Ecosystem Theory and the Adoption of Artificial Intelligence in SMEs

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Abstract: Given the various risks involved in incorporating artificial intelligence (AI) and machine learning into their business operations, firms are at an inflection point about how to do so. In this paper, we propose that for small medium-sized enterprises (SMEs), which lack capital, large quantities of data, and expertise, the best solution would be to join a pre-existing (or developing) ecosystem. From the two potential alternatives available to an SME, going it alone or depending on a larger corporation, we argue for a third option, the joining of an ecosystem of organizations that use AI systems in their operations, as the golden mean. We conclude with some practical and theoretical implications.

Keywords: Artificial intelligence, Adoption of artificial intelligence, SME (small to medium-sized business), Ecosystems, AI research and development, Data autonomy

1. Introduction

Currently, SMEs are making choices about the degree to which they will utilize AI and the ever-expanding capabilities of this new technology (IBM Global AI Adoption Index 2022, 2022; Sjodin, et al 2021). The literature surrounding AI is vast and growing daily. However, when we use an adoption lense we start to see a gap in the literature. Most of the research offers knowledge about large corporations and in particular large tech companies. SMEs make up a very large part of the economy and yet understanding how they are adapting to the introduction of AI has not been examined in as much detail. A significant portion of the literature outlines how ecosystems are used by IT companies for innovation and adopting AI and we became interested to see how ecosystems related to and possibly provided utility to SMEs. Adopting AI technologies is not straightforward, there are many challenges involved and they fall into three key categories. The first challenge is cost. The amount of capital available for R&D has historically been a limiting factor (Schumpeter, 1934). How businesses finance AI adoption (Sharma et al., 2024) and the availability of capital will directly affect the type of AI adopted and its success in providing positive outcomes. The second challenge is the availability of relevant, clean and usable data in sufficient quantities (Jacobides et al., 2021, Hopf et al., 2023). This data is used to train an AI on a particular business function, so it needs to be usable both technically and legally. Finally, one of the biggest challenges in adopting AI is the expertise and knowledge (Alet, 2024) required for a technical system roll out that could have far-reaching effects on business operations. Those who wish to implement AI need to understand both the business problem and how AI can solve it, and such expertise is in high demand (The Human Capital Behind AI, 2021).

Given that SMEs do not usually have access to the above resources, they cannot develop AI alone and must depend on a large tech company for both access to expertise and to significant pools of relevant data. The adoption of AI is surprisingly easy when relying on a large tech firm, however there is a danger in this choice, one that might not be realized for many years, data autonomy is surrendered. Data autonomy in this sense, means a company's ability to use its data exclusively. Large tech firms will pool the data, maybe with the data of other companies within related industries in order to train and make an AI more responsive. In essence, the data that a company generates each year in order to become more competitive is accessible to all through a 'common' AI. Along with 'abdicating the expertise' of how the AI will be trained and what it will focus on to the tech firm, the SME will often have to adopt the large tech firm's platform, perhaps their enterprise software or their cloud computing options, all of these options serve to make it progressively harder for the SME to change services or gain back its autonomy. The speed with which AI is making it into industries and business sectors makes the situation even more precarious to SMEs who may opt for the easiest and fastest choice because of the fear that competitors may already be using AI to gain advantage.

In this paper, we propose a third option, as the golden mean between going it alone and becoming fully dependant on a larger organization for SMEs, which want to implement AI systems in their operations. This third option consists of SMEs joining pre-existing ecosystems of organizations that use AI systems in their operations. Understanding that this recommendation can at first seem counterintuitive, join a group to maintain autonomy, we outline how that can be accomplished.

Ecosystems provide unique opportunities that can create an advantage for firms incorporating AI technologies (Moore, 1993, Williamson & De Meyer, 2012, Müller-Stewens & Stonig, 2019, Holgersson et al., 2022). J.H. Moore defined an ecosystem as "a network of organizations and individuals that co-evolve their capabilities and roles and align their investments so as to create additional value and/or improve efficiency" (Moore, 1993, p.76). Ecosystems are particularly useful to firms when adapting to emerging competitive trends, respond to large technological competitive forces, or developing innovations (Zhang & Williamson, 2021). By joining ecosystems SMEs we argue, can to a certain extent avoid both the need for developing all the necessary resources alone or becoming fully dependent on another larger organization. SMEs gain greater access to experts and have the impetus to develop in-house knowledge, they can pool R&D resources sharing innovations or they can develop parts of a greater whole within the ecosystem. Most importantly they have the ability to retain greater data autonomy.

Ecosystems allow for a deeper inter-relationship between firms, “business ecosystems are an organizational form that enables coordination between independent but complementary players around a shared value proposition, thus creating added value.” (Müller-Stewens and Stonig, 2019, p. 3). There is utility in developing a deeper understanding of business ecosystems to determine if they can be used as a strategy to solve this problem. Questions also arise about how big of an impact the apparent lack of capital for research and development for AI has on businesses, and in particular SMEs. The implications of deepening our knowledge in applying ecosystem theory to the adoption of AI by SMEs are twofold. First, it can offer SMEs new strategy options to help them modernize and remain competitive using AI which given the sheer size of SMEs in the economy, can lead to significant market opportunities. Additionally, a better understanding could guide policymakers and help focus their efforts on supporting SMEs more efficiently and effectively.

The remainder of our paper proceeds as follows. In the next section, we discuss the main problems of AI adoption in business and then we refine our view of these issues to focus on SMEs, specifically the options of exploring AI alone or depending on another larger corporation for its AI adoption. Following, we discuss the main characteristics of ecosystems and proceed to argue that SMEs joining AI ecosystems can avoid, to some extent the previously identified problems. We conclude by discussing the implications of our work for research and managerial practice.

2. Issues Surrounding the Introduction of AI

The business community, government and researchers are all actively discussing AI. According to the IBM Institute, “Roughly half of CEOs feel pressure from business partners to accelerate adoption of generative AI - and two-thirds of executives say their organization needs to quickly adopt generative AI for innovation. However, only 39% of organizations are currently implementing or operating generative AI for innovation and research.” (IBM Global AI Adoption Index, 2022). Despite high interest, adoption lags. Businesses are utilizing this moment to analyze their business needs and identify where AI can add value.

AI availability for business use is extensive with free large language models and bundled options from companies like Microsoft and Adobe. However, adopting commercial off-the-shelf (COTS) AI models may limit overall control and create dependencies on the platform provider. “There are important differences between firms that adopt only off-the-shelf AI solutions and those that build in-house capacity for AI.” (Automation Nation AI Adoption in Canadian Businesses, p. 62). Integrating company data into AI models can complicate future transitions and unintentionally agreeing to a greater relationship with the platform than just the purchase of a service. Data management is crucial (Freeman et al., 2021). To avoid losing competitive advantage, business should consider developing unique, tailored AI strategies for decision-making, process improvement, and innovation. Further, all these COTS options are readily available to an organization's competitors. Therefore, this type of adoption should be entertained as a minimum so that no advantage is surrendered. Simply put, a business could gain a competitive advantage through choosing the harder strategy of developing a more unique and tailored approach, perhaps focusing on how AI can improve its ability to conduct strategic decision making, business process improvement or innovation.

The adoption of AI must be preceded with analysis and understanding the issue. The discrepancy between those business leaders who claim that incorporating AI into their business is very important and those who are moving forward and adopting the new technology can be understood by viewing the problem through the experience lens (The Human Capital Behind AI, 2021). Often an 'issue champion for AI' is needed to shepherd the issue and ensure that the organization is making the right choices in the lead-up to the adoption of AI. There exists the “importance of AI-relevant competencies (e.g., data scientists with deployment-oriented skills or domain experts that can make productive use of data)” (Ångström et al., 2023, p. 7). As the trend of AI adoption increases

so too does the demands on the labour market for those with AI-related skills for example, in Canada it is noted that there has been 17% more hiring in the AI sector than the total labour market from 2018 to 2022 (AI Index Report, 2023).

It has been a long-established norm that firms have difficulty in funding R&D by accessing external funds (Schumpeter, 1934). Carrying debt to conduct R&D presents two distinct issues. First securing debt for R&D requires a higher level of ROI guarantee than for a similar loan intended for capital investment and secondly, the SME needs to demonstrate adequate cash flow to service the debt (Czarnitzki and Hottenrott, 2011).

3. SMEs

By sharing these resources, businesses can significantly reduce the costs associated with acquiring them. Ecosystems can be the “Key to minimizing an important cost disadvantage relative to vertically integrated structures” (Williamson & De Meyer, 2012, p. 33). Adopting the strategy of joining an ecosystem, businesses can share risks and learn from the successes and failures of other ecosystem members (Nalebuff & Brandenburger, 1997). This can reduce costs associated with trial and error (Müller-Stewens & Stonig, 2019) and increase the likelihood of successful innovation and AI adoption. An ecosystem that includes partners, suppliers, and customers helps align those businesses - bringing them all on to the same page “to deliver customer value cost-efficiently in an ecosystem, the activities of partners with complementary capabilities need to be aligned” (Williamson & De Meyer, 2012, p. 35).

Shared costs reduce organizational expenses. Collaboration through an ecosystem can mitigate the largest obstacle to AI adoption: knowledge. Many SMEs lack the understanding to develop, adopt and utilize AI. Approximately 35 to 38 percent of organizations identify the lack of expertise or in-house AI competency as a barrier (Ulrich & Frank, 2021, p. 2156). Conversely, "38% of executives say their organization has the in-house expertise to adopt generative AI for innovation" (Harness the Power of Ecosystem Innovation, IBM Institute for Business Value. https://ibm.co/ceo-generative-ai-innovation).

Most SMEs lack enough AI knowledge needed to assure leadership (Sharma et al., 2024) that expenditures will provide ROI, and that relevant data can be made available for the project. The possibility of proposing changes to a business' core competencies -while the business is operating -will be met with some degree of resistance creating another barrier to the adoption of AI (Alet, 2024). These skill sets are not common (The Human Capital Behind AI, 2021) and many large organizations have been hiring AI experts from academia and tech companies in order to secure their in-house talent. “Undersupply of the relevant skills is known to have first-order effects over innovation and economic performance and shapes the competitiveness of firms, industries and countries alike.” (The Human Capital behind AI, 2021, p. 18). The demand for AI positions in the US labour market tripled over the 5 years from 2014 to 2019 (The Human Capital Behind AI, 2021). Securing in-demand talent is seen to be a greater issue amongst SMEs than for large companies with deep pockets. Access to a cadre of knowledgeable staff will become increasingly important if companies want to remain competitive.

Interestingly, of the three constraints that affect businesses when they consider adopting AI for their organization, the one with the most impact would appear to be access to available, relevant, and clean data (Jacobides et al., 2021, Hopf et al., 2023). Currently, businesses have many options for utilizing AI, mostly commercial off-the-shelf (COTS) solutions. For example, a company can install a customer service chatbot on their IT network, or purchase 'AI as a service' from an external provider, such as an externally hosted LLM or supply-chain advice for a subscription fee. While these options count as AI adoption, they are also available to competitors, offering little competitive advantage. To gain an edge, companies need to develop AI models that are more relevant, unique, and specific to their needs which requires relevant data.

Unfortunately, the lack of this data is a significant hurdle to the development of an AI model (Hopf et al., 2023). The requirement for data that is both relevant to the organization (i.e. customer product preferences) clean (verified and structured in a way to facilitate learning) and exists in large enough quantities makes AI adoption quite difficult for SMEs (Ångström et al., 2023). Data preparation is equally as important as the quantity of data required for machine learning. The data needs to be cleaned, which essentially means it needs to be verified for accuracy and completeness. Lack of data is a common barrier to the adoption of AI as “Organizations are often faced with limited data for machine learning applications. They often need to wait a considerable amount of time, sometimes years, before they have collected sufficiently large and representative amount of data” (Hopf et al., 2023, p. 35). When the data changes or new data is produced, it too needs to be prepared to be useful. Ecosystem data if pooled and applied to the problem of AI adoption, could provide the needed amounts and enhance the AI model and increasing its efficacy (Alet, 2023).

4. Business Ecosystems

Ecosystems provide access to shared resources, perhaps reducing the need to secure outside capital. These resources can include data, technology, infrastructure, and human capital all of which are crucial for innovation and AI adoption. In an environment where resources are finite, collaboration can provide benefits. The structure and modular connectivity of ecosystems lend themselves to collaboration and notably innovation or solving complex problems (Tsvetkova and Gustafsson, 2012). Ecosystems have been documented to provide a competitive advantage to those organizations employing them to solve problems like complex innovation or the adoption of digital platforms. (Adner & Kapoor, 2010, Williamson & De Meyer, 2012).

An ecosystem differs from a value chain (Porter, 1987) and a supply chain (Simchi-Lev, 2005). Value and supply chains involve bilateral, transaction based- relationships. If an organization is removed, the chain can be restored by replacing the organization or internalizing its function. In contrast, removing an entity from an ecosystem has broader implications (Alet, 2023). Additionally, it is important to distinguish between an ecosystem and a digital platform (Jacobides et al., 2021) large companies like Apple and Amazon are often mis-labeled as ecosystems. They are platforms that allow use for a fee or profit-sharing. For example, Apple offers developers code to create applications compatible with iOS profiting from future sales. Apple governs this network (Cusumano and Gawer, 2002) and can remove any developer from it. In its simplest form, "a platform is nothing more than a technological foundation that brings together different activities (of players and objects) in a coordinated way." (Müller-Stewens & Stonig, 2019, p. 5) Due to the requirement of information sharing and coordination - *platforms are necessary for ecosystems, however, platforms aren't necessarily ecosystems*.

The business ecosystem is a force multiplier that provides greater value to the members than could be otherwise achieved through partnerships, supply-chain contracts, or shared digital platforms. The ultimate purpose of an ecosystem is the materialization of a joint value proposition by several players that cannot be achieved by any one of these players in isolation (Jacobides et al., 2018). Organizations can adopt a joint strategy to share resources, knowledge, research, and business data. Understanding of the adoption of AI through ecosystem theory offers solutions to complex problems and also offers practical applications beyond academia.

5. SMEs and AI Ecosystems

There are a lot of conflicting signals about how to adopt AI so a business can gain an advantage. The problems faced by SMEs are capital availability (Sharma et al., 2024), clean and usable data in sufficient quantities (Jacobides et al., 2021, Hopf et al., 2023) and expertise and knowledge (Alet, 2024). Further to the aforementioned common innovation adoption problems, new issues specifically relating to data autonomy, the development of an 'in house' or readily available knowledge cadre, and control over the new AI business tools all make the choices of how a SMEs adopts AI more complex. Business ecosystems, we maintain, can address all these issues better than alternative organizational forms.

Regarding cost, early indication by Fortune 500 companies have shown that AI, when adopted into a business effectively, have reduced costs in “supply chain management (-52%), service operations (-45%), and risk (-43%). On the revenue side, the functions that most respondents saw increases in because of AI adoption were marketing and sales (70%), product and/or service development (70%), and strategy and corporate finance (65%)” (McKinsey -Global AI Survey 2021). The interest in AI adoption is increasing however, cost remains a barrier. Development, training, data-related, infrastructure and maintenance costs all hinder greater adoption despite the benefits and interest. Adopting AI requires a research and development mindset, not just capital investment, significant data preparation is needed. Adopting AI can be a greater commitment than adopting CRM or enterprise software, requiring research, development and project management skills. All of which can provide a disincentive for AI adoption amongst SMEs based solely on the difficulty of this task (Sharma et al., 2024).

AI adoption through a large provider like Microsoft (ChatGPT 4.o) or Amazon (Azure) can take many forms. Developer tools are made available by large tech companies as a way of inducing SMEs to choose one AI over another. However, this does not work for a SME unless they have the requisite knowledge to use those developer tools or a knowledge cadre in their employ. Knowing this, the large tech companies recommend other businesses that, for a fee or by subscribing to an ongoing service, specialize in helping SMEs to adopt a large tech's AI. In both of these arrangements the SME would still be required to surrender their data (past and future) to the large tech firm. This data would of course be pooled and used to enhance the AI and its future training requirements. The problem with this model is twofold. First, data autonomy is surrendered, and full control is lost. Ironically, a SMEs data could conceivably be pooled with their competitors' data using the same AI. This instance would see

a very limited advantage gained by using AI and in fact a loss of profitability because of the ongoing outlay of capital in using the big tech's AI platform.

6. Implications and Conclusion

The integration of AI into business operations has become a strategic imperative. SMEs leveraging ecosystems for AI development can significantly enhance their business processes, leading to a multitude of positive implications. Initially, access to resources and expertise is a key advantage. AI development requires substantial resources and specialized knowledge, which businesses may lack. By participating in an ecosystem, they can access shared resources and tap into the collective expertise of the ecosystem, thereby overcoming resource constraints and accelerating AI development. The interconnectedness and diversity of ecosystems can provide a buffer against uncertainties and changes in the business environment. This can enable firms to adapt and respond effectively to challenges and disruptions in their AI development efforts. It provides access to resources and expertise, fosters innovation, enhances learning and capability development, provides market access and opportunities, and retains much more autonomy for the SME.

Although the use of an ecosystem could lower costs and provide necessary access to data and AI knowledge there are still limitations to what this strategy can achieve. While large corporations have been at the forefront of adopting AI, SMEs have found adoption difficult. SMEs may be reluctant to share their data within the ecosystem due to privacy and security concerns. Choosing to join an existing ecosystem over a large tech firm's platform would give the SME much greater control over the data and how it is handled. A similar critique of joining an ecosystem arises when the future costs of development are considered. Would it not be better to join a large tech firm and allow them to focus on innovation? Unfortunately, once committed to a particular large tech AI the cost can only increase over time as the difficulty a SME would face to leave that platform and move to another would prove to be much greater than staying. A SME may very well take the decision to let large tech 'take care' of their AI, which would have them surrender their data autonomy, make them in some ways 'beholden' to big tech and would not allow them the opportunity to innovate independently of any of their competitors who are also part of the same or similar large tech corporation's AI platform.

The practical implications offered by the approach of joining an ecosystem offer new options to SMEs that are concerned about data autonomy, the development of their own knowledge cadre and maintaining more control over their AI tools. As well, this approach may be of interest to government policymakers who seek to support local or home country SMEs and their ability to maintain their autonomy and competitiveness. More exploration of ecosystem theory, specifically determining the line between what makes an ecosystem and what becomes a platform dominated by one large member could provide great insight to academia on how AI is being adopted both regionally and in different industries. Future studies could explore not only how entrepreneurs are utilizing this powerful business tool but also if AI is helping to create more entrepreneurs or if the only winners of the new AI landscape are the existing large tech firms.

In conclusion, ecosystems, with their collaborative, innovative, and resilient nature, could provide a powerful approach to help solve complex business problems such as the adoption of AI by SMEs. As businesses continue to grapple with increasing complexities in the global business environment, the role of business ecosystems is likely to become even more significant. Seeking to overcome the barriers to AI adoption, organizations may use joining an existing business ecosystem as a strategy to reduce capital costs, share knowledge and perhaps most importantly retain their data autonomy.

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