

Impact of Adopting Industry 4.0 Technologies by SMEs in Smaller Countries

Assignment 2 – Introduction to Industry 4.0 Essay

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Introduction

The fourth industrial revolution, also referred to as Industry 4.0, has the potential to transform how Small and Medium-sized Enterprises (SMEs) operate across the globe. Since it was firstly introduced in 2011 (Winter, 2020), it is changing the way companies manufacture, improve, and distribute their products (IBM, n.d.). This is possible due to the advancements in technologies such as Internet of Things (IoT), Artificial Intelligence (AI), Advanced Manufacturing, Cyber Security and Cloud Computing which are transforming the way companies produce goods and services.

The concept of Industry 4.0 is rooted in the idea of creating a smart factory, where machines and systems can communicate with each other and make decisions autonomously. This leads to greater efficiency, flexibility, and customisation of production as well as improvements in performance and reduced human intervention. The integration of Industry 4.0 technologies also allows for greater connectivity between different parts of the supply chain, enabling greater collaboration and optimisation. These benefits are especially important for SMEs in smaller countries, as they often face challenges in competing with larger, more established companies.

However, the adoption of Industry 4.0 technologies by SMEs in smaller countries is not without its challenges. SMEs in smaller countries are increasingly facing the challenge and pressure to adopt Industry 4.0 technologies in order to remain competitive in the global marketplace. The adoption of Industry 4.0 technologies also poses a number of challenges for SMEs in smaller countries, such as a lack of knowledge and expertise, limited access to funding, and a lack of infrastructure. Additionally, it can also be costly and time-consuming, which may be significant barriers for SMEs in smaller countries. Many SMEs in smaller countries may also lack a methodical approach to implementation which often leads to confusion and setbacks.

This essay begins by exploring the impact of adopting Industry 4.0 technologies by SMEs in smaller countries including the benefits and challenges they face in implementing these technologies. It then explores the requirement for technologies, the need to assess appropriate elements of an organisation and other humanistic elements that has an impact on adopting Industry 4.0 technologies. Subsequently, this essay will identify appropriate case studies that shows real-life examples of how SMEs have adopted Industry 4.0 technologies. This aims to identify the best practices, identify the key factors for success and identify ways in which Industry 4.0 can help SMEs in smaller countries become more competitive in the global marketplace.

Main Content

The adoption of Industry 4.0 technologies by SMEs in smaller countries can have a significant impact on their operations and competitiveness, both positively and negatively.

Once, automation was only really possible for large companies, however, automation is now achievable and affordable for even small businesses (Countingup, 2022). Streamlining their business operations can lead to cost savings which can be particularly important for SMEs with limited resources. One of the main benefits of adopting Industry 4.0 technologies for SMEs in smaller countries is improved efficiency. By implementing automation, this can help SMEs in small countries to optimise their production processes and overall productivity. Additionally, the use of robotics and automation can help SMEs to increase output while reducing labour costs. Automation refers to the use of technology to perform tasks without human intervention. This can include tasks such as manufacturing, transportation, and data processing. More specifically, SMEs can take advantage of this by automating their social media to consistently schedule a post in advance for their existing and potential customers. Chatbots can also be implemented on the company's website to deal with simple customer service questions which can ultimately free up human agents to do other things in the business. For small companies with a small group of staff, this can be very beneficial. Additionally, analytical tools such as Google Analytics can automate the collection and analysis of data across platforms such as the company's web and app (Google, n.d.).

For example, Wildner, a fashion company based in Germany that provides on-demand textile printing services had success from automating some of its most challenging processes such as printing, order fulfilment and reporting (Etchegaray, 2022). They saw improvements on these aspects and even saw output increases of 190% in their printing stations (Etchegaray, 2021). They went from manually collecting and sorting out orders to automating processes to speed up overall production.

Linked to automation, AI and machine learning can automate repetitive tasks such as data entry and analysis which can free up employees to focus on more valuable work. This, however, relies on the technology being properly setup by a trained professional to ensure that it runs smoothly. Machine learning is a type of artificial intelligence that allows systems to learn and improve from experience without being explicitly programmed. Machine learning capabilities can include tasks such as image and speech recognition, natural language processing, decision-making, and predictive analytics. These capabilities are often implemented using techniques such as supervised and unsupervised learning, deep learning, and reinforcement learning (Audaces, 2022). In addition to this, AI and machine learning can assist with data analysis and provide insights that can help SMEs make better business decisions. It has the ability to improve the quality of products and services by gathering and analysing data to identify patterns and trends, which can be used to improve the design and production of their products. Allowing the technology to personalise products and services for customers based on the data gathered can help generate unique designs which can increase sales and improve customer satisfaction. With predictive maintenance technology, AI and machine learning can also be used to predict when equipment is likely to fail, allowing SMEs to schedule maintenance before a breakdown occurs (Fiix, n.d.).

By using Internet of Things (IoT) devices to track and monitor production processes, SMEs can gain real-time insights into their operations, allowing them to identify and address bottlenecks and inefficiencies. Additionally, the use of robotics and automation can help SMEs to increase output while reducing labour costs. Another benefit of Industry 4.0 technologies for SMEs is increased access to global markets. With the use of technologies such as the

Internet of Things, SMEs can collect and analyse data from their customers and suppliers in real-time, allowing them to make more informed decisions about their operations. Smart and digitalised technologies such as IoT decentralise communication and provide the opportunities for new firms to overcome the barriers of geographical location and access international markets through cocreation business models and changes of the value chains (Kovaite, et al., 2019). Co-creation refers to involving internal and external stakeholders (customers and/or employees) to participate in a collaborative design or problem-solving process to produce a mutually valued outcome (Livescault, 2023). With the Industry 4.0 technologies, this is possible to achieve globally, allowing SMEs to connect with a wider potential market. Value chain is the process or steps that go into the creating of a finished product, from its initial design to its arrival at a customer's door (Tardi, 2022). Both of these can help SMEs in smaller countries to better understand and respond to the needs of their customers, which can be key to expanding their reach in the global marketplace. By using IoT devices to track and monitor production processes, SMEs can gain real-time insights into their operations, allowing them to identify and address bottlenecks and inefficiencies.

Hekotek, a manufacturer of woodworking equipment based in Estonia, are using IoT devices and sensors to monitor and optimise production processes in the wood processing industry. They mainly offer smart factory solutions for the woodworking industry which consists of various sensors and intelligently connected devices to monitor the entire plant to optimise the production or to identify problems (Trade with Estonia, 2020). This has helped companies to increase efficiency, reduce waste and costs, and improve product quality.

The global trend in the market indicates that large companies do not dominate over small companies like they used to in the past. With the technological advancements available today, young, fast and tech-savvy companies with the right approach and investments have tangible chances to get closer to market leaders (Lugovsky, 2021). For example, a previous Factory of the Future program held in Belgium consisted of 65% SMEs (The North Sea Region, 2018).

Industry 4.0 technologies can also help SMEs in small countries to reduce costs associated with labour, energy, and materials. For example, by using 3D printing and advanced manufacturing technologies, SMEs can reduce their investment in traditional manufacturing. 3D printing and AMT create less waste than traditional manufacturing methods, making it more environmentally friendly. Small businesses are often faced with problems like less manpower, less resources, slower production, or no technological innovation (MANUFACTUR3D, 2022). With rapid advancements, 3D printers and materials are now more affordable and accessible for small businesses allowing them to develop and create accurate prototypes in-house that can be used for product testing. Furthermore, the use of advanced technologies such as 3D printing and virtual reality can also aid in product development and testing, allowing SMEs to bring new products to market faster and at lower costs. Additionally, 3D printing allows for low-volume production and is very effective for small production runs, making it ideal for SMEs that do not have the resources to produce large quantities of products. This also eliminates the need for tooling and moulds which is very expensive. Overall, these benefits can help businesses to increase competitiveness and to stand out from its biggest competitors which can ultimately attract investors, existing and potential customers and access new markets.

Another benefit is its ability to improve customer service and experience with the use of Virtual Reality (VR) and Augmented Reality (AR). These technologies are used to improve the training, visualisation, and collaboration of employees, suppliers, and customers. Augmented Reality uses digital technology to provide an experience of the real world with the added computer-generated features in real-time (Navarrete, 2021). An example of this would be buying a piece of furniture and checking how well it fits in its intended environment. Virtual

Reality is similar to Augmented Reality, but instead of augmenting real-world images and sounds, Virtual Reality applications can create computer-generated 3D environments and fully virtual experiences (Navarrete, 2021). An example of this is a person interested in buying a car checking the features, interior and exterior of the vehicle using a VR-powered headset. Both VR and AR can be used to create accurate 3D simulations where training can be safe and free of consequences. SMEs can benefit from this as it can eliminate any off-site training costs whilst providing training in a safe and affordable manner (Hurix, 2022). Another example is an SME called VR Motion who are based in Indonesia which offers various VR panorama virtual tours for Hotels, Resorts, Apartments and so on.

It has been reported that the global market size of VR technology was US\$15.81 billion in 2020 and is expected to increase by 2028 (Grant View Research, n.d.). With advancements in AR & VR technology, both could provide small businesses with opportunities to connect with customers worldwide (Ojasvini, 2022).

The fourth industrial revolution also relates to digital twin technologies which can also benefit SMEs in smaller countries. A digital twin is a virtual representation of a physical object or system (IBM, n.d.). Digital twin technology is used in a variety of industries, including manufacturing, automotive, supply chain, architecture, construction, health care and retail (Newton, 2021). The connectivity, data storage, computing, and bandwidth required to process massive volumes of data involved in creating digital twins were cost-prohibitive in the past, but things have changed since then (SpringML, n.d). Now it can be used to simulate and analyse the performance of the physical object or system in real-time quickly and efficiently, allowing for the prediction of potential issues and optimisation of its design or operation. This can help SMEs in small countries to improve their supply chain transparency, traceability and efficiency. As stated previously, digital transformation will allow SMEs to enhance their competitiveness and reach new markets. Digitalisation also allows industrial SMEs to introduce effective processes to mass produce higher-quality products at lower costs (Lugovsky, 2021).

Data analytics and cloud computing can also help SMEs in small countries to access and analyse data that can help them to optimize their operations, improve their performance and make better business decisions. Data analytics can provide SMEs with insights into their operations and customer behaviour, which can help them make more informed decisions on business activities. Cloud computing allows companies to access and process large amounts of data quickly and easily which can help them streamline their operations and improve efficiency. Cloud computing will help with the delivery of computing services such as servers, storage, databases, networking, software, analytics, and intelligence (Microsoft, 2023). Cloud computing can help organisations reduce costs associated with data storage and management, as well as provide access to advanced analytics tools without the need for expensive infrastructure. With this, Cloud computing also allows SMEs to scale their operations as their business grows without having to invest in new hardware or software. This ultimately leads to the SMEs being able to analyse data from different sources easily which will allow them to gain a deeper understanding of their customers' needs and preferences, which can help them improve customer service and increase customer loyalty. The valuable insights readily available will provide the organisation with a competitive advantage against their competitors and allow them to quickly respond to changes in the market.

Lastly, adopting Industry 4.0 can help SMEs with securing their cybersecurity. This can be used to protect their data, assets, confidentiality, and operations from cyber threats. Having an effective cybersecurity provides SMEs with the confidence to create, innovate and personalise product offerings that can deliver substantial market opportunity and business

growth (Lloyd, 2020). Defending against cybercrime can deliver genuine benefits for SMEs and result in more valuable organisations. Many industries have regulations that require companies to implement certain cybersecurity measures, such as the NIS regulations which require essential service providers to undertake risk assessments and put in place reasonable and proportionate security measures to protect their network (Gov UK, 2022). Additionally, the implementation of a robust cybersecurity measures can demonstrate to customers and other stakeholders that they take the protection of sensitive information seriously. This can increase trust and credibility which can lead to increased business opportunities and revenue. Cybersecurity measures can help organisations detect and respond to cyber threats more quickly and effectively. This can improve operational efficiency and reduce downtime caused by cyberattacks (Lloyd, 2020).

While Industry 4.0 technologies have the potential to benefit small and medium-sized enterprises (SMEs) in small countries, there are also several challenges that SMEs may face when implementing these technologies.

First of all, there are challenges to adopting automation for SMEs in smaller countries. Automation can increase efficiency, reduce costs, improve accuracy and consistency, but it can also lead to job losses in certain industries. The automation of industrial processes through the use of robots and other technologies can lead to the replacement of human workers, which can have a negative impact on the employment opportunities for people in the local area. Automation can lead to job loss among existing employees which can potentially damage the company's reputation and affect the overall economy of small countries (Pettinger, 2021). Automation also has the inability to failover to manual operations if systems and automation fail, relying fully on automation can backfire at some point (Shacklett, 2018). Chronext, a digital platform for buying and selling new, pre-owned and vintage luxury watches (Chronext, 2023), like many other companies, was looking for a way to automate simple repetitive tasks (Herauf, 2020). They eventually onboarded Zendesk, a cloud-based help desk management solution (Software Advice, 2022), in order to provide the expected support by their customers, however, they soon realised that writing code to automate customer service processes was consuming too much time and resources (Etchegaray, 2022).

A report by the European Commission in 2016 has suggested that there is a lack of support and guidance of best practices for adoption new technologies for SMEs (ID Norway, 2020). SMEs in smaller countries may have less access to the latest technologies and information about Industry 4.0 than larger companies or companies in larger countries. They may struggle to find the right employees with the necessary skills and expertise to implement and maintain such technologies. Access to skills is often cited as the biggest barrier to digital transformation especially for SMEs in small countries (NI Business, n.d.). SMEs may also struggle with the complexity of Industry 4.0 technologies once implemented. They may not have the technical expertise to fully utilize these systems, which can limit their ability to benefit from the advancements of the technologies. Cultural change is also a vital aspect of implementing new technologies. Workers must be prepared for the technology shift by the management as big changes can make them unwilling or resistant to adapt (NI Business, n.d.).

Small and medium-sized companies often lack a comprehensive strategy which can be challenging if not realised early in the process. They may struggle with a lack or unorganised resources, including funding, technical expertise, and personnel. They may also find it difficult to identify which technologies and processes to actually adopt and how to integrate them into their existing operations. It is important for the management or directors to develop a comprehensive strategy that takes into account their specific needs, capabilities, and goals. This strategy should include a clear vision for the future, as well as specific objectives and

timelines for achieving them. SMEs should also consider their current technology infrastructure and identify any gaps or areas that need to be updated. SMEs may also have limited access to data and data analytics, making it difficult for them to optimize their production processes and improve their performance. It's also important to involve all stakeholders, including employees, customers and suppliers in the implementation process to ensure that the company's goals align with everyone's interests. With a lack of planning, the implementation process will be more likely to fail or face more challenges along the way.

Another challenge is the limited financial resources that SMEs in smaller countries have to invest in Industry 4.0 technologies. The purchase and installation of advanced technologies such as robots, sensors, and software can be very expensive, and many SMEs may not have the financial resources to invest in these systems. As there is usually a large capital investment required, this makes it more difficult for SMEs to afford the necessary equipment, software and infrastructure. High cost implementation can result in a big loan being taken out by the company in order to afford the technology, however, this can put the company in a risky situation as success is not guaranteed. Limited access to reliable internet, electricity, and other basic infrastructure can affect the performance and reliability of the chosen technology. Additionally, the cost of training employees to use these technologies can also be high, which can be a significant burden for small businesses. However, there are several ways that SMEs can overcome this challenge. One way is to start small and gradually implement the technologies over time. This can help to minimize the initial investment required and allow the SME to see a return on investment before committing to further implementation. Another way is to take advantage of government funding and grants that are available to help SMEs implement Industry 4.0 technologies. Many governments around the world have programs in place to support SMEs in adopting new technologies, and these can be a great way to access the funding needed to implement Industry 4.0 technologies. SMEs can also partner with other companies or organisations to share the cost of implementing the technology that both parties can benefit from. This can include partnering with other SMEs, larger companies, or research institutions.

Furthermore, SMEs in smaller countries may face legal and regulatory challenges when it comes to implementing Industry 4.0 technologies, such as data privacy and security laws. SMEs may be required to comply with data protection laws and regulations when collecting, processing, and storing data generated by Industry 4.0 technologies. It is also important to understand the need to protect their own intellectual property and ensure that they are not infringing on any existing intellectual property rights. A well comprehensive patent search can be requested from a patent attorney to ensure that it is covered (OC Patent Lawyer, 2018). Additionally, the technologies may also be subject to specific regulations and standards, such as those related to safety, energy efficiency, and emissions. SMEs may need to ensure that they are compliant with these regulations and standards. And lastly, SMEs may be held liable for any negative impacts or harm caused by their Industry 4.0 technologies, such as equipment failure or data breaches. All things must be considered which can be costly and complex but it will avoid any unnecessary or unwanted costs to arise in the future.

SMEs may also face challenges in terms of data privacy and security. As it relies heavily on the collection and analysis of data, this can make the business more vulnerable to cyberattacks. SMEs may also not have the resources to invest in cybersecurity measures to protect their data which cannot be delayed. Cyberattacks can cause devastating consequences for any business, however, SMEs in small countries may be more particularly vulnerable to cyber-attacks, which can compromise the security of their data and disrupt their operations. The risk of hacking, tampering or using data for malicious intent becomes more prevalent when everything is connected, which ultimately leads to data security breach

(Firican, n.d.). Verizon's 2022 Data Breach Investigations Report states that 43% of data breaches involve small business victims (Halperin, 2023). This can be due to small businesses failing to use data security software, lack of preparation or other security measures. This can be avoided by implementing a comprehensive cybersecurity plan which may include using a robust antivirus software and secure devices. As well as, educating employees about the risk and raising awareness internally. It is crucial to continually train employees on cyberattack risks (Halperin, 2023).

Overall, SMEs in small countries may face a number of challenges when implementing Industry 4.0 technologies, including financial, technical, and regulatory challenges, making it important for them to ensure to create a well-structured strategy plan for implementing the desired Industry 4.0 technology.

Conclusion

In conclusion, the impact of adopting Industry 4.0 technologies by SMEs in smaller countries is significant. The integration of advanced technologies such as the Artificial Intelligence (AI), Internet of Things (IoT), Cybersecurity, Additive Manufacturing Technologies, Virtual and Augmented Reality (VR & AR) and Automation into the manufacturing processes has the potential to increase efficiency, reduce costs, and improve product quality for its internal and external stakeholders. This in turn, can help SMEs in smaller countries to remain competitive in the global market, as well as create new opportunities for growth and expansion.

However, it is important to note that the implementation of Industry 4.0 technologies is not without its challenges. While there are certainly benefits to be gained, smaller countries may face difficulties in terms of access to funding, lack of skilled workforce and availability, and limited infrastructure. Moreover, there is a risk of increased automation leading to job losses, which can have a negative impact on local communities.

To overcome these challenges, it is crucial for SMEs in smaller countries to have access to adequate resources and support. This can include government funding and training programs, as well as collaborations with larger companies and research institutions. Additionally, it is important for SMEs to adopt a strategic approach to technology adoption, focusing on areas where they can gain the most benefit while minimising disruption to their operations. Despite these challenges, SMEs in smaller countries should consider the long-term benefits that Industry 4.0 technologies can bring and actively seek ways to overcome the barriers to adoption.

Overall, the impact of Industry 4.0 technologies on SMEs in smaller countries is multifaceted, with both potential benefits and challenges which needs to be carefully considered. Nevertheless, it is clear that the integration of these technologies can lead to significant improvements in efficiency and competitiveness and is an essential step for SMEs in smaller countries to take in order to remain relevant in the global market.

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