MSc in Major Programme Management

The Impact of Programme Management on the Speed of AI Development in Semiconductor Industries

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The Impact of Programme Management on the Speed of AI Development in Semiconductor Industries

ABSTRACT

The rapid advancement of AI has swept through the technology industry. The dissertation explores the relationship between AI projects and programme management. We try to analyze the various programme management parameters that contribute to the differences in AI projects development speed among high-tech IC companies.

Drawing on literature from AI projects management theory, the literature indicates that the rapidly evolving AI tools are gradually being integrated into various dimensions of programme management, and individual program parameters also have some impacts on AI development. However, there is less emphasis on the interrelationships between these parameters and which parameters are truly the most critical management parameters in AI programme.

The dissertation was researched through the mixed-method process. Qualitative data was sampled through interviews with team members working in different IC companies, with diverse experiences, locations, backgrounds, and roles. The data extraction and analysis are carried out using the latest AI neural deep learning network models to finally predict the main elements in high-tech programme management.

Overall, this research demonstrates technique skills and leadership become the critical parameters, and execution, culture, and organization have less impact on AI programmes compared to traditional ones. “Technology and Leadership” should always remain our primary focus during our AI programme management in IC industries.

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AI	Artificial Intelligence
IC	Integrated Circuit
PM	Project Manager
R&D	Research and Development

Chapter 1. Introduction

1.1 The Speed of AI Development in Semiconductor Industries

"Artificial intelligence will reach human levels by around 2029. Follow that our further to say, 2045, we will have multiplied the intelligence, the human biological machine civilization will have expanded. "—Ray Kurzweil

From the groundbreaking emergence of ChatGPT to AlphaFold's revolutionary achievements in protein folding prediction, from the autonomous driving of Waymo to Watson's cognitive healthcare computing system. The evolution of Artificial intelligence (AI) is progressing at an astonishing pace, perpetually astounding the technique world. AI generally encompasses several major branches, like Machine Learning, Natural Language Processing, Computer Vision, Robotics, etc. AI primarily refers to sophisticated systems that operate based on models that emulate the human brain (Karamthulla et all., 2024).

The Semiconductor industries play a crucial role in advancing AI development. IC (Integrated Circuit) and AI have a close collaboration and interdependent relationship. IC industries provide more efficient and stable solutions to drive AI's progressing speed. As widely recognized, Moore's Law has governed the speed of IC industry development for over half a century, with the industry historically doubling performance every two years. What about the AI development speed in semiconductor industries? As Fig1 shows, much faster than the previous IC industry's speed by leap and bounds, 10 times increasing the compute speed per year!

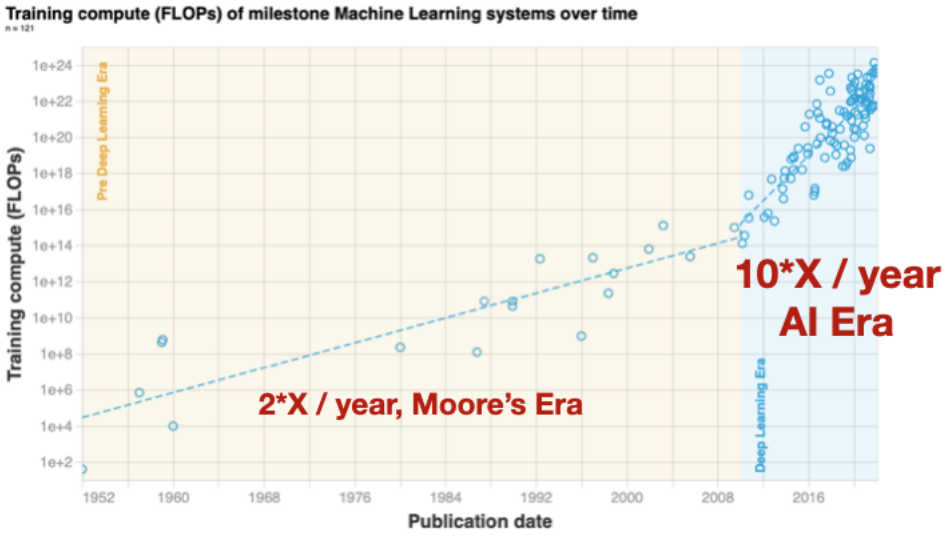

Figure 1. IC developed speed in Morre Era & AI Era Source: Sevilla et all.,2022

1.2 Challenges of AI Development in Semiconductor Programme Management

Just like other traditional industries, IC programme management is unwavering in our relentless pursuit of "better, faster, cheaper" too (MacCormack A.,Wynn J., 2003). In our real life, majority IC programme managers struggled to meet the project cost, performance, and deadlines. Therefore, leading future IC industries, or even catching up with such a rapid AI development speed has become the greatest challenge facing each IC company.

In the face of this groundbreaking new AI technology, IC projects confront a profound array of uncertainties. Lack of a clear specification from the customers, lack of experience with these particular novel products, complex external environment, emerging factors unknowable, resource constraints, and stakeholder communication issues, tradeoffs between trust and control, all these issues highlight the persistent challenges faced by project managers (Atkinson R., Crawford L. and Ward S., 2006).

Obviously, striving for everything perfection in strategy, processes, organization, culture, technique, capital, communication, relationship, etc. is unrealistic for a company. No superhuman would establish an extreme company for AI. So, what is the fundamental step towards our goal? we understand AI, and so does the programme management, but what the interaction between them? How far we can go if we keep the current programme management mindset? Although no company was powered by AI a decade ago, what are the strengths and differences of the AI-leading companies compared with others in IC industries today? We are eager to figure out a new path and philosophy for developing AI. Therefore, identifying the most critical factors influencing the speed of AI development in semiconductor programme management is the aim of this dissertation.

1.3 Dissertation Structure

The first chapter of the thesis introduces the basic concepts of AI, its development status, the main technological branches of AI, and the interdependence of the IC industry and AI. From the IC development data of the past 60 years, it is estimated that the product performance demand of AI for ICs in the future is roughly 10 times the growth rate per year. The paper further discusses the important challenges encountered in AI project management in the above context and the high degree of uncertainty and ambiguity faced by AI projects. The questions at the end set the stage for further exploration of how to stand out in programme management of AI.

Chapter 2 of the dissertation primarily summarizes the relevant literature, public, books, paper research state of AI programme management. The author also identifies the research

gap between this dissertation and other works of literature. List the 4 main hypothesis and research questions in AI programme management before we start our study.

Chapter 3 mainly describes the research method used in the dissertation. Through interviews with 11 different AI project-related people in the IC domain, conduct a qualitative analysis based on the interview results.

Chapter 4 conducts a comparative analysis of interview results, including their different descriptions of strategy, leadership, organization, culture, and innovation in IC programme management.

Chapter 5 deeply dives into a comparison of 11 interview results with traditional project management perspectives, trying to understand the underlying reasons in IC prgramme management, and predicting the pattern of efficient AI programme management way.

Chapter 6 summarizes the conclusion of the dissertation, looks forward to the AI programme management future in the IC industry, and describes the research limit.

Chapter 2. Literature review

2.1 AI application impact on Program management

We are reimagining our world with the rise of AI technology. AI is widely adopted in various industries, utilized by different types of companies, and applied in both classical and emerging new sections across regions, including biology, healthcare, education, and finance. Similarly, in the project management domain, AI also has demonstrated outstanding performance, significantly improving many aspects of project management skills in areas such as cost, execution, schedule planning, strategizing, and risk control.

The global market predicts AI will grow from 2.5 billion dollars in 2023 to 5.7 billion dollars by 2028. According to a report by Deloitte, 64% of organizations have implemented AI (Deloitte, 2020). A survey reveals 21% of project managers say they are already using AI in their project management. And 91% of project managers believe AI will have a moderate impact on their projects.

In traditional programs, managers often struggle to meet project objectives and deadlines (Klojcnik T., 2018). And we use time, cost, and quality for project evaluation (Atkinson, 1999). AI applications have made a significant impact in various aspects, such as strategy, leadership, organization, culture, technique, and execution (Singh, 2022). AI-powered programs enhance teamwork, mitigate risk, make better plans, and improve efficiency (Collins et al., 2021; Foster, 1988; Elrajoubi, 2020). AI technique excels in analyzing and refining the market and technique data, with a strong talent for supporting decision-making, predictive analysis, and risk control, which enables project managers to address issues earlier and more accurately (Smith T., Johnson M., 2023). AI can automate processes and evaluate

tons of data from sources, enabling managers to understand the critical path of the projects clearly (Garter, 2019). AI technology drives functionalities to enhance project governance and oversight (Garter, 2022). Furthermore, AI enhances projects by automating repetitive tasks which improves the execution speed dramatically (Smith, Jones, 2023). AI technologies powered optimization across various project management (McKinsey, 2021). AI integration with program management platforms also become more widespread (Garter, 2022).

In the high-technique IC industry, common routine applications of AI in program management are very widespread, including production forecasting, project scheduling, chip design automation, design review, yield improvement, test automation, and defect identification (Davenport H., Mittal N., 2023). Overall, AI technology's role mainly is to enhance data analysis, intelligent assistance, decision-making, resource management, predictive planning, risk management, and communication (Davenport H., Mittal N., 2023). AI complements the skills of project managers, helping them to lead projects more efficiently. Due to the extremely complex processes in a high-technique IC industry, building AI-powered programme platforms can leverage project workflows, and offer transparent project processes (Appio, 2021). Merging human ingenuity with AI technology will play an increasingly important role in empowering project success.

2.2 Programme management impact on AI development

Given AI's outstanding application across various industries, all-in on AI, we need to further explore AI potential in the project, considering the interaction between AI and Program management (Davenport H., Mittal N., 2023). We need to identify the AI optimal synergy in our daily management practices and discover a new management approach that maximizes the AI development speed, allowing us to fully extend our business value.

This dissertation is based on the programme management fundamental framework--- STAR model (Galbraith 2014). I researched the following 5 aspects: strategy, organization, reward, people, and process. The model is developed by many works of literature (Bechky, 2006; Shenhar, 2001). The model is widely used as a project reference to evaluate, implement, and verify its availability to programme management.

Given that the AI project is a novel type with significant technical complexity and challenges, in addition to the traditional programme management analysis above, I also explored several new aspects, such as technique skill impact, and innovation culture impact on AI development.

Firstly, we investigate the impact of companies' strategic direction on AI high-tech projects. By strategically adjusting to AI, enterprises can usually gain a stronger competitive position and higher market share. Organizations that actively adopt artificial intelligence technology in various business aspects of the enterprise, typically obtain increased benefits (Oliviera 2014; Nam 2021). Companies most often get meaningful cost reductions from AI program management and supply chain management. When a new technology can achieve better profit expectations than the current technology, then the enterprise tends to adopt this new one (Lee, 2004; Pilai, Sivathanu, 2020).

The ability of AI to support organizations in achieving anticipated performance is a significant advantage over other technologies. Therefore, the adoption of AI as a new technology is often driven by the company's strategic need to stay competitive in the market (Nguyen, 2022). Moreover, the identification of strategies should not be static but actively

scrutinize changes in both internal and external factors. Continuously adapt strategies based on the reviews and performance of AI, establish feedback loops, and iterate on the process to optimism. (McKinsey, 2021)

Secondly, we investigate the impact of leadership on AI programmes. Management and leadership support is the strongest influence in the development of AI (Nguygen, 2022; Baabdullah, 2021). Senior management is responsible for strategic decision-making and driving execution across the organization (Trocin, 2021). Thus, it's difficult to move forward with any decisions and plans in an organization without consistent and sustained support for AI from senior managers. A survey reveals that a lack of proper AI leadership can lead to costly failures. (Gartner, 2022).

Thirdly, we explore the impact of organizational structure in AI high-tech projects. Establishing clear governance structures is essential for AI-driven initiatives in the organization. AI defining regular execution processes can ensure an organization with transparency, and accountability (Gartner, 2022).

AI-driven organizational structure often combines with other basic conditions of the enterprise. Although the AI-driven organization-related theory is still limited, one of the theories is the DOI (Diffusion of Innovation) theory, which investigates that the success of new technologies such as AI depends on the characteristics of individual leadership, as well as the internal and external characteristics of the organization (Oliveira, Martins, 2010). Another theoretical framework is the TOE theoretical framework (Tornatzky, Fleischer, 1990) which explains how three different types of factors, i.e., technology, organization, and

environment, influence the adoption and implementation of technological innovations (Baker 2012).

Fourthly, we dive into the impact of organizational culture in innovation on AI high-tech projects. AI is more creative and closely aligned with innovation than any other technology (Hengstler, 2016; Usai, 2021). As a strategic technology leading the next wave of technological revolution and industrial transformation, AI has already been regarded as a core element in corporate innovation (Appio, 2021; Johnson, 2022). Several scholars, Pietronudo et al. (2022), have already suggested that research on the relationship between the two areas of AI and innovation should be strengthened. Culture building for AI-related projects should be committed to developing a culture of innovation, creating dedicated spaces for proofs-of-concept, exploring new technologies and products, encouraging risk-taking, learn lessons from failures. (O'Neil, 2018)

AI is considered a disruptive and innovative technology that is reshaping all aspects of traditional business, models, strategies, etc (Bag, 2021; Upadhyay, 2022). For enterprises, AI digital innovation is not simply the introduction and application of digital technology. It involves a full comprehensive transformation and innovations across various dimensions, including corporate strategy, organization culture, performance management, and business models (Nambisan, 2017). There is an urgent need for companies to process strong value creation and innovation capabilities (Jahanmir, Cavadas 2018). This enables the identification and capture opportunities for AI innovation and value creation in the digital environment, therefore, enhancing operational efficiency (Bharadwaj, 2013; Ritter, 2020), and creating more value for customers (Yeow 2018).

Lastly, we studied the impact of technological advancements in AI high-tech projects. Relevant studies have identified that employees with specialized knowledge are crucial to driving technology transformation and new technology adoption in companies. A survey of 207 IT staff in Australia has revealed that organizations' lack of knowledge and skills to assess, build, and deploy AI solutions is the primary barrier to AI adoption (Alsheiabni, 2019). In a separate qualitative study involving 25 AI experts, it was found that knowledge and culture were important prerequisites for AI adoption (Johnk, 2021). Similarly, a quantitative study indicates that skills have a positive impact on companies adopting AI-driven big data analytics (Bag, 2021). In addition, expertise skills, as fundamental to technology implementation, have been repeatedly shown to play an important role in the diffusion of innovation in firms (Zhu, 2003; Lin, 2008). Organizations with specialists are more likely to frequently adopt AI technologies. Lack of technique skills and data governance practice, issues like bias, and data quality can arise and destroy the AI system (Gartner, 2022). Therefore, companies should focus on cultivating a culture of continuous learning and enhancing cross-functional collaboration to develop talent and internal technique capabilities. (Gandomi, Haider, 2015).

A key distinction of AI apart from other technologies is its profound relationship between AI and data. Big data-driven dynamic capabilities enable enterprises to better perceive and capture knowledge management activities. Big data analytics facilitate knowledge sharing, especially data integration, and also increase the corresponding speed of innovation (Warner, 2019). Digital innovation is not simply the introduction and application of digital technology, but involves a full range of changes and innovations in corporate strategy, corporate culture, performance management and business models (Nambisan S, Lyytinen K, 2017; Vial 2019).

There is an urgent need for companies to have a strong capacity for value creation and innovation (Jahanmir 2018).

2.3 Programme management Issue and Hypothesis on AI development

A vast number of papers have discussed the extensive potential applications of AI, and the impact of AI products on the various parameters of the programme management: strategy, organization, reward, people, process, etc. Even so, we find there are still many obstacles hindering the further development of the company's AI-related product lines. For instance, among the many factors influencing AI, which are the most critical? How to deal with the cooperation and coordination between AI and humans when implementing AI technology? How should we address the relationship between the new AI technology with the existing technology? In the high-tech IC sector, when do we manage AI-related product lines? what specific issues should we pay special attention to compared with other industrial fields? Only through further refinement and in-depth analysis can we more deeply and accurately guide the development and expansion of our AI projects. We need to define an approach that will better accommodate the specific circumstances of different companies with different resource backgrounds, and more accurately match the needs of high-tech industries for AI development.

When our product strategy involves AI-related industries or projects, our entire set of programme management: organization, team, culture, and process must also be adjusted accordingly. Before making corresponding adjustments, it’s essential to have a clear understanding of which programme management aspects are more conducive to the development of AI. This insight will have a positive impact and significance on our subsequent management style and organizational structure. So, among the numerous

influencing factors, which are the most critical points in differentiating IC companies? Which are the non-critical management factor points with a smaller impact on the outcome of AI development? Based on my experience with project management in the IC high-tech industry, I propose the following 4 hypotheses:

- Hypothesis 1: Since the AI project inherently requires corresponding changes, adaption, and reform of many aspects of the traditional project, I infer that companies that are sensitive to reform will develop AI faster. This kind of reform includes strategy change, technology change, organizational structure change, personnel change, and management style change, and they also encompass shifts in execution steps and work methods along the timeline. In short, companies that are bold enough to reinvent their past approaches will undoubtedly more likely to stand out in the competitive landscape of AI.
- Hypothesis 2: Companies with a high AI technique background will develop AI faster. AI project is a new technology field close to advanced technological expertise and strong data processing ability. In the evolving field, where everyone starts from scratch, a company with strong learning ability, strong data processing ability, and skills to accept new knowledge will develop AI very fast. In this kind of technology-led new project, stakeholder's decision-making must largely be based on the company's technical capabilities. As a result, companies with overall high-level AI technology, gain a substantial advantage in the development of AI projects.
- Hypothesis 3: Leaders who support the vigorous development of AI and stakeholders who are willing to invest heavily in new AI technologies, their company's AI projects develop faster. Given the intense competition among IC companies, the strategies of each company are complicated and changeable, coupled with frequent stakeholder disagreement. Then the company with more aggressive investment undoubtedly will

have better resources to develop AI-related projects compared to the relatively conservative or hesitant stakeholders.

- Hypothesis 4: Like other emerging technologies, AI's development is full of twists turns, and unpredictable. Gartner, an international authoritative research organization, released Hype Cycle for Data, Analytics, and AI in China (Anonos, 2024). The curve is mainly used to help users track the maturity and future potential of AI technology. The Y-axis of the curve represents expectations, indicating people's anticipation of the technology, and the horizontal axis indicates the maturity of the technology, consists of five parts corresponding to the five stages of the development of a new technology: the budding period when the innovation is triggered, the Peak of Inflated Expectations, the Trough Period of Disillusionment, and the Slope of Enlightenment, and the Plateau of Productivity, as shown in Figure 2. Therefore, I propose the hypothesis that the development of AI projects and technologies in various high-tech companies and fields is likely to zigzag forward, characterized by peaks and valleys.

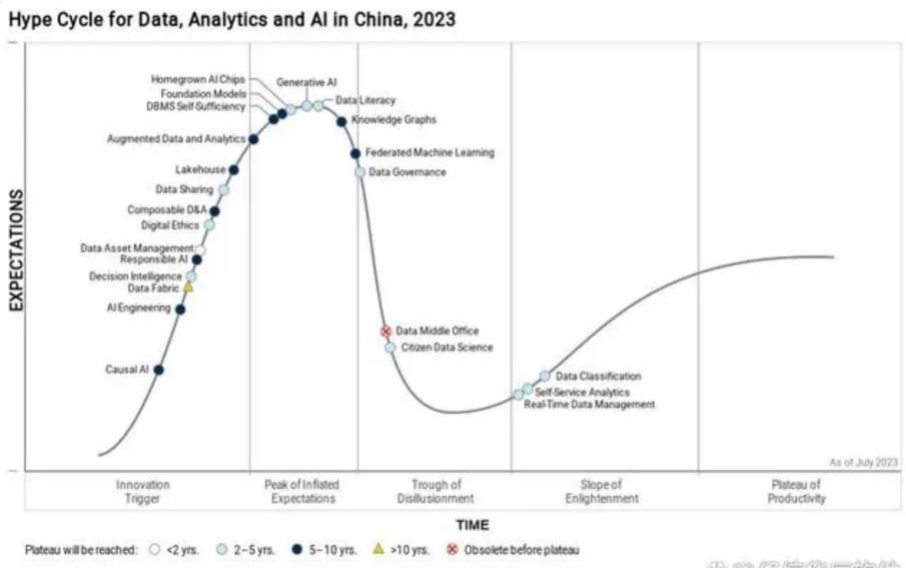

Figure 2. Hype Cycle for Data, Analytics, and AI in China. Source: Anonos, 2024

Chapter 3. Methodology

3.1 Research Area

The research area of this thesis focuses on the impact of programme management on AI development in the high-tech IC field. The influence of various industries on AI development is more based on the wide range of applications. However, the AI impact on the high-tech IC fields is more complex and far-reaching. This is because the development of the hardware of AI technology relies on hardware provided by the semiconductor industry. At the same time, AI applications can return, further accelerating the pace and iteration of IC programmes. The two are in a mutually reinforcing relationship.

3.2 Research Method

To complete the findings of my thesis, I chose to mixed-method research design. Primary data was collected by interviews. Interview data is real data from people in the IC company. By analyzing this data in real time, we can further refine literature review findings. Secondary data comes from the published survey, official documents, and annual financial reports from each company. These mixed sources allow validation of an unbiased view of the programme management (Maylor, Blackmon, 2005).

3.3 Data Sample

In order to further improve the accuracy and diversity of sampling data. The interview was held with individuals from start-up companies to world top technology giants like Apple, Microsoft. To capture the holistic oversight throughout the company, the interviewers come from varying hierarchical positions. To mitigate cultural differences and biases, we covered

companies in Asia, North America, and Europe to expand the diversity of our sampling data, As shown in Table 1, we can clearly see diversity and differences of experience, positions, and many other aspects among the interviewers.

Table 1. Classification of Interviewees

Code	Title	Company employees	Experience	Country
VIP1	Fellow	>100,000	10-20 years	China
VIP2	CoFounder/CTO	1,000-10,000	20-30 years	China
VIP3	CoFounder/CEO	<1,000	30-40 years	European
VIP4	CoFounder/CEO	1,000-10,000	30-40 years	USA
VIP5	Vice Present	>100,000	20-30 years	China
VIP6	Direcotery	10,000-50,000	15-20 years	China
VIP7	Direcotery	1,000-10,000	20-30 years	China
VIP8	Direcotery	>100,000	15-20 years	USA
VIP9	Project Manager	1,000-10,000	15-20 years	European
VIP10	Project Manager	10,000-50,000	15-20 years	USA
VIP11	Enginneer	>100,000	0-10 years	USA

I interviewed 11 people in four weeks. Each interview time is between 45 minutes to 120 minutes, and all were audio recorded. The interview was undertaken according to the University of Oxford social sciences research code of ethics. All interviewees signed the participant information sheet before the interview and double-checked the record and transcript after the interview (Appendix A, and B).

3.4 Data Collection

The interview question of this thesis mainly focuses on the framework model of project management: strategy, organization, reward, people, and process. The above five aspects have interconnections and mutual influences with each other. As a result, the questions often overlap and intersect. We tailored some unique questions to align with the product characteristics of each IC company involved in our interviews.

Due to the special technical attributes of AI, in addition to the five traditional areas analyses above, we also focus on questions about technical skill impact, and innovation culture building. The questions also consider how AI introduces new management tools and analyzes the companies' new decision-making tendencies. Similarly, since the high-tech IC field with political context, questions related to strategy and process were designed with the characteristics of a fast-changing market environment and high-complexity process in the IC field (Appendix B). Since companies with varying technology levels will adopt different strategies for AI project development, we expect to identify the optimal intersection of AI and programme management in this paper that best suits each company's context and background. While there should not be a one-size-fits-all answer, we aim to uncover a pattern and trend through the interview questions.

3.5 Data Analysis

The data were analyzed mainly using qualitative analysis by the model of Kolb's learning cycle (Maylor, Bloackmon, 2005). Transcribed recordings were transferred into qualitative data manually. Based on the analysis of the raw data, the original data was encoded according to a fixed coding system (Appendix C). Our code was selected by context and conditions (Tsai, 2011). The raw data was then reconstructed and classified for further study. Next, we reconnected the data in a refined order for further analysis of the AI impact (Strass, 2007). Coding results are listed in Appendix D.

Then I use the AI deep learning model to identify the relationships between each parameter in project management with project AI deliver results, as Fig 3 illustrates. The AI deep learning analysis model is programmed by Python, and the AI training code is written and verified by

myself, more details about parameter analysis programming processes are provided in Appendix E.

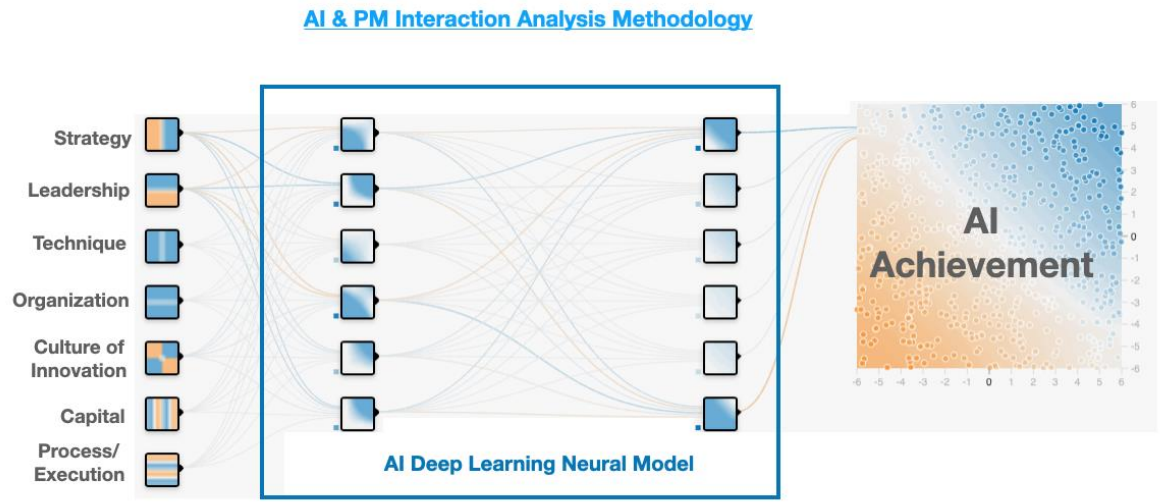

Figure 3. Data Parameter Analysis by AI Deep Learning Model

The final step of data analysis is drawing graphical pictures according to the program running results. Find key issues of impact parameter to AI project, then translate the parameter to some pattern, finally try to predict the tendency, describe the cause-and-effect loop, or build a new model. The whole analysis loop is as Fig 4 illustrates.

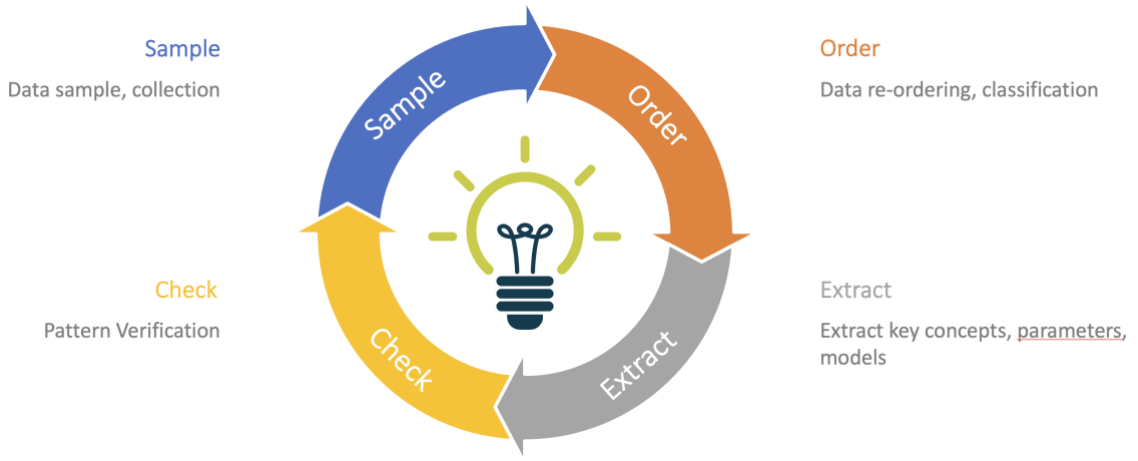

Figure 4. Data Analysis Learning Cycle (Kolb, 1984)

Chapter 4. Findings

4.1 Strategic Differences among IC Companies

Among the companies interviewed, everyone had a clear idea of what they wanted to achieve with AI. Almost all of the respondents expressed strong confidence that they would significantly focus on integrating AI into their current R&D and operational systems. Since AI's widely recognized stability and reliability in automation and reproducible tasks, there is a high degree of consensus on the strategic direction of using AI to enhance internal efficiency:

> *" Definitely, we are hoping that AI will help with the efficiency of R&D as a whole."(VIP1,VIP2,VIP4,VIP5,VIP6,VIP10)*
>
> *"AI can automate and replace on a lot of work that we have right now."(VIP8)*
>
> *"AI is right to help us solve problems and to make us more efficient. I see AI is coming soon, solving all sorts of problems for us. AI will be everywhere in the future." (VIP11)*
>
> *"Actually, the R&D process is a wealth of experience and past knowledge. The challenge lies in how to swiftly apply this knowledge and experiences to the new projects to avoid redundant efforts and inefficiencies!" (VIP5)*

In other AI strategic directions, such as AI-driven products and new business models, some companies have also shown varying degrees of interest and consideration.

"In areas like image recognition and language processing, where AI can surpass the previous traditional algorithms, it is possible that the product will give priority adoption on such AI application. " (VIP5)

AI requires constant strategy and managing the latest practices (Manfredi, 2021).AI is different from transitional projects because it involves cross-function collaboration, dynamic stakeholder decision-making, and technique integration skills. All these companies want to use AI to be more business successful. Each is confident in the future of AI technology.

"I think it would be everywhere just like in the 1990s Internet and computers were kind of sporadically that you could see them here and there, and also, they are used everywhere. Ten years from now, we will see AI all around us, just like we see Google today." (VIP11)

This shows that companies, at all levels, converge on a similar AI strategic direction. In other words, strategic goals among different companies don't differ significantly. Simply having strategies and goals alone is not enough to stand out in the development of AI. Therefore, we need to further investigate the impact of other management differences on the speed of AI development.

4.2 Leadership Style Differences among IC Companies

Leadership contains self-awareness, self-regulation, motivation, social skills, and so on. Based on different emotional intelligence and circumstances, there exists the coercive style, authoritative style, affiliative style, pace-setting style, and coaching style in the organizations (Daniel, 2023). In the dissertation, we primarily explore side-step the

differences in leadership among companies by examining the variations in decision-making and execution methods across different teams and organizations.

The dominant decision-making styles fall into the following three main categories, each of which was observed in different companies during our interviews:

1. The boss plans and makes a decision himself with less discussion.
2. After some discussion with the main team members, the boss makes the final decision.
3. The team decides together.

In some small to medium-sized enterprises in China, we can see that they adopt the first approach to making decisions, which is called the coercive style (VIP2, VIP7). There are two reasons for them to adopt this kind of decision-making approach. On the one hand, due to the relatively weak team dynamics and limited internal technical and product resources, decisions are typically made directly by the boss after negotiation with the customer and investment; on the other hand, the team's limited vision and ability make it challenging to grasp the decision-making logic of the top management, leading them to rely on a top-down, authoritarian approach for quick decisions. Powerful leaders can make unilateral decisions. (Vroom, Yetton, 1973). They believe that is very unrealistic to discuss with everyone before making a joint decision.

In some small to medium-sized companies in Europe and the United States, companies adopting the 2nd decision-making method are predominant (VIP3, VIP4, VIP10). They view discussions with key team members as a knowledge and information gathering process, which facilitates the boss to make more informed choices. Similarly, they also prefer not to

broaden the scope of the discussion, as they still aim to set the strategic direction as soon as possible. They believe involving too many participants will make it difficult to reach a consensus and hinder the decision's progress. (Kathleen, 1989)

> *"Although the decision-making power lies with the leader, it's important to communicate with key team members before making a choice. This approach ensures a well-rounded understanding of the situation from multiple perspectives. It's difficult to achieve consensus every time, but this method can increase the accuracy of decision while also maintaining efficiency and effectiveness." (VIP3).*

A third type of decision-making, the shared decision-making method, is adopted in larger companies in both the East and the West (VIP1, VIP5, VIP9).

> *"Before making any decision, everyone should be given a full voice to express their opinions. This ensures that our decisions are executable and that the data we have collected is comprehensive and accurate."(VIP1)*
>
> *"Our boss has vote power, meaning they can decide to stop or cancel the projects. However, they don't have the authority to approve it alone; the decision must be agreed upon by the majority of the team." (VIP1)*

In fact, team-based decision-making does not slow down the speed of the process. On the contrary, the more comprehensive the real-time information, multiple alternatives, and data we gather before making a decision, the more thorough the thinking, and the more decisive and swift the final decision will be (Kathleen, 1989).

> *"This way, all people understand the reasoning behind the decision, which can help avoid a lot of resistance during the final implementation of the process. The follow-up process will likely be more consistent, leading to better overall results" (VIP5).*

It is important to note that among the two leading IC giants in the world excelling in AI, their decision-making does not follow a fixed style. It's highly flexible and depends on the nature of the decision to make. They employ the combination of the above three decision-making approaches. Strategic, technical, team building, management, supply chain, and so on, each has distinct decision-making teams and approaches, demonstrating high adaptability.

> *"My boss has a very high emotional intelligence and adapts her decision-making style based on the situation. When a new project is about to begin, she makes decisions collectively, allowing everyone to share their opinions. However, when decisions involve internal conflicts of interest within the team, she makes the call on her own, without consulting others" (VIP8).*
>
> *"Our approach is that you need to involve all the relevant people based on the nature of the decision to solve the problem together. They will provide you with comprehensive input on information, execution, product quality, and other aspects" (VIP11).*

Different decision-making approaches lead to a variation in the execution and efficiency of their teams. The first and second approaches require more time to explain to each member of the team exactly what the background of the decision is, why it was made, and otherwise execution becomes challenging. In contrast, the third and most flexible way tends to execute very smoothly and quickly. Obviously, nothing is free. The team that can provide sufficient data and cooperate with the boss to make all kinds of decisions must have strong professional skills, aligned business goals, and a harmonious corporate culture. To operate such a high-performance team also entails high cost, making such kind of a team and decision-making

way is more common in the well-capitalized IC companies. Conversely, companies with weaker team capabilities, where operational and maintenance costs are lower, often rely on more powerful bosses and founders to make intuitive judgments on a variety of high uncertainties. This team configuration is very common in some small and medium-sized start-up companies.

4.3 Data-processing Capabilities Differences among IC Companies

> *"If AI fuels a company, data fuels AI. Companies that are serious about AI must be serious about data—collecting it, integrating it, storing it, and making it broadly accessible."*
>
> *(Davenport, T. H., Mittal, N. 2023)*

In terms of data processing and the establishment of digital platforms, although almost every company is involved to some extent, the technology gap is still quite pronounced. Some companies remain at the stage where each department handles its own data independently, without a unified data processing platform (VIP3, VIP4, VIP7, VIP9). While these companies have their own CAD team to support the construction of the corresponding platform to a certain extent, their involvement is often limited to design assistance. More comprehensive efforts towards cross-departmental digital platform establishment and analysis are still relatively restricted (VIP1, VIP5).

Almost all companies that are growing rapidly in AI have dedicated data processing and analytics platforms (Davenport, T. H., Mittal, N. 2023). Integrating data from the design or custom system may be the most challenging part of the AI development journey. Accumulating data from their daily R&D work, operation, supply chain or customers was an

important preparation for a shift to the AI business. A mature digital platform made it possible for developers to get access to internal and external data effectively. Data-based category and analysis is a great tool for AI project development (Manfredi, 2021). Using a large set of data from a variety of resources can enable project managers to discover trends, critical paths, and patterns much more efficiently and accurately (Pinto-Alves, 2023).

Among them is a Chinese IPO company that, while not large enough to be considered a major player, has a long-term deep focus on digital platform building, data collection, data analysis expert hiring, and ensuring their digital platform's successful application into their operation and business model. The company's digital platform operating model can be considered a leading position in China.

> *"Without a complete data platform to support, you can't accurately determine what portion of your own work. Additionally, today's success may not be replicable tomorrow if there is no scientific management method in place. All the technology and all the company's operations are underpinned by a fundamental technical logic. I can access all the data from various projects, departments, sales, and operations at any time immediately. This allows me to make quick decisions and judgments based on my own historical data. Building this digital platform is essential for our company's growth over the next five to ten years." (VIP2)*

The above view is equally echoed by interviews with several leading international AI semiconductor giants:

> *"So, if you do not draw on the most advanced digital platform to manage projects, finance, customers, product data, and numerous design versions, your company can't*

be able to grow. Many business leaders, thinking their resources and manpower are limited, focus all their energy on product development and neglect building a digital platform. The more they do this, the more the data is messed up. Then the slower their progress, the more the project cannot be done!" (VIP6)

"You said each team can automatically submit the data. No, it can't automatically submit data. It must be someone programming them, then automatically. As a result, we have a lot of people try to do the programming work to make the data collection automatically." (VIP8)

"Our platform is very well-defined, with established processes for managing, storing and analyzing data, as well as comparing data differences. All these procedures are relatively mature." (VIP10)

In addition to the construction of digital platforms, how to deeply bind and integrate AI technology with one's company's business becomes another key factor for the success of AI projects. The AI project team consists of multi-function groups like domain experts, end-customers, stakeholders, data analyzer teams, and technique support teams in different fields. The organization needs to arrange the cooperation and communication discipline well so that each team can work in the same direction for AI-driven projects. (Chen et al.,2019)

"AI experts, they're like I'm there to help you do some optimization or to try to see from an outside perspective. What could I do to use my background in machine learning? We try to build an extra layer of knowledge behind that's what we do every day." (VIP11)

The leader in IC company shows a great interest in learning more about AI technology, how to master the AI technology for their team, how to lead AI projects, and how to use AI tools.

"Any tool should be integrated into the broader framework of the company's process system, because no tool operates in isolation." (VIP2)

"We learned from each of the major Chinese internet companies about how they handle large volumes of internal data. We then took these effective strategies and methods. And restructured them according to the specific needs of our company." (VIP2)

Overall, combining "top-down and bottom-up" various layers of technical resources to further develop AI technology is a must.

4.4 Organizational Differences among IC Companies

AI is undoubtedly powerful, but if our organizational structure, business model, and people remain unchanged, if so, AI is helpless! An organization means the platform often creates a shared understanding of all the information, technique, methodology, success, and failures lessons, tools, and support.

Considering the organization structures, the most important is to align the current technology resource with the organization's strategy. Organizations must support limited resources, a friendly innovation atmosphere, the company's goal, and stakeholders' requirements.

"The organizational structure must align perfectly with the strategy. This alignment significantly enhances efficiency by allowing more specialized individuals to focus on their areas of expertise."(VIP5)

When it comes to organizational setup research, we found almost all companies have relatively flat hierarchy, regardless of the size of the company. In technology companies, the need for communication on numerous and complex technical topics is high. Directly and open communication can stimulate new designs in everyday work. A hierarchical organizational structure with too many layers is indeed an obstacle to high-technique product development!

> *"The hierarchy of our organization is very flat: boss and employees, two levels only. We want to have the information flow easily among everybody in session. We don't want to have too many filters." (VIP3, VIP4)*
>
> *"We can't say our hierarchy is flat or hierarchy, is just fit for what we want."(VIP9, VIP11)*

Additionally, the ability to adapt organizational structures is crucial. Most of the companies possess the capability to flexibly adjust organizational frameworks.

> *"If the company wants to be able to develop AI well, it must be flexible in its organizational structure."(VIP6)*
>
> *"We frequently adjust our organizational structure in response to changes in the business environment. We've been looking at some of the organization's issues and we've been going over the strategy issues once a year and basically just trying to match them up." (VIP1, VIP3, VIP4)*
>
> *"Some aspects can be predicted in advance, and you can set up the organizational structure. However, even then, you'll find that this organizational structure can't be used all the way through to the end. You'll need transitional stages and temporary organizational structure before you can finally get the project done."(VIP2)*

In the discussion on the organizational structure, I also explored the talent development and hiring practices of various companies. The cultivation of specialized talent has an absolutely decisive impact on AI competition. Nearly all of them employ a combination of internal talent development and external recruitment to build their teams.

> *"The biggest challenge in AI development is actuarially talent. Since your company has its existing business model and new production line. The team must be a mix of old and new tech teams. You need to carefully balance the collaboration between both groups of talent." (VIP4)*

However, some companies stand out for their strong capacity of their own talent cultivation and internal talent transformation. While they actively hire external AI experts, they also invest heavily in training and developing their existing employees. Companies adopting this talent strategy place extremely high demands on their own original technical staff. Due to the development of AI requires a large pool of related talents, relying solely on external recruitment is not realistic. As a result, the AI development of such companies tends to swiftly complete the organizational restructuring and product transitions necessary for AI products. (VIP9, VIP11)

4.5 Innovation Culture Differences among IC Companies

"It's all about commitment to change – affective, continuance, and normative commitment."

Lynne Herscovitch

The success of AI projects requires an innovation culture to address the complexities in AI environments (Katirai, 2023). The fast-changing context makes project managers responsible for adaptability and agility (Katirai, 2023). The development of AI depends not only on a company's technological capabilities, leadership, and culture, but also on a company's ability to innovate, reform, and self-improve, which is critical.

From the interviews, we learned that different companies vary significantly in their attitudes toward innovation, the frequency and scope of change, the speed of reforms, and their execution capabilities. Some companies believe that in order to protect their existing business and teams, they should adopt a "small-steps, quick move" approach, gradually testing new initiatives:

> *"The speed of the reform should be proportional to the size of the benefits, inversely proportional to the scale, and strongly correlated with the impact trigger." (VIP11)*
>
> *"Trying to take a small spoon at the beginning" (VIP3, VIP4)*
>
> *"However, when it comes to actual implementation into the product, we are cautious. Because every time you import something new it leads to uncertainty and instability." (VIP2, VIP4)*

Two highly successful large tech companies expressed a relatively aggressive, optimistic attitude toward reforms, with fast execution speed when it comes to change.

> *"There's pressure to push through, but it has to move forward. Major product changes are never stress-free, and once the decision is made, the pile moves fast." (VIP1)*

"I'm definitely going in a positive manner toward the change. Team members are also very good, they try to understand the new change, investigate more into it, maybe add some point." (VIP11)

Generally speaking, the larger the company, the more complex the reforms and the greater the number of issues involved. The ability to "turn the small boat quickly" is a core competitive advantage for smaller companies. However, the two international giants we interviewed have both demonstrated swift and mature capabilities in driving reforms.

"Engineers often feel pain for various changes. So we set a comprehensive change management process to ensure smooth execution throughout the reform cycle. By following a series of established procedures, you can successfully complete the reform."(VIP8)

"Change is a part of their life, and they have become accustomed to it. They know that changes will inevitably occur at regular intervals, leaving no room for choice."(VIP1)

"The extent of the reforms you undertake requires discernment, the larger the changes, the greater the resistance you may face. The quality of your judgment in making these decisions ultimately determines the fate of the company."(VIP4)

These smart large-scale tech companies have not only implemented modular design in their high-tech products but have also achieved modular management in project oversight. Even within the complex and less frequent domain of innovation, they have distilled commonalities and developed efficient modular management processes that enable them to respond swiftly to change.

4.6 Investment Differences among IC Companies

In the dissertation, we also compare the differences among various IC companies in their investment in new technologies, particularly AI direction. The vast majority of these companies have dedicated research time, team, and funding to AI development. The key differences lie in the depth of their research and the scale of their investment.

> *"The company has a dedicated innovation management investment. Every year, it allocates funds for innovation research and sends current employees for training."(VIP1)*
>
> *"Our company is committed to investing 30% of our annual budget into researching new products and technologies, such as AI. This is essential and must be done, no matter how challenging. As the leading company in the industry, if we don't drive innovation, who will do it? It is our responsibility to the world."(VIP9)*
>
> *"We do not have the capacity to explore so much to try new things rather we implement what other people have tried and tested if it's good ."(VIP9)*

The majority of companies believe that the level of investment in AI should be determined by its actual return on investment. They must be able to demonstrate to all stakeholders that AI technology can enhance operational efficiency or generate revenue before committing to further investment. (VIP5,VIP4,VIP3)

> *"We should avoid having unrealistic expectations about AI's effectiveness. It won't become a magic solution just by being implemented. Instead, we need to identify tasks that are suitable for AI, and then work on pushing those boundaries with a trial-and-error approach and an open mindset. We should avoid spending too much money all*

at once and instead proceed with incremental testing and experimentation." (VIP1, VIP5)

When I asked an interviewee, "When you were developing a world-class leading product like ChatGPT, was your attitude positive or did you try to move forward slowly fearing that many of the technical or market issues unresolved? How was such a groundbreaking technological product like this born? His response revealed the fearless courage with which technology companies in the face of challenges!

"We never step back even if there a problem, we always move forward right away even if you make a mistake, you still move forward to solve it." (VIP8)

When I asked if you were worried that the development of AI would eventually replace your jobs, I heard two opposite responses:

"Given the trend of AI, it is true that AI will replace some engineers' jobs" (VIP6).

"Precisely because of the development of AI, we will have more development work in the future. Microsoft Excel eliminated the need for certain accounting tasks, but the accountants who use Excel are still around. The same will be true for AI" (VIP11).

When I asked if you are worried about innovation drastically in your product and you will lose the market and customers, I once again heard two opposite answers:

"Our customers expect our products to be stable, so we can't change too much. We make incremental changes so that while we are developing something entirely new, customers experience no noticeable difference." (VIP10, VIP1)

"New technologies can be explored, but any changes to the product must be approached with extreme caution. From a technical concept to a prototype, then to a

product, selling to customers, maintaining it, and finally making modifications, each step takes time. This process requires time and effort." (VIP2, VIP4)

"If we don't make such radical changes, we are very worried that we will lose our customers soon." (VIP8)

Clearly, the two opposite conclusions are both valid. Obviously, for the world's leading high-tech companies, the courage to undertake such drastic changes is closely tied to their technological powers. Conversely, for some companies with weaker technological capabilities, adopting a small step-by-step, little-by-little trial-and-error approach to stabilize their products and retain customers is a wise strategy. Therefore, the ability of science and technology is not only reflected in product performance. It also indirectly shapes an enterprise's strategic objectives, culture, communication, and execution.

Chapter 5. Discussion

5.1 Key Influencing Factors Between AI and Program Management

From the findings in the interview, we can see that despite the unique circumstances of each company, those that achieve success in AI share many common traits. Establishing a project management system that accelerates AI development doesn't require supernature abilities. Rather, it's the commitment of these companies to these 2 key skills: First, data processing skills development, the technical depth of AI tech talent; Second, flexible and resilient leadership based on real-world conditions. As shown in Figure 5.

AI has a strong modular character (Ansar A, Flyvbjerg B, 2022; Tee, Davies, Whyte, 2019) that enables to transfer of the current solutions to other projects easily. AI project is also convenient to recombine each AI project component to create a new product. However, the gap between the existing technology and AI's specifics is too large to transfer directly. Instead, the project requires an adapted methodology to catch the AI challenge and opportunity. All these specific AI characters and modular designs mean we should understand the existing techniques and approaches deeply ahead.

Additionally, a company's technology level directly influences the company's strategic goals, cost, product positioning, and the speed of technological upgrading. Beyond that, technical expertise also dominates the way of teamwork, communication, and the company's culture. Teams with varying levels of technical proficiency and vision face fundamentally different opportunities and pressures, investment environments, and competitive situations. The aforementioned differences, driven by variations in technological capabilities, in turn indirectly shape a company's management styles and organizational cultures.

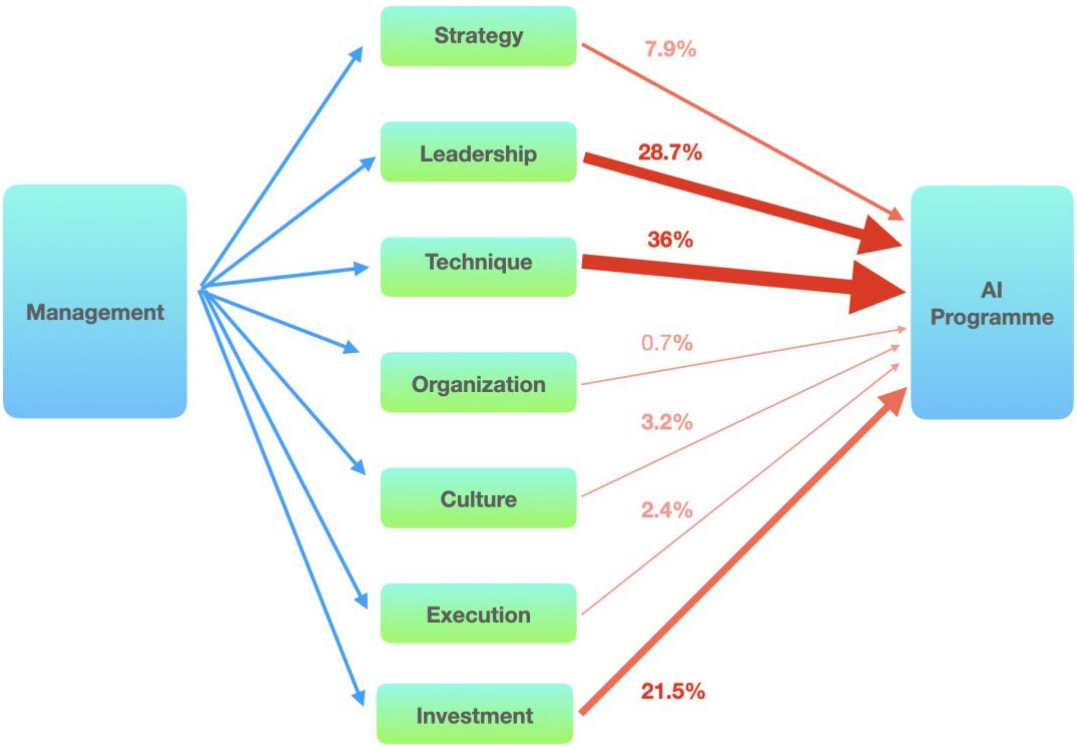

Figure 5. The Impact Parameters Between AI and Programme Management

In our limited interviews on AI R&D development, we explored leadership responses to AI adoption. We have thoroughly discussed from various perspectives the impact of leadership on the following aspects, including uncertainty in AI R&D efforts, changes in employee work engagement (Braganza, 2021), impact on AI project performance, the relationship between AI and management, and its connection to overall corporate business (Lee, 2022). We found the choice of management and leadership styles can create significant differences and impacts on the following aspects of a company: whether to enhance collaboration and cross-functional cooperation in different teams, how to flexible trade-off short-term goals among different business stakeholders, how to timely import and merging new technique experts to the current technique team, how to forster communication, knowledge sharing, and

leveraging diverse insights (Khan et al., 2024). All above are also key factors to impact the pace of AI project development.

Equally important, and essential to guiding the development of the AI programme, are these flexible and adaptable management strategies. These relatively flexible and fluid management strategies inevitably require a strong, situational leader who can adjust short-term goals and formulate new strategies in response to available resources (Winter M, 2003), market shifts, and technological capabilities. In the highly uncertain world of AI project development, leadership that is both flexible and goal-oriented is the core competence of the company (Stadler C,2021; Senge, Hamilton, and Kania, 2015).

5.2 Insignificant Influencing Factors between AI and Program Management

In conventional project management, we typically think of strategy, execution, and organizational structure as critical to the success or failure of a project. However, during our interviews, we found that for AI project management in high-tech companies, these factors did not present very significant differences in these aspects from company to company, as Fig 5 depicted.

When discussing the issue of AI strategic planning and investment planning, almost all of the middle, senior managers, regardless of the size of the company, regardless of the Americas, Asia, and Europe, unanimously agreed that it is necessary to vigorously invest money, time in the training of AI talent development and technology advancement. They consistently emphasized the need to formulate all AI development strategies tailored to their specific contexts, focus on AI products, improve the efficiency of internal research and development,

enhance the entire ecosystem, and so on. The above aspects, according to the actual situation of the enterprise, formulate the development strategy of the AI project. They all simultaneously maintained their focus on AI projects, contemplating the advancement of AI technology and enhancing action in this field.

In terms of execution, almost each company is able to achieve its particular strategic objectives of the project. Similarly, each company establishes its own organizational structure based on its specific personnel and project needs, so there is minimal difference between the companies at these levels.

Summarily, in the competitive landscape of AI, success is not solely determined purely based on the formulation of strategic goals, strong execution, or organizational structure and other aspects to stand out, because almost all high-tech companies, in these aspects, are relatively mature and reliable. These factors tend to evolve slowly, reducing the difficulty of implementation. In fact, these aspects are not particularly complex within IC companies, with little variation between each company. The real differentiators that create significant gaps between companies lie in the power of technological capabilities and flexible, changeable, dynamic leadership.

5.3 Time Curve of AI R&D Development in High-tech Company

According to the historical curve of the past new technological revolutions and the AI attention span chart released by Garter (Fig 2.), The iterative process between new technology and old technology follows a cyclical process. Take the technique route to music tools development as an example in Figure 6. When new technology shows its first

emergence, it often experiences short-lived attention, like a fleeting moment in the spotlight. This is because the emergence of new technology inevitably leads to a wide range of problems that can't be fully solved at the outset, causing the old technology again to re-capture the market. It waits until the maturity of the new technology is higher when it completely crushes the old technology in all aspects, people will gain more confidence in the development and adoption of the new technology.

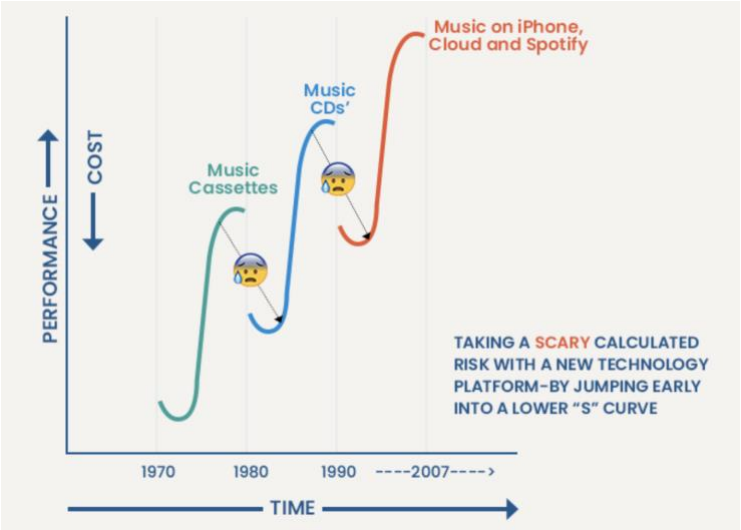

Figure 6. The Technology S-Curve (Source: Clayton M., 2017)

However, the development of AI technology within various high-tech companies does not seem to follow this traditional evolution of the alternation between old and new technologies. Since the inception of AI technology, it has been strong to maintain a stable, consistent trajectory of rapid growth for the past nearly 10 years. Companies with stronger technological capabilities have taken big steps forward, fearlessly addressing any significant challenges by mobilizing all available resources to overcome them. On the other hand, companies with weaker technological capabilities have insisted on taking small steps and advancing steadily progress, bit by bit, in order to minimize uncertainty (Hobbs, Petit, 2017; Abrahamsson P, 2017; Sońta Drączkowska E, 2020). The overall project development curve of AI within each company is depicted in Figure 7.

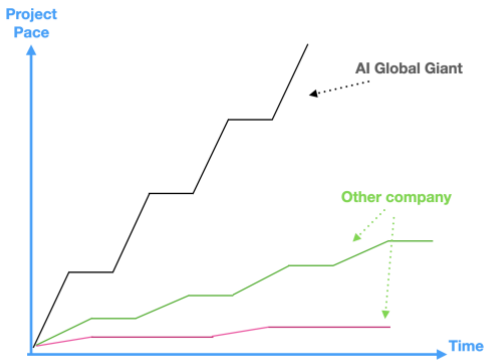

Figure 7. AI Development Pace Curve in High-tech IC Company

The executives of various high-tech companies exhibit extraordinary confidence in AI projects and technologies. Although they also clearly understand that in their development of AI has to go through a slow and difficult time, requiring repeated iterations before gaining their customers' acceptance. They are unchanging in their initial thinking, constant in investing more in AI, continuous in their endeavors, unwavering in their determination, and clear in their goals, without any fear of failure. This unwavering sense of purpose came from almost every executive interview. This fearless and steadfast dedication spirit of discovery is prevalent in high-tech companies all over the world, and I believe, embodies this spirit of technological advancement that truly drives humanity forward.

In conclusion, the initial hypotheses 1, 2 and 3 have proven to be largely accurate. Innovation capability, technological skills, leadership, are indeed crucial to the AI programme's success. However, there is a slight deviation in hypothesis 4. The trajectory of AI development has shown no significant fluctuations within the company. On the contrary, AI has consistently remained a focal point, with unwavering attention and ongoing development across IC companies.

Chapter 6. Conclusions, Recommendations, and Future Work

Apple is a technology company, but we never forget that the devices we make are imagined by human minds, built by human hands, and are meant to improve human lives."

--Tim Cook

6. 1 Finding Summary

Through interviews and data analysis, it identifies the key elements for AI project success, The data focuses on analyzing these IC companies. With detailed results of the analysis stressed differences in management parameters which leads to the huge disparity in the final AI offerings of each company. As Fig 8 illustrates. We coded and categorized the interview results, followed by two rounds of data analysis. The first round of interview analysis was conducted to analyze the primary differences among companies in relation to strategy, technology, leadership, culture, organization, execution, and investment, above seven fundamental management issues; In the second round, we further subdivided the management focus into 24 specific areas in management, comparing the weight of differences between the companies in finer level of granularity.

In the first round of interview analysis, technology capability emerges as the most crucial factor 36.0% among the total 7 factors in the development strength of numerous IC companies. Technique skill is definitely the top impact parameter in AI project development. Only a high technique level can fulfill all the perspective strategies.

The second critical factor is flexible leadership, occupied 28.7%. AI development is in a complex and fast-changing environment, with limited resources, and cross-function teams, the flexible leadership style can balance the resistance of the whole project and keep the goal in the meantime (Nair A, 2019; Müller R, 2010). Capital investment, including expert hiring, money investment, and team training time budget is the third important parameter, proportion of 21.5% in total.

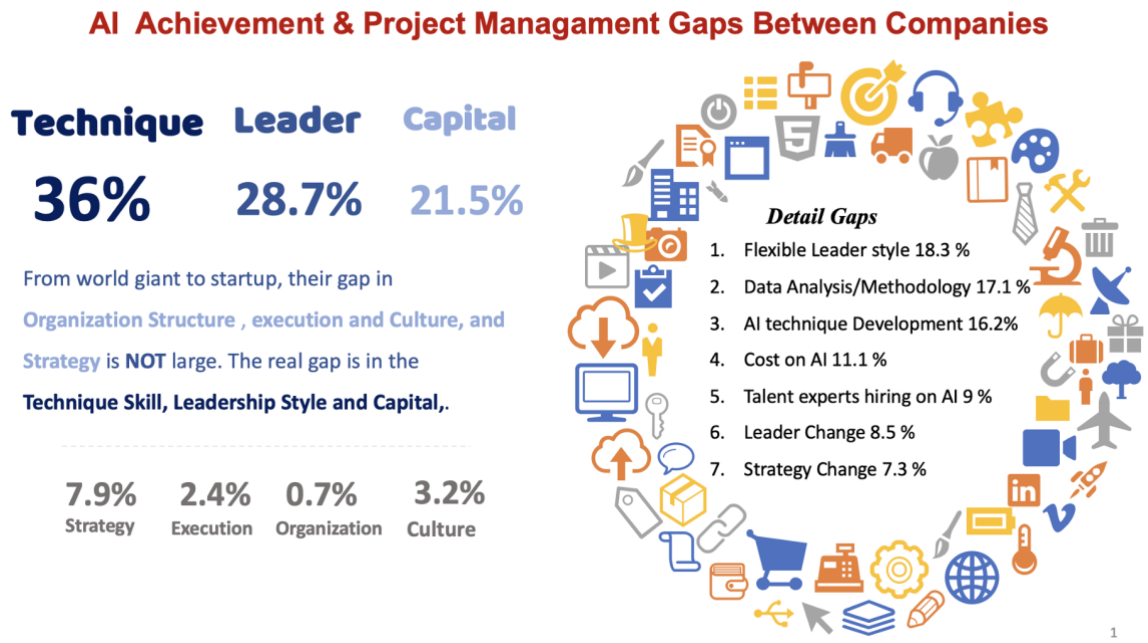

Figure 8. AI Achievement & Programme Management Gap Parameters

In the second round of interview analysis among 24 specific questions, leadership that can accurately respond to the complex context proves to be the most critical 18.3%. The secondary reason accounting for the disparity is the technological capabilities. Among them, data processing capability stands out as the most crucial technological factor for AI technology development, accounting for 17.1 %, and AI technology capability itself constitutes 16.2 %.

Capital operation consistently ranks third place in these two round analyses, 22.5% in first round analysis and 11% in the second round. From the interview results analysis, we can see the execution and organization didn't impact as much as we thought before. This may be because compared to other parameters, these are relatively easy to achieve by each company. Although market shares and product types vary across companies, the above aspects do not vary much among these companies, suggesting that organization, execution, and culture are not the most critical factors that lead to competitive victories in AI projects.

The interview results of the two different analyses corroborate each other and show a consistent pattern. They demonstrated the same results effectively: "Technology and People" should always remain our primary focus during our program management in IC industries.

6.2 Limitation

Firstly, there is a limitation in the scale of the programme. Because AI requires considerable data input and a complex process design cycle, so AI-based projects may not be proper for smaller product lines (Singh, Hiju, 2022; Elrajoubi, 2020). The weak points and benefits of AI projects should be assessed. It's also necessary to evaluate the project social and ethical impact before the AI project starts (Sahadevan S.,2012).

Secondly, AI program management methods selection often incorporates different context area. Context includes industry requirements, competitors, customer preferences, impeding factors, development states, market trends, AI acceptance, trust level, ethical guidelines, end-users, strategy, politics, market, technique ability, investment, and so on. Identifying limitations and analyzing context factors represent a basis for management methods selection.

The application, organization, culture, and data must be aligned when we start the AI project to decrease the potential project risk.

“Change is a process! One size doesn’t fit all.” (Andrew Pettigrew). Although the fundamental steps were the same, each company adopted its own path to move forward. We are confident and hope that our research will serve as a valuable reference for each company to make programme management adjustments. However, each industry has its own specific programme management focus, and each company still operates within its own unique context to complete the adjustments and conversions. Therefore, it remains essential for organizations to make choices based on their individual context, organizational structure, culture, and capital circumstances.

6.3 Future Work

AI is an epoch-making high-tech technology. Beyond the existing various amazing applications, in the future, it is poised to make limitless advancements in areas of 3D imaging, communication, intelligent recognition, intelligent management, automation, and so on. Leveraging AI projects holds the promise of enhancing the efficiency of high-technique program management. AI contributes to automation, strategy, decision-making processes and so on can result in a more rapid development future.

In the process of the development of AI technology, how AI and human beings can cooperate, how human beings should make regulations and control for AI, how to combine AI's ability and human's analytical ability, how to mutually fusion individual complement each other's strengths and weaknesses, how to achieve the best. This is not a static survey and

research can be solved, this result will gradually change with the depth of human exploration of AI. AI programme management is not a “one-and-done” effort, it continuously evolves alongside innovations and contexts.

APPENDICES

A. Participation Information Sheet

B. Interview Questionnaire

C. Interview Question Coding

D. Interview Results

E. AI Deep Learning Model Generating, and Training

APPENDIX A

Oxford Saïd Business School
Park End Street
Oxford
OX1 1HP

Redacted to protect the identity of the candidate: *1076552*

The Impact of Programme Management on the Speed of AI Development in Semiconductor Industries

Participation Information Sheet

Ethics Approval Reference: SSH_SBS_C1A_24_50

1. Introductory paragraph

You are being invited to take part in a research project. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether you wish to take part.

2. Why is this research being conducted?

AI is a hot topic and new direction in our IC industry, I would like to select some data to analysis the project management impact to AI development.

Questions which need to investigate:

- The limitations of AI applications and tools in major programme management.
- How to make appropriate choices in AI approach, AI solution measurement
- How to align existing AI techniques and approaches with our project goals and context?

- How to achieve harmonious collaboration between AI and humans in our projects?

3. Why have I been invited to take part?

I will try to find 11 people in IC or AI industries in my study, they should come from different countries, different kinds of companies, different positions in each company. Participants will include IC company CTO, co-founder, engineer, they come from both western world, eastern world, their background also will cover both monopoly giants, IPO IC companies and new start-ups.

4. Do I have to take part?

No. It is up to you to decide whether to take part. You can withdraw yourself from the research, without giving a reason.

If you decide to join, the deadline by which you can withdraw any information you have contributed to the research is 1st, Aug 2024. If you decide to withdraw after data has been collected, all those data will not be used for the study and will be deleted upon receiving your withdraw notice.

5. What will happen to me if I take part in the research?

If you are happy to take part in the study, I appreciate your help, your share, and your experiences in IC industries.

You could answer questions in an interview question list that should last approximately 45 mins. If you agree, the interview will be audio recorded. At the same time, notes will be taken together. You can use your mother language to answer the questions. You can select the interview online or face to face freely.

The interview will take only once, after I collect all the information from other participants, I will send you the final analysis data results for you to double check.

6. What are the possible disadvantages and risks in taking part?

There are no risks and disadvantages in taking part of this research program for participants.

7. Are there any benefits in taking part?

While there are no immediate benefits for those people participating in the research, it is hoped that this research will lead to you more deep thinking about our industry, about AI development all over the world.

According to the analysis results, you can understand the differences between each IC company. I hope the results can help you more in your future.

8. Expenses and payments

There will be no payment for taking part in this research.

9. What information will be collected and why is the collection of this information relevant for achieving the research objectives?

I will keep your business information well, I won't ask any questions related to your name, your team, your company name. I don't ask any questions about your future product plans, or any accurate data related to your team. I only record your opinion and ideas about management.

The researcher supervisor and I will have access to the research data.

Identifiable data (including consent forms) will be stored on Microsoft Teams, and Oxford University servers (Nexus 365, One Drive for Business SharePoint). Other research data will be stored for 3 years after publication or public release of the work of the research.

10. Will the research be published? Could I be identified from any publications or other research outputs?

The findings from the research will be written in up dissertation. It will not be possible for participants to be identifiable from the outputs. I would like your permission to use direct quotations but without identifying you in any research outputs. A copy of my dissertation will be deposited both in print and online in the *Oxford University Research Archive* where its access will be restricted.

11. Data Protection

The University of Oxford is the data controller with respect to your personal data, and as such will determine how your personal data is used in the research. The University will process your personal data for the purpose of the research outlined above. Research is a task that is performed in the public interest. Further information about your rights with respect to your personal data is available from the University's Information Compliance web site at *https://compliance.admin.ox.ac.uk/individual-rights*.

12. Who is funding the research?

Saïd Business School and myself.

13. Who has reviewed this research?

This research has received ethics approval from a subcommittee of the University of Oxford Central University Research Ethics Committee.

14.* Who do I contact if I have a concern about the research or wish to complain*?

If you have a concern about any aspect of this research, please contact（**Redacted to protect the identity of the candidate:** 1076552） and we will do our best to answer your query. I will acknowledge your concern within 10 working days and give you an indication of how it will be dealt with. If you remain unhappy or wish to make a formal complaint, please contact the Chair of the Research Ethics Committee at the University of Oxford who will seek to resolve the matter as soon as possible:

The Chair, Social Sciences , and Humanities Interdivisional Research Ethics Committee; Email: ethics@socsci.ox.ac.uk; Address: Research Services, University of Oxford, Boundary Brook House, Churchill Drive, Headington, Oxford OX3 7GB

15. Further Information and Contact Details

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APPENDIX B

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The Impact of Programme Management on the Speed of AI Development in Semiconductor Industries

Interview Questions

Ethics Approval Reference: SSH_SBS_C1A_24_50

1. AI Application Strategy in High-Tech Program

1) Which domain below you are interested in AI application in your company?

   i. New Products with hot AI application scenario

   ii. AI is used in R&D Design to improve efficiency.

   iii. AI is used in the supply chain and expand our customers.

   iv. AI development in the new business model.

2) Would you please explain more about the reason for the above choice?

2. Leadership Impact in High-Tech Program

1). What is the decision-making way in your team?

   i. The boss plans and decides himself with less discussion.

   ii. After some discussion with the directors, the Boss makes the final decision.

   iii. The team decides together.

2). If there is AI, will your team change your decision-making? What's the AI's role?

3). Which domain, you don't want AI to join the decision-making? You would like to protect your data, or you don't trust AI?

4). Which domain, you would like AI to help you more when you make a decision?

3. Technique Impact in High-Tech Program

a. Which level below can match your team's state in your team?

i. You have an IT/CAD team that is focused on digital platform building.

ii. You have a mature digital management and R&D platform in your system.

iii. You start to think about building a digital system in your project.

iv. You don't need a team to focus on data, it's waste money, data comes from each team separately in their daily life.

b. Which level below can match your data collection and analysis state in your team?

i. Your data is coming from each department's daily work.

ii. Your data is discrete, you have project data, customer data, and financial data.

iii. You have a lot of experience on R&D data analysis, and you have a flexible digital platform for the database, and you always change the way how to use them.

iv. you are clearly about how to use your old database in a digital platform in the future.

v. You have a quite safe way how to store and protect your team data.

4. **Organization Impact in High-Tech Program**

a. Which domain below matches your organization state in your company?

i. Quite flat organization in the company.

ii. Quite a hierarchy organization in the company.

iii. Frequently changed leader style or organization in the company.

iv. Unchanged leader style or organization in the company.

v. Your organization is quite flexible to make a big change.

vi. Your organization works across the different team quite well.

b. Which domain below matches your organization's AI state in your company?

i. The organization matches our company's strategy quite well.

ii. You know how to make the AI cooperation with your current organization well.

iii. You don't know how to make the AI cooperation with your current organization well.

iv. Your customer, supply change already own an AI ecosystem for you

3). If you would like to put AI in your team, which kind of organizational improvement is necessary in your company?

5. **Innovation and Culture State in High-Tech Program**

a. Which domain below matches your innovation state in your company?

i. We always develop new products, (not new versions of the old products, I mean a totally new one.)

ii. We always try new techniques in our current products.

iii. We changed a lot of the team members in our team.

iv. We changed a lot in the directions of each period.

v. We change our way to finish the same product development frequently.

vi. We change our customers a lot.

vii. We change the boss/leader of the team a lot.

viii. I change the company/team a lot.

b. If you would like to make a big change in your company, what's is probably happening in your team?

i. A majority of team members will be happy and excited, whatever the change.

ii. A majority of team members will feel risky and pressured, whatever the change.

iii. When I made some changes, I made it a little bit, slower, to observe what's happened in the past

iv. When I made some changes before, I took the action sharply and made a strong action to push the team members.

v. Any change will take a long time until everyone can accept it.

vi. Change can be done quite fast in my company.

c. Which matches more in your company?

i. We don't put the money on this risky thing.

ii. It would cost a lot of time to train the employees for AI and our customers. It's cost too much time for the company. Each team is under high pressure with current projects, nobody has spare time to try a totally new thing.

iii. AI is still an uncertain domain to try. We prefer some reliable ways.

d. Would you please explain how you made the change in your company before?

6. **Challenges in AI application**

a. What are the biggest challenges in AI application in your management?

i. Vague strategy in AI application

ii. Data protection requirement.

iii. Not all stakeholders are interested in AI.

iv. Team technique skill is limited for new AI products and applications.

v. It’s hard to change the current cooperation way in our team.

vi. We don’t have enough time and money for AI.

2). Would you please explain the AI application level of your current team?

APPENDIX C

Interview Questions Coding Table

Coding	*Coding Number_Question1*	*Coding Number_Question2*
S1	*Strategy*	*Strategy for External Product clearly*
S2	*Strategy*	*Strategy Change*
S3	*Strategy*	*Strategy for internal Process clearly*
L1	*Leadership*	*Bottom/Top Decision Making*
L2	*Leadership*	*flexible leader style*
L3	*Leadership*	*Leader Change*
T1	*Technique Skill*	*Data Analysis/Methodology*
T2	*Technique Skill*	*Digital Platform building*
T3	*Technique Skill*	*New technique innovation*
T4	*Technique Skill*	*AI technique Development*
O1	*Organization Structure*	*Flatten/Hierachy Organization*
O2	*Organization Structure*	*Reward system*
O3	*Organization Structure*	*Organization Changable*
C1	*Capital*	*Time Cost on AI*
C2	*Capital*	*Budget on AI*
C3	*Capital*	*Talent hiring on AI*
I1	*Culture*	*Attitude for new things in top*
I2	*Culture*	*Attitude for new things in bottom*
I3	*Culture*	*Transparant*
I4	*Culture*	*Pressure/Workload*
P1	*Process*	*Cross Team work*
P2	*Process*	*Result measure/accessment*
P3	*Process*	*Process speed for new change*
P4	*Process*	*Engineer training on AI*
A	*AI Market Scale*	*AI or Digital Data technique Development State*

Results Ranking Criteria:

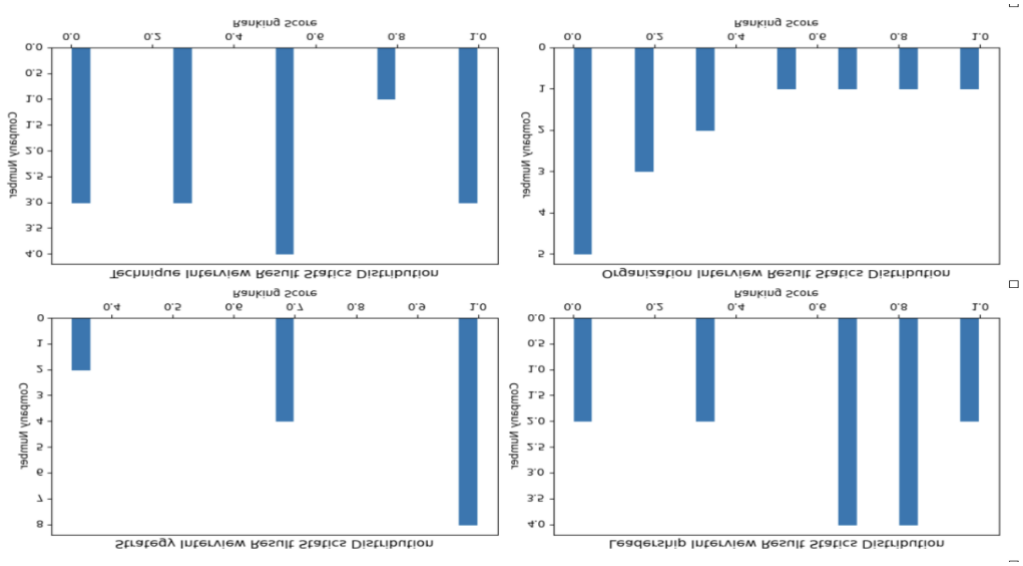
- Changeable/Bottom-up/Random: 1
- Stable/Top-down/Fixed: 0
- Achievement/AI Market Scale Ranking:
  - World Top 1 AI Design Company: 10
  - World Top 10 AI Design Company: 8
  - Successful Digital Platform in Company: 6
  - Do some research on AI in Company: 4
  - Do nothing on AI: 2

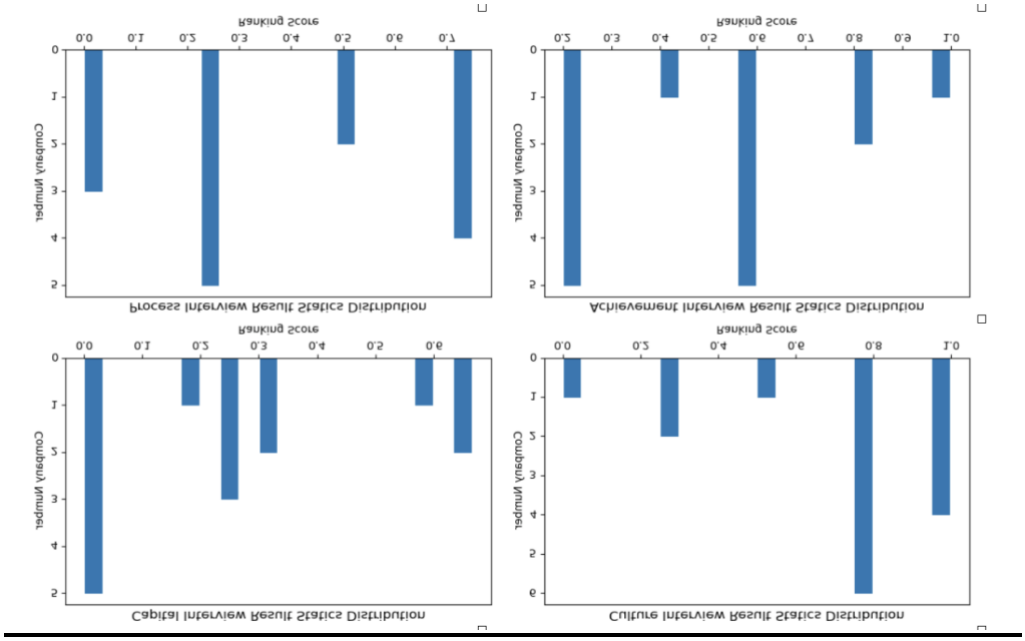
APPENDIX D

Interviewer Results

	S1	S2	S2	L1	L2	L3	T1	T2	T3	T4	O1	O2	O3	C1	C2	C3	I1	I2	I3	I4	P1	P2
VIP1	1	1	1	1	1	1	0	1	1	0	0,5	1	1	1	1	1	1	1	1	0	1	1
VIP2	1	1	1	0	0	0	1	1	1	0	0,5	1	1	1	1	1	1	0	1	1	1	1
VIP3	1	0	1	0	0,5	0	0	0	0	0	1	1	1	0	0	0	0	0	1	1	1	1
VIP4	1	1	0	0	0	0	0	0	1	0	0,5	1	1	1	1	1	1	0	1	1	0	1
VIP5	1	1	1	1	0	1	0	1	1	0	0,5	1	1	1	1	1	1	1	1	0	1	1
VIP6	1	1	1	0	0	1	0	0	1	1	0,5	1	1	1	1	1	0	0	0	1	0	1
VIP7	1	0	0	0	0	0	0	0	1	0	0,5	0	0	0	0	1	0	0	0	1	1	0
VIP8	1	1	1	0,5	1	0	1	1	1	1	0,5	1	1	1	1	1	1	1	1	1	1	1
VIP9	1	1	0	1	0	0	0	0	0	0	0,5	0	0	0	0	0	0	1	1	1	1	0
VIP10	1	1	1	0,5	0	0	1	1	1	1	0,5	1	1	1	1	1	1	1	1	1	1	1
VIP11	1	1	1	0,5	0	0	1	1	1	1	0,5	1	1	1	1	1	1	1	1	1	1	1

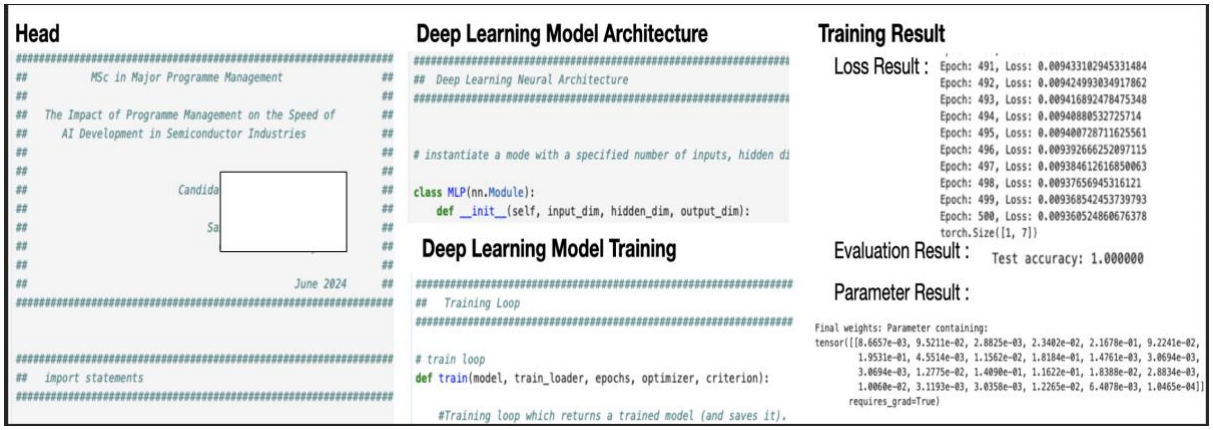
Interviewer Statistic Results





APPENDIX E

Data Analysis: AI Deep Learning Model Generating, and Training



Head

```
##########################################################
##          MSc in Major Programme Management           ##
##                                                      ##
##   The Impact of Programme Management on the Speed of ##
##      AI Development in Semiconductor Industries      ##
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##                                        June 2024     ##
##########################################################


##########################################################
##   import statements
##########################################################
```

Deep Learning Model Architecture

```
##########################################################
##  Deep Learning Neural Architecture
##########################################################


# instantiate a mode with a specified number of inputs, hidden di

class MLP(nn.Module):
    def __init__(self, input_dim, hidden_dim, output_dim):
```

Deep Learning Model Training

```
##########################################################
##   Training Loop
##########################################################


# train loop
def train(model, train_loader, epochs, optimizer, criterion):

    #Training loop which returns a trained model (and saves it).
```

Training Result

Loss Result :

```
Epoch: 491, Loss: 0.009433102945331484
Epoch: 492, Loss: 0.009424993034917862
Epoch: 493, Loss: 0.009416892478475348
Epoch: 494, Loss: 0.009408880532725714
Epoch: 495, Loss: 0.009400728711625561
Epoch: 496, Loss: 0.009392666252097115
Epoch: 497, Loss: 0.009384612616850063
Epoch: 498, Loss: 0.009376569453161121
Epoch: 499, Loss: 0.009368542453739793
Epoch: 500, Loss: 0.009360524860676378
torch.Size([1, 7])
```

Evaluation Result : Test accuracy: 1.000000

Parameter Result :

```
Final weights: Parameter containing:
tensor([[8.6657e-03, 9.5211e-02, 2.8825e-03, 2.3402e-02, 2.1678e-01, 9.2241e-02,
         1.9531e-01, 4.5514e-03, 1.1562e-02, 1.8184e-01, 1.4761e-03, 3.0694e-03,
         3.0694e-03, 1.2775e-02, 1.4090e-01, 1.1622e-01, 1.8388e-02, 2.8834e-03,
         1.0060e-02, 3.1193e-03, 3.0358e-03, 1.2265e-02, 6.4078e-03, 1.0465e-04]]
        requires_grad=True)
```

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