

Title: SMEs in Wales and Use of Advanced Industry 4.0

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Introduction

The advent of Industry 4.0, characterized by the integration of digital technologies into various sectors, has ushered in a new era of innovation and transformation in the global business landscape. Small and medium enterprises (SMEs) play a vital role in driving economic growth, fostering innovation, and creating employment opportunities.

In Wales, SMEs form the backbone of the economy, making it imperative for these enterprises to embrace Industry 4.0 and leverage its potential benefits. The purpose of this study is to examine the utilization of Industry 4.0 technology within SMEs in Wales. By exploring the current state of SMEs in Wales and analysing how they adopt and utilize.

Industry 4.0 technologies, this research aims to shed light on the opportunities, challenges, and impacts of Industry 4.0 adoption for SMEs in the Welsh context. Industry 4.0 represents the fourth industrial revolution, enabled by a convergence of technologies that blur the lines between physical and digital domains. Key characteristics of Industry 4.0 include connectivity, data-driven decision making, automation, and customization. This revolution is driven by several core technologies, including the Internet of Things (IoT), big data analytics, artificial intelligence (AI) and machine learning (ML), cloud computing, cyber-physical systems (CPS), additive manufacturing (3D printing), augmented reality (AR), and virtual reality (VR), as well as robotics and automation.

SMEs form a significant portion of the Welsh business landscape, accounting for a substantial share of employment and contributing to the country's economic prosperity. However, SMEs face various challenges, such as limited resources, lack of technological awareness, and intense competition.

Embracing Industry 4.0 technologies offers SMEs in Wales a range of opportunities, including improved operational efficiency, enhanced competitiveness, and increased innovation potential. This study will examine case studies of Welsh SMEs that have successfully integrated Industry 4.0 technologies into their operations. These case studies will highlight how SMEs in Wales are adopting technologies such as IoT, big data analytics, AI and ML, cloud computing, CPS, 3D printing, AR, and VR to improve supply chain management, decision-making processes, manufacturing capabilities, and customer experiences.

The benefits and impacts of Industry 4.0 adoption for SMEs in Wales will be explored, including increased operational efficiency, enhanced competitiveness in the global market, improved decision-making, cost reduction, and the empowerment of innovation and new business models.

However, the adoption of Industry 4.0 technologies by SMEs is not without its challenges and barriers.

This study will also address the obstacles faced by SMEs in Wales, including lack of awareness and knowledge, financial constraints, skills gaps, data security concerns, interoperability issues, and resistance to change. Recommendations for overcoming these challenges and charting a path towards successful Industry 4.0 adoption will be provided. In conclusion, this study aims to provide insights into the utilization of Industry 4.0 technology within SMEs in Wales. By examining the

current landscape, exploring case studies, and analysing the benefits, challenges, and future directions, this research will contribute to a deeper understanding of how SMEs in Wales can harness the power of Industry 4.0 to thrive in the digital age.

SMEs in Wales

SMEs (Small and Medium Enterprises) play a crucial role in the economy of Wales. These enterprises are often the backbone of local communities, driving economic growth, creating employment opportunities, and fostering innovation. In this section, we will examine the current landscape of SMEs in Wales, their significance, and the challenges they face.

Definition and Significance of SMEs in Wales:

SMEs are typically defined based on their size, with employee numbers and turnover serving as key criteria. In Wales, the official definition of an SME follows the European Union's classification, which categorizes enterprises into micro, small, and medium-sized based on their staff headcount and financial figures.

SMEs hold significant importance in the Welsh economy. According to the Federation of Small Businesses (FSB), SMEs make up over 99% of all enterprises in Wales. They contribute to job creation, provide local goods and services, and play an essential role in the supply chains of larger businesses. SMEs are also drivers of innovation, often being nimble and adaptable to market changes.

SMEs

SME (or small and medium-sized enterprise) captures the vast majority of the nation's business population.

Yet in certain circumstances, what is defined as SME has specific criteria that may affect how your business operates, or what support it is entitled to.

Small and medium Sized enterprises is a term that can capture a large number of different business types and sizes, from a single person operation to companies with hundreds of employees.

For business in United Kingdom, Small and Medium-Sized businesses are defined differently depending on government body or scheme doing the defining.

The broadest definition of a Small Medium-Sized is determined by the number of employees a business has.

On 3rd of October 2022 a new legislation came into force in UK stating that. An SME is any business with fewer than 500 employees, whereas previously, the definition was capped at business with fewer than 250 employees.

UK/EU SME Definition

Beyond the change to the headcount criteria, the UK government shares one definition of SMEs with European union. In that definition, SMEs are broken down into three categories:

Micro business, Small Business and Medium Business.

- Micro business: 0 to 9 employees, with turnover or balance sheet less than or equal to 2 million Euros.
- Small business: 10 to 49 employees, with turnover or balance sheet less than or equal to 10 million Euros.
- Medium business: 50 to 499 (in uk) employees, with balance sheet of 43 million Euros or turn over less than 50 million.

Industry 4.0 Beneficial to SMEs.

The first Industrial revolution used Water and Steam power to mechanise production.

The second Industrial revolution used Electric power to create mass production.

The Industrial revolution used Electronics and Information technology to automate production.

Klaus Schwab, Founder and Executive Chairman of the World Economic Forum, argued in 2016 that the world is on the brink of the Fourth Industrial Revolution, a range of new technologies bring together the physical, digital, and biological spheres.

Examples of these are advances emerging from automation, artificial intelligence (AI), autonomous vehicles, energy storage and the internet over things (IoT).

Schwab states that the speed, scope and impact on systems across nations, industries and society of these changes means that this represents a distinct Fourth Industrial Revolution rather than an extension of the Third Industrial Revolution.

Many specialists claim that its three trademark futures are, Quality, Speed and Flexibility.

These drivers are crucial for any business, especially for Small and Medium-Sized (SME) businesses that make up to 98.6% of all manufacturing companies in the U.S.

Digitalization allows industrial SMEs to introduce effective process to mass produce higher-quality product at lower costs.

When talking about technologies the cornerstones that are shaping Industry 4.0 for business of all sizes are:

- Cloud computing
- Internet of Things (IoT)
- Big Data and Analytics
- Additive manufacturing
- Autonomous robotics

The global trend in the market indicates that large companies do not necessary dominate over small ones like they used to.

Instead, young, fast, and tech-savvy companies with the right approach, and investment have tangible chances to get closer to market leaders.

More SMEs en mass are willing to move towards the industry of tomorrow.

For example, in Belgium, out of 265 companies involved in a " Factory of the Future" program, 65% represent SMEs.

To Sum Up

The concept of Industry 4.0 is essential for industrial SMEs and has already had a massive impact on the world economy.

In the near future, it will set the rules of the game and dictate how to stay competitive for big and small business alike.

This way, its fair to conclude the future looks promising for those SMEs that will grasp these advances in technology to benefit from a wide array of opportunities.

If we talk about readiness in terms of production process, then the pharmaceutical SMEs seem among the first to dip their toes into Industry 4.0.

Such businesses are already well automated, operating under international standards and regulations and readily accept new technologies. But, again, the transition to a new technological order does not depend on a single enterprise but the whole ecosystem on a state level.

Contribution of SMEs to the Welsh Economy:

SMEs in Wales make substantial contributions to the overall economic prosperity of the region. They account for a significant portion of employment, offering job opportunities across diverse sectors such as retail, manufacturing, hospitality, and professional services. The Welsh Government acknowledges the importance of SMEs in achieving economic growth, promoting entrepreneurship, and supporting local communities.

The Welsh economy is facing the challenge of a lifetime. As in previous Industrial revolutions, there is an opportunity for transformation both positive and negative.

For every prediction that tens of thousands of jobs could be lost, there is another study talking up the positives of robots taking the drudgery from our work lives.

This enquiry has not followed the normal path, and this report is a beginning rather than the end.

The Welsh Committee has sought to raise awareness of some key ideas and concepts, and engage a discussion about how Wales is preparing for Industry 4.0. This report makes recommendations to the government, but it also poses questions for all with interest in Wales economic prosperity.

The growing body of studies and reports concerning automation and AI give a range of outcomes.

The challenges of automation and artificial intelligence have the potential to dominate the next 30-40 years.

Given the anticipated scale and speed of the change, the economy, infrastructure and skills Committee undertook a broad, high-level enquiry into Industry 4.0, as the Fourth Industrial Revolution is sometime known, to consider how it might affect Wales in the future, and what we should be doing to prepare.

In Wales technology is developing apace. From self-service supermarket check outs to an Artificial Intelligence (AI) machine arguing convincingly with a human debating champion, robotics and automation are current reality.

But as Professor Calvin Jones of Cardiff Business School points out "it's the social context of that technology, that will determine where the threats and the resistance or resilience arises" in the future.

William Sachiti, founder of Welsh Company that designs and builds fully autonomous vehicles felt the change was inevitable, but said "the world adapts, we adapt".

Professor Richard Davies, Vice chancellor of Swansea University agreed that we would adapt but was clear that 'it's about pace of change, because we are facing unprecedented rate of change, with huge adjustments to be made.

It is vital Wales is ready not merely to respond, but able to shape the debate so that rather than being blown away by change, Wales can harness it.

Themes for Future Work in Wales

- Reducing Inequality

If the industry 4.0 has the potential to accelerate inequalities, what social and political response should be taken to avoid this.

What policy response could Wales take to ensure that Industry 4.0 presents an opportunity to reduce inequality then widen the gap?

- Precision Agriculture

Precision Agriculture uses technology to improve the efficiency and therefore sustainability of farming systems. It uses technologies such as sensors, drones, GBS systems and enhanced autonomous machinery to optimize production.

Professor Simon Blackmore , head of agriculture robotics, Harper Adams University, described precision farming as “very disruptive”. He suggested there would be a change in the way farming machinery is developed in the future, with the trend to build bigger farming machines to create economies of scale.

Professor Blackmore described Wales as “disenfranchised from the use of these big machines”, because predominantly Wales got small and medium -sized farms and small medium-sized fields. At the same time: Cabinet Secretary of Economy and Transport quoted:

“we have developed a new economic strategy that’s designed to supercharge those Industries of tomorrow, but also future proof areas of the economy that needs to transition in the age of automation”.

Witness also told Walsh Committee about the opportunity’s precision agriculture presents to improve the environment.

Jason Llewellyn, an arable farmer in Pembrokeshire, was clear that, there are definitely soil and water benefits from using precision technology.

He told the committee how his farm uses precision farming to benefit the environment, like:

How farmers now resist the use of insecticides immensely and, on certain crops don’t use them at all. He said, we are quite a lot of margins about the place, which again we have been able to manage properly because we have defined boundary within the GBS Systems that don’t encroach on those, which helps our biodiversity.

With the help of Industry 4.0, the idea of having Robotic milking-even just a single day on a small farm, is becoming quite prevalent now. And so, the use of this technology is enabling people to remain in rural areas rather than having to go elsewhere.

Another SME company in Wales using Industry 4.0 is MYPINPAD.

Forged Silicon Valley, it’s the Welsh valleys that are producing the latest technical talent. Launched in 2012 by Justin Pyke, MYPINPAD provides secure technology that is certainly putting Wales on the technological map.

MYPIPAD offers secure multi-factor authentication technology for unsecured touch screen devices, including smart phones and tablets.

Justin Pyke quoted:

“Bing an SME in Wales is an advantage, given the reduced office costs and our central Cardiff location, which sits within a close-knit tech community”.

Challenges Faced by SMEs in Wales:

Despite their significance, SMEs in Wales face numerous challenges that can hinder their growth, and sustainability. These challenges include:

1. **Limited Resources:** SMEs often operate with limited financial and human resources, making it challenging to invest in technology, innovation, and workforce development.
2. **Technological Awareness:** Some SMEs may lack awareness and understanding of the potential benefits and applications of Industry 4.0 technologies. This can create a barrier to adoption and hinder their competitiveness.
3. **Access to Finance:** SMEs may struggle to secure funding for business expansion, investment in new technologies, or research and development initiatives.
4. **Skills Gap:** Finding and retaining skilled employees can be a challenge for SMEs, especially in specialized fields related to digital technologies and advanced manufacturing.
5. **Market Competition:** SMEs face competition from both local and global players, necessitating innovative strategies to differentiate themselves and capture market share.

Opportunities for SMEs in the Era of Industry 4.0:

While SMEs face challenges, they also have significant opportunities to thrive in the era of Industry 4.0. Industry 4.0 technologies offer SMEs the potential to streamline operations, improve efficiency, enhance product quality, and create new business models. By leveraging digital technologies such as IoT, AI, big data analytics, and automation, SMEs can optimize their processes, access valuable insights, and gain a competitive edge.

The adoption of Industry 4.0 technologies among Welsh SMEs is gaining momentum as the Welsh SMEs are embracing various Industry 4.0 technologies utilizing them in their operations.

1. Internet of Things (IoT):

The IoT enables the connection of physical devices and objects to the internet, allowing for real-time data exchange and remote monitoring. Welsh SMEs are adopting IoT to improve supply chain management, enhance asset tracking and monitoring, optimize inventory control, and enable predictive maintenance. For example, a manufacturing SME may use IoT sensors to monitor machine performance and detect maintenance needs proactively, minimizing downtime and reducing costs.

2. Big Data Analytics:

Big data analytics involves extracting valuable insights from large volumes of data to drive informed decision-making. Welsh SMEs are leveraging big data analytics to analyze customer behavior, identify market trends, optimize production processes, and enhance product quality. By analyzing data from various sources, SMEs can make data-driven decisions and gain a competitive edge in the market.

3. Artificial Intelligence (AI) and Machine Learning (ML):

AI and ML technologies are empowering Welsh SMEs to automate processes, improve operational efficiency, and enhance customer experiences. SMEs are using AI-powered chatbots to provide

personalized customer support, implementing ML algorithms to optimize production schedules, and utilizing AI driven analytics to generate accurate sales forecasts. These technologies enable SMEs to make better decisions, automate repetitive tasks, and enhance productivity.

4. Cloud Computing:

Cloud computing offers scalable and cost effective solutions for Welsh SMEs, providing them with access to computing resources, storage, and software applications on-demand. SMEs are adopting cloud-based platforms for data storage, collaboration, and software-as-a service (SaaS) applications. Cloud computing enables SMEs to reduce infrastructure costs, improve data accessibility, and enhance collaboration between teams.

5. Cyber-Physical Systems (CPS):

CPS involves the integration of physical systems with digital technologies to create intelligent and interconnected systems. Welsh SMEs are implementing CPS in manufacturing processes, where physical systems interact with digital systems to optimize production and enable realtime monitoring. For instance, SMEs may use CPS to connect machines, sensors, and production lines to improve efficiency, quality control, and predictive maintenance.

6. Additive Manufacturing (3D Printing):

3D printing is revolutionizing manufacturing processes by enabling rapid prototyping, customization, and cost-effective production. Welsh SMEs are embracing 3D printing to accelerate product development cycles, create customized products, and reduce material waste. SMEs can leverage 3D printing to produce prototypes, spare parts, and small-scale production runs, offering flexibility and agility in their operations.

7. Augmented Reality (AR) and Virtual Reality (VR):

AR and VR technologies are transforming how Welsh SMEs engage with customers, train employees, and design products. SMEs are utilizing AR to provide immersive product experiences, offer virtual showrooms, and enhance remote collaboration. VR is being used for employee training, virtual simulations, and interactive design processes. AR and VR technologies enable SMEs to deliver enhanced customer experiences and improve internal operations.

8. Robotics and Automation:

Welsh SMEs are adopting robotics and automation to enhance productivity, improve efficiency, and reduce costs. SMEs are implementing robotic systems for tasks such as assembly, packaging, and quality control.

Automation technologies streamline repetitive processes, increase accuracy, and free up human resources for higher-value tasks. This adoption of robotics and automation enables SMEs to scale their operations and compete effectively. By embracing these Industry 4.0 technologies, Welsh SMEs are gaining a competitive edge, enhancing their operational capabilities, and expanding their market reach. These technologies enable SMEs to optimize processes, drive innovation, improve customer satisfaction, and respond effectively to dynamic market demand benefits and impacts of Industry 4.0 for SMEs.

The adoption of Industry 4.0 technologies has profound benefits and impacts on Welsh SMEs, enabling them to enhance their competitiveness, improve operational efficiency, and drive innovation.

The benefits and impacts of Industry 4.0 adoption for SMEs in Wales.

1. Increased Operational Efficiency:

Industry 4.0 technologies offer Welsh SMEs opportunities to streamline their operations and optimize efficiency. Through automation, robotics, and intelligent systems, SMEs can eliminate manual and repetitive tasks, reduce production lead times, minimize errors, and enhance overall productivity. This improved efficiency leads to cost savings, increased output, and better resource allocation.

2. Enhanced Competitiveness:

By embracing Industry 4.0, Welsh SMEs can gain a competitive edge in both domestic and global markets. The adoption of technologies such as IoT, big data analytics, and AI enables SMEs to gain valuable insights into customer preferences, market trends, and production processes. With this information, SMEs can develop innovative products, deliver personalized experiences, and respond quickly to market demands, positioning themselves as agile and customer-centric organizations.

3. Improved Decision-Making:

Industry 4.0 technologies provide SMEs with access to real-time data and advanced analytics capabilities. This empowers decision-makers with accurate and actionable insights, enabling informed and data-driven decision-making. By leveraging big data analytics and AI algorithms, SMEs can make more precise forecasts, optimize inventory management, identify operational bottlenecks, and implement proactive maintenance strategies. Improved decision making leads to better resource utilization, cost reduction, and improved business outcomes.

4. Cost Reduction and Resource Optimization:

Industry 4.0 technologies enable Welsh SMEs to optimize their resource utilization and reduce costs. Automation and robotics minimize manual labour requirements, lowering labour costs and increasing production efficiency. Predictive maintenance enabled by IoT and AI reduces downtime, extends equipment lifespan, and reduces maintenance expenses. Cloud computing offers cost-effective storage and computing resources without the need for large upfront investments in infrastructure. Overall, Industry 4.0 technologies help SMEs optimize their operations and achieve cost efficiencies.

5. Empowering Innovation and New Business Models:

Industry 4.0 opens avenues for innovation and the development of new business models. By integrating technologies like 3D printing, AR, and VR, SMEs can rapidly prototype and customize products, shorten the time-to-market, and cater to individual customer needs. Additionally, the connectivity and data exchange capabilities of Industry 4.0 enable SMEs to collaborate with partners, customers, and suppliers in new ways, fostering innovation through open innovation ecosystems and supply chain integration.

6. Enhanced Customer Experience:

Industry 4.0 technologies enable Welsh SMEs to deliver enhanced customer experiences. With access to real-time data and customer insights, SMEs can personalize products and services, offer customized solutions, and provide seamless interactions across various channels. AR and VR technologies enhance customer engagement and visualization, allowing SMEs to showcase products virtually or provide immersive experiences. These technologies enable SMEs to meet evolving customer expectations, increase satisfaction levels, and build long-lasting customer relationships. It is important to note that while the benefits of Industry 4.0 adoption for SMEs in Wales are substantial, there are also challenges and barriers to overcome. These challenges include the need for technological awareness, access to financing, skills development, data security concerns,

interoperability, and resistance to change. The next section will delve into these challenges and provide recommendations for addressing them.

Challenges and Barriers

The adoption of Industry 4.0 technologies in Welsh SMEs is not without its challenges and barriers. These hurdles can impede the successful implementation and utilization of advanced technologies. In this section, we will explore the key challenges and barriers faced by SMEs in Wales when adopting Industry 4.0 technologies and provide recommendations for overcoming them.

1. Limited Awareness and Knowledge:

One significant challenge for SMEs is the limited awareness and understanding of Industry 4.0 technologies. Many SMEs may not be fully aware of the potential benefits and applications of these technologies or may lack the necessary knowledge to implement them effectively. To overcome this challenge, SMEs should prioritize education and awareness initiatives, such as training programs, workshops, and collaborations with technology experts and industry associations. The Welsh Government and relevant organizations can play a vital role in disseminating information and providing guidance to SMEs.

2. Financial Constraints:

Financial constraints pose a significant barrier to SMEs when adopting Industry 4.0 technologies. Implementing advanced technologies often requires substantial investments in equipment, software, training, and infrastructure upgrades. SMEs may face challenges in securing the necessary funding. To address this barrier, SMEs can explore funding options such as government grants, loans, and partnerships with technology providers. Public-private collaborations can also facilitate access to funding and resources for SMEs.

3. Skills Gap:

The shortage of skilled employees with expertise in Industry 4.0 technologies is another challenge for SMEs. The rapid evolution of technology requires a workforce with specialized skills in areas such as data analytics, AI, cybersecurity, and digital manufacturing. SMEs can overcome this challenge by investing in employee training and development programs, collaborating with educational institutions to develop relevant curricula, and fostering partnerships with technology providers. Creating apprenticeship programs and offering internships can also help develop a skilled talent pool.

4. Data Security Concerns:

The adoption of Industry 4.0 technologies involves the collection and analysis of vast amounts of data. SMEs may have concerns about data security, privacy, and compliance with regulations. To address these concerns, SMEs should implement robust cybersecurity measures, including data encryption, secure cloud storage solutions, and regular data backups. Collaboration with cybersecurity experts can help SMEs assess and mitigate risks, ensuring the protection of sensitive data.

5. Interoperability Issues:

Interoperability, the ability of different systems and technologies to communicate and work seamlessly together, can be a significant barrier to Industry 4.0 adoption. SMEs often rely on multiple technologies and platforms, and ensuring their compatibility and integration can be complex. SMEs should prioritize interoperability when selecting technology solutions, opting for standardized protocols and open architecture systems. Collaboration with technology providers and industry partners can help address interoperability challenges and ensure smooth integration of technologies.

6. Resistance to Change:

Resistance to change within SMEs can hinder the adoption of Industry 4.0 technologies. Employees may be resistant to new processes, technologies, or organizational changes. To overcome this barrier, SMEs should foster a culture of innovation and change management. Leadership should communicate the benefits of Industry 4.0 adoption, involve employees in the decision-making process, provide training and support during the transition, and recognize and reward innovation and successful implementation. Demonstrating tangible benefits and showcasing successful case studies can help alleviate resistance to change. In summary, Welsh SMEs face challenges and barriers when adopting Industry 4.0 technologies, including limited awareness, financial constraints, skills gap, data security concerns, interoperability issues, and resistance to change. However, by addressing these challenges and implementing the recommended strategies, SMEs can overcome these barriers and unlock the potential benefits of Industry 4.0 technologies. The next section will provide recommendations for SMEs in Wales to successfully navigate the adoption of Industry 4.0 technologies.

In conclusion, SMEs in Wales play a vital role in the economy, driving growth, creating jobs, and fostering innovation. The adoption of Industry 4.0 technologies presents significant opportunities for Welsh SMEs to enhance their competitiveness, improve operational efficiency, and drive innovation. Through the adoption of technologies such as IoT, big data analytics, AI, cloud computing, and robotics, SMEs can streamline their operations, optimize resource utilization, make data-driven decisions, and deliver enhanced customer experiences. Industry 4.0 technologies enable SMEs to achieve cost efficiencies, improve productivity, and respond effectively to market demands. However, the adoption of Industry 4.0 technologies is not without its challenges. Limited awareness, financial constraints, skills gap, data security concerns, interoperability issues, and resistance to change pose significant barriers for SMEs. To overcome these challenges, SMEs in Wales should prioritize education and awareness initiatives, explore funding options, invest in employee training, implement robust cybersecurity measures, prioritize interoperability, and foster a culture of innovation and change management. The Welsh Government, industry associations, and technology providers can play a crucial role in supporting SMEs by providing guidance, facilitating access to funding and resources, and fostering collaborations and partnerships. By embracing Industry 4.0 technologies and overcoming the challenges, Welsh SMEs can position themselves for sustained growth, increased competitiveness, and long-term success. The successful adoption of Industry 4.0 technologies will not only benefit individual SMEs but also contribute to the overall economic prosperity of Wales. It is an exciting time for Welsh SMEs to leverage the transformative power of Industry 4.0 and drive innovation in their respective industries.