moderately, showing that firms have an awareness that market trends but in the same breath need to improve upon their ability to obtain information about the market, interpret that information, and respond to it.
- Market Intelligence showed the strongest relationship with Uncertainty Reduction, followed by Innovation Capability. This indicates that firms with stronger market awareness are better positioned to reduce uncertainty.
- Planning (Strategic Planning) explained a significant but less strong positive effect on reduction of uncertainty: planning is important but not as effective as innovation or market intelligence.
- External collaboration and flexibility were less strongly associated with uncertainty reduction, implying that, while enabling, they are not as central as those practices facilitating innovation and planning.

The study examined the means of alleviating the uncertainty associated with technological and market risk in high-tech industries, and has a specific interest in Finnish firms like Nokia Corporation. Among these variables, the one that had the most powerful effect on uncertainty reduction was innovation capability because it helps firms to better align to the changes in industry environment. Finally, reducing uncertainty requires critical aspects such as strategic planning and market intelligence, in which firms highlighted that proactive strategies to anticipate risks and potential disruptions are indispensable. The findings are in line with the general consensus that, disciple stability requires a high degree of forward- looking capability to navigate and operate in precarious high- uncertainty environments.

Despite this, in both cases, the study indicated certain areas where there is room for progress, especially with regard to flexibility and cooperation with external parties. Even though these practices helped reduce uncertainty, they influenced much less than innovation and strategic planning. The results imply that by developing more of these resources both further nurturing and developing further each of the resources available particularly through external collaboration firms could enhance their adaptability and resilience. Finally, the paper highlights the importance of innovation, strategic planning, and market intelligence, all of which are tools to reduce uncertainty within high technology corporations. And reinforcing these practises as well as collaboration and flexibility can help organizations manage the high-tech industry complexities now and in the future.

5.2 Practical Recommendations for Industry Stakeholders

The results suggest that practitioners in the industry need to invest more resources to improve innovation capability, strategic planning and market intelligence, which in turn minimizes the uncertainty for high-tech firms. Companies need to build an innovative culture, to resources to leverage, develop and invest in research and development to remain competitive. Instead, strategic planning should be robust, predicting where disruptions may come from, and bringing the organization in line with long-term goals. Finally, particular high-tech companies should go for spending money on outside organizations to leverage the useful interactions and expertise available to them as doing this enhances the risk management process.

Building minute flexibility will likewise serve firms react more successfully to surprise changes in their relevant enhanced or sentimental landscape. Policymakers and other stakeholders can promote these practices by facilitating the environment for innovation and collaboration, e.g. providing R&D incentives or by promoting partnerships.

5.3 Research Limitations

The study is geographically and organizationally bounded by Finnish high-technology firms (e.g., Nokia Corporation). This kind of limited focus could hinder the ability to generalize to larger, more diverse technology markets. On the other hand, due to methodological limitations, this study employs quantitative methods which are not suitable to convey the complex nature of strategic decision-making processes, nor the rich perspectives of cultural norms on how innovation and collaboration may take place. Furthermore, data restrictions also did not allow an investigation of the longitudinal effects of strategic practices over time.

5.4 Future Research Possibilities

To achieve more comparative knowledge, future research could address geographical variations of uncertainty reduction strategies in high-tech firms. Explanatory qualitative approaches may have given us more insight into organizational behaviour and the contextual dynamics at play. Future studies can explore the positive beacon of light by focusing how emerging technologies and digital transformation can affect strategic adaptability. Such case studies could also focus on SMEs to provide different angles on flexibility and external search as strategies to cope with uncertainty in the international high-tech sector.

6 REFERENCES

Bughin, J., Catlin, T., Hirt, M., & Willmott, P. (2019). Learning to manage uncertainty with AI. *MIT Sloan Management Review*. Retrieved from https://sloanreview.mit.edu/projects/learning-to-manage-uncertainty-with-ai/

Chesbrough, H. W. (2003). *Open innovation: The new imperative for creating and profiting from technology*. Harvard Business School Press. https://store.hbr.org/product/open-innovation-the-new-imperative-for-creating-and-profiting-from-technology/8377

Ghadge, A., Kidd, E., Bhattacharjee, A., & Tiwari, M. K. (2019). Sustainable procurement performance of large enterprises across supply chain tiers and geographic regions. *International Journal of Production Research*, *57*(3), 764-778. https://doi.org/10.1080/00207543.2018.1482431

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis (7th ed.)*. Pearson.

Huang, Y., Baruah, B., & Ward, A. (2022). How founder-entrepreneurs from Chinese high-tech SMEs assess market risks and explore new opportunities for growth and survival during COVID-19. *Small Business International Review,* *6*(2), e504. https://doi.org/10.26784/sbir.v6i2.504

Huang, Y., Baruah, B., & Ward, T. (2021, September). How do high-tech software SMEs in China manage risks and survive in today's complex environment. In *16th European Conference on Innovation and Entrepreneurship, ECIE 2021* (pp. 1144 1152). Academic Conferences International Limited.

Huang, Z., & Hou, B. (2023). How does economic resilience enhance the innovation capability of the high-tech industry? Evidence from China. *Systems, 11*(11), 531. https://doi.org/10.3390/systems11110531

Jin, G., Xu, J., Liu, F., Haris, M., & Weqar, F. (2022). Does R&D investment moderate the relationship between the COVID-19 pandemic and firm performance in China's high-tech industries? Based on DuPont components. *Technology Analysis & Strategic Management, 34*(12), 1464 1478. https://doi.org/10.1080/09537325.2022.2041427

Junshu, D., Shaofeng, P., & Jisheng, P. (2020). Research on technology innovation risk evaluation of high-tech enterprises based on fuzzy evaluation. *Journal of Intelligent & Fuzzy Systems, 38*(6), 6805 6814. https://doi.org/10.3233/JIFS-179758

McAfee, A., Brynjolfsson, E., Davenport, T. H., Patil, D. J., & Barton, D. (2012). Big data: The management revolution. *Harvard Business Review, 90*(10), 60 68. https://hbr.org/2012/10/big-data-the-management-revolution

Moensted, M. (2013). High-tech, uncertainty and innovation: The opportunity for high-tech entrepreneurship. In *High-Tech Entrepreneurship* (pp. 15 32). Routledge.

O'Connor, G. C., & Rice, M. P. (2013). A comprehensive model of uncertainty associated with radical innovation. *Journal of Product Innovation Management, 30*, 2 18. https://doi.org/10.1111/jpim.12060

Phaal, R., Farrukh, C. J. P., & Probert, D. R. (2004). Technology roadmapping A planning framework for evolution and revolution. *Technological Forecasting and Social Change, 71*(1 2), 5 26. https://doi.org/10.1016/S0040-1625(03)00072-6

Popkova, E. G., Xakimova, M. F., Troyanskaya, M. A., Petrenko, E. S., & Fokina, O. V. (2024). Responsible innovations as tools for the management of financial risks to projects of high-tech companies for their sustainable development. *Risks, 12*(2), 21. https://doi.org/10.3390/risks12020021

Qu, S., Wang, J., Li, Y., & Wang, K. (2023). How does risk-taking affect the green technology innovation of high-tech enterprises in China: The moderating role of financial mismatch. *Environmental Science and Pollution Research, 30*(9), 23747 23763. https://doi.org/10.1007/s11356-022-24393-7

Sadeh, A., & Dvir, D. (2020). The effect of technological risk, market uncertainty and the level of complexity on new technology ventures' success. *International Journal of Innovation Management, 24*(05), 2050047. https://doi.org/10.1142/S1363919620500474

Singh, V., & Sharma, S. K. (2024). Key Variables of High-Tech Products Influencing High-Tech Industries: A Hybrid Multi-Criteria Decision-Making Analysis. *IEEE Engineering Management Review, 11*(6), 1-36.

Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education*, 2, 53 55. https://doi.org/10.5116/ijme.4dfb.8dfd

Teece, D. J. (2007). Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal, 28*(13), 1319 1350. https://doi.org/10.1002/smj.640

Tsai, Y., Lin, J. Y., & Kurekova, L. (2009). Innovative R&D and optimal investment under uncertainty in high-tech industries: An implication for emerging economies. *Research Policy, 38*(8), 1388 1395.

William, M., & Fengrong, W. (2022). Economic policy uncertainty and industry innovation: Cross country evidence. *The Quarterly Review of Economics and Finance, 84*, 208 228. https://doi.org/10.1016/j.qref.2021.02.014

Yang, W., Zheng, X., & Yang, Y. (2024). Impact of environmental regulation on export technological complexity of high-tech industries in

Chinese manufacturing. *Economies, 12*(2), 50. https://doi.org/10.3390/economies12020050

Zhu, Y., Sun, Z., Zhang, S., & Wang, X. (2021). Economic policy uncertainty, environmental regulation, and green innovation: An empirical study based on Chinese high-tech enterprises. *International Journal of Environmental Research and Public Health, 18*(18), 9503. https://doi.org/10.3390/ijerph18189503

APPENDICES

Appendix 1: Survey Questionnaire

The questionnaire will be used to conduct my academic research study entitled: "How High-Tech Industries Can Reduce Uncertainty on Technological and Market Risk." My name is MD Hasib Ahmed, a Master student at Vaasan Ammattikorkeakoulu – University of Applied Sciences. Your participation is completely voluntary, and we will keep your responses confidential. The collected data will be stored securely and the data will not be used out of an academic context. We ask you to take a few minutes and honestly and accurately fill out this questionnaire. Thank you for your participation in this research.

Group A: Respondent's Profile

(Please tick the most appropriate option)

Question	Options
What is your gender?	□ Male □ Female □ Prefer not to say
What is your age group?	□ 18–30 years □ 31–45 years □ 46 years and above
What is your highest educational qualification?	□ Bachelor's Degree □ Master's Degree □ Doctoral Degree
What department you are working currently at?	□ Research & Development (R&D) □ Operations □ Marketing □ IT □ Strategy & Planning □ Other (Specify): _____
How long have you worked at Nokia?	□ Less than 1 year □ 1–3 years □ 4–6 years □ 7–10 years □ More than 10 years
What is your job position?	□ Entry Level □ Mid-Level Management □ Senior Management □ Director/Executive

Group B: Likert Scale Questions

The items are measured in 5- Point Likert scales 1 as strongly disagree, 2 as disagree, 3 as neutral, 4 as agree and 5 as strongly agree.

Variable	Item Statement	1	2	3	4	5
Innovation Capability	The firm encourages creativity and experimentation.	☐	☐	☐	☐	☐
	Investment in innovation is prioritized.	☐	☐	☐	☐	☐
	New technologies are rapidly adopted.	☐	☐	☐	☐	☐
	Innovation is aligned with long-term goals.	☐	☐	☐	☐	☐
	Innovation supports competitive advantage.	☐	☐	☐	☐	☐
External Collaboration	The company partners with startups and tech firms.	☐	☐	☐	☐	☐
	Joint ventures are used to explore new markets.	☐	☐	☐	☐	☐
	External collaboration enhances innovation output.	☐	☐	☐	☐	☐
	Cross-border partnerships are actively pursued.	☐	☐	☐	☐	☐
	External networks are essential to innovation.	☐	☐	☐	☐	☐
Flexibility	Resources are reallocated quickly during changes.	☐	☐	☐	☐	☐
	Flexible structures help adapt to disruption.	☐	☐	☐	☐	☐
	Employees are trained for multiple roles.	☐	☐	☐	☐	☐
	Flexible strategies respond to uncertainty.	☐	☐	☐	☐	☐
	Decision-making processes are adaptable.	☐	☐	☐	☐	☐
Market Intelligence	Market data is regularly collected.	☐	☐	☐	☐	☐
	Competitor activity is closely tracked.	☐	☐	☐	☐	☐
	Customer preferences are continuously analyzed.	☐	☐	☐	☐	☐
	Emerging trends are identified early.	☐	☐	☐	☐	☐
	Data-driven decisions are standard practice.	☐	☐	☐	☐	☐

Strategic Planning	The company has a well-defined long-term strategy.	☐	☐	☐	☐	☐
	Strategic goals adapt to external changes.	☐	☐	☐	☐	☐
	Scenario planning is used in forecasting.	☐	☐	☐	☐	☐
	The strategic plan considers market volatility.	☐	☐	☐	☐	☐
	Strategic reviews are conducted regularly.	☐	☐	☐	☐	☐
Uncertainty Reduction (DV)	The company has reduced uncertainty through strategy.	☐	☐	☐	☐	☐
	Risk is managed proactively.	☐	☐	☐	☐	☐
	The firm is resilient in uncertain environments.	☐	☐	☐	☐	☐
	Strategic responses to disruption are effective.	☐	☐	☐	☐	☐
	Overall business risk has been minimized.	☐	☐	☐	☐	☐

Thank you for your time and effort