

Industry 4.0 Emerging Technologies to Benefit Data Analysis for Customer Motivators in Service

Exploring the impact of economic,
social and sustainable changes for an SME

Introduction to Industry 4.0 : Assignment 2

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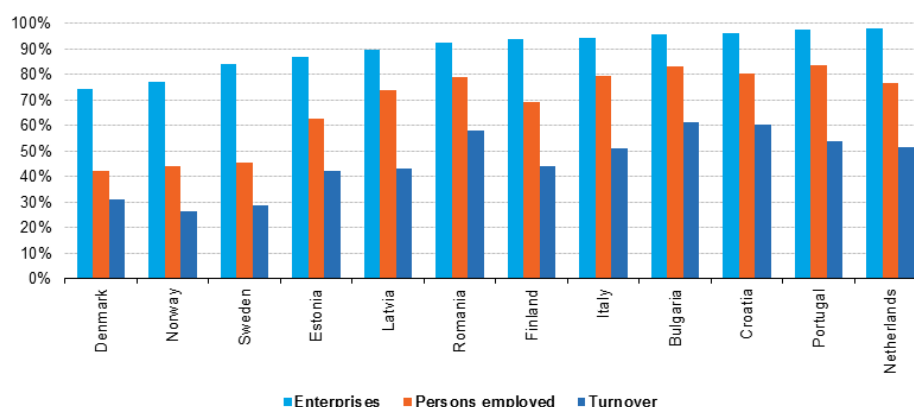
<i>Abbreviation</i>	<i>Explanation</i>
I4.0	Industry 4.0
AI	Artificial Intelligence
CC	Cloud Computing
IoT	Internet of Things
SME	Small Medium Enterprise
IAM	Identity and Access Management
IT	Information Technology
GCC	Green Cloud Computing
ICC	Intelligent Cloud Computing
PII	Personally Identifiable Information
PoLP	Principle of Least Privilege
WPA	Wi-Fi Protected Access
CISA	Crypto Impact and Sustainability Accelerator
ESG	Environmental, Social, and Governance
SOL	Solana
NFT	Non-Fungible Token
R&D	Research and Development
SDG	Sustainable Development Goals
GDP	Gross Domestic Product
BaaS	Blockchain as a Service

1. Introduction

The term Industry 4.0 (I4.0) was coined in 2011 starting out with only four core technologies supporting the implementation of this digital process, these were Artificial Intelligence (AI), Cloud Computing (CC), big data and the Internet of Things (IOT) (Liao et al., 2017). Each industrial revolution has been described as 'models' defining a selection of economic processes (More, 2000). The purpose of I4.0 is to find independence through a process within a digital or industrial area, by exploring a solution to a problem with innovative techniques will support the investment of service improvements. Although I4.0 originally began as an industrial policy platform (Reischauer, 2018) today it is considered an essential stage of advancement for companies allowing interconnection for a more acute integrated process. I4.0 is transforming technologies, economies and societies, acting as an umbrella to support a variety of different business growth goals and improving processes for productivity and efficiency.

In Europe small and medium-sized enterprises (SME) are considered pivotal in ensuring economic growth, innovation, job creation and social integration (Łabędzka, 2021). As of 1st January 2021 there were 5.6 million SMEs in the UK with 0-249 employees, this accounted for 99 percent of all businesses in the country (Hutton and Ward, 2021). With SMEs spearheading the industrialisation it is important to support them with the transition of introducing I4.0 processes, for example new business models and partnerships will help provide access to services and softwares in reaching the market leaders.

Number of enterprises, persons employed and turnover, independent enterprises share of all enterprises with fewer than 250 persons employed



Countries participating in the 2016 Microdata linking project.

eurostat 

(Papadopoulos et al., 2018)

Many countries have started their own initiatives, for example the EU's most innovative country Sweden is at the forefront with a Smart Industry that is revolutionary to the way business is done. This country pushes boundaries of the industrial economy, for example the total annual turnover in Sweden is a staggering 24 billion euros by Swedish suppliers of industrial technologies, and the country's energy grid is 98 percent fossil-free with more than 60 percent of the electric supply coming from renewables. With the use of advanced technologies and a culture of collaboration, sustainability is always the main focus in thriving for a low-carbon future (Scheibenpflug, n.d.).

The aim of this essay is to collate information that will help an SME formulate ways to better understand both new and existing customers through the compilation of different data collecting methods. By exploring the relevant I4.0 technologies this will help support SMEs to progress and transition into a more consolidated way of working from an economic, social and sustainability viewpoint. From a SME perspective, this essay will investigate:

- The scale and broadness of advancing technologies to support data analysis.
- The impact an I4.0 technology might have during a process whilst promoting growth.
- The importance of quality management, a resilient workforce and maintaining company values to meet brand values.
- The opportunities and challenges that may occur whilst thriving towards specific geopolitical and sustainable goals.

With the focus being on SME's, the customer experience must be considered throughout due to the competitive pressure from other businesses. Carrying out background research will give a better understanding of the service being delivered and will also establish the applicable information needed to supplement the SME's ability. An example of an SME looking to move away from manual processes and transition into I4.0 technology for data analysis is The DO Lectures, a global encouragement network based in Wales hosting life-changing events with talks given by some of the world's most accomplished mavericks that are then shared to the world online for free (The DO Lectures, 2022). When the COVID-19 pandemic hit in 2020, the company began curating and selling educational online courses to help people in business and life via both live and pre-recorded lessons through a third party platform.

The SMEs that are particularly thriving should adapt I4.0 to allow for growth both nationally and internationally, identifying areas for improvements will benefit from actionable

insight within their data. The constraints that SME's primarily face are financial and knowledge limitations (Orzes et al., 2020), and although the possibilities feel unlimited within every emerging technology this is why it is important to support what is already in place and fix the smaller inefficiencies. Designing a system or process that has a clear purpose will not only minimise risk but also benefit both people and planet.

In conclusion, from an SME perspective this essay will review:

- The impact, aims and objectives in choosing the best suited technologies for change.
- The economic growth and potential of accelerated technology advancement.
- Looking at social solutions to challenge efficiency by reviewing business models to meet demand.
- And, sustainable options that will benefit data analysis thus striving for a circular economy reducing pressure on the planet.

It is predicted a pivotal shift is happening and there is opportunity to take advantage of new technologies to improve both the society and environment. Gaining a better understanding of the target market through data collection will deepen the relationship between the company and customer, the aim is to focus on the impact and the actual need of the technologies. Speculative fiction author William Gibson believes that the future is already here it just isn't distributed evenly yet (Ministry of Defence, 2018).

2. Technologies

The accompanying segment will investigate the I4.0 arising technologies whilst considering the advantages or drawbacks when analysing the use of data to better understand the customer motivators. Some benefits of introducing I4.0 technologies are the actionable insight from the data to predict patterns through algorithms, managing quality within the customised digitalisation of a service, competitive advancement to improve a current automated method problem, the profitable investment of software cost, flexibility to adapt to agile processes and overall efficiency. Each contributory technology will be stated with context for justification.

2.1. Internet of Things (IoT)

The purpose of IoT is to connect and exchange data with another system over the internet that leads to useful information and knowledgeable insight, without the prerequisite of human-to-human or human-to-computer interaction (Rana and Sharma, 2020). This technology is helping companies gather actionable data to better understand customer behaviour and fundamentally execute successful contextual marketing for a services or product.

Although machine learning technologies are a financial investment, especially for SMEs, there are huge benefits and opportunities to introduce advance system efficiency into daily processes. IoT focuses on a variety of technologies such as automation, machine learning, and interconnectivity, all having momentous impact on business operations for data collecting that some SMEs might not be aware of. Examples of how this data can be collected are through integrating algorithms, use of sensors and computing devices as these will lower energy, cost, waste and power consumption by regulating particular processes and thus improving productivity. This unconditional technology precision allows for minimal error as decisions are succinct, the valuable insights gained for customer motivators is data that SMEs might not have had access to if this technology wasn't applied. As the popularity for IoT software increases the prices for these systems and devices are becoming cheaper and more affordable, it is estimated that by 2025 there could be 75 billion IoT consumer devices accessible world-wide (Statista, 2022a).

There are some risks that need to be considered when it comes to IoT cybersecurity, by implementing the correct cybersecurity software this will stop online bad actors stealing data. Due to the increase of more IoT technologies emerging such as wearables and identity

management frameworks (IAM), SMEs must be vigilant when it comes to keeping security updated to reduce vulnerabilities within system entry points (Boeckl et al., 2019). SMEs need to have the right approach for the scalability of IoT, and although it can be presented as a complex and expensive technology there are many options that will best suit the business and its budget, still making the running efficient and cost effective.

The social impact of introducing IoT has been positive as it helps businesses better understand their target market and supports the investment of service design improvements. There is huge marketing potential of digitally interacting with the consumer with highly contextual targeted messaging, by delivering relevant information will deepen relationships and enhance the user-experience. Introducing automation into the workforce will not allow jobs to become obsolete, instead it will uphold opportunities for roles inside the organisation that may not exist right now freeing employees from monotonous tasks and improving staff satisfaction.

From a sustainable perspective IoT is making huge steps towards more energy efficient processes with innovative technologies supporting environmental and geopolitical doubt. For example data analysis is supporting smart energy management systems in reducing costs and increasing user satisfaction, monitoring air pollution is being recorded with real-time insight to prevent gas leakages, and tackling the problem of unwanted waste with smart technology to collect information for efficient decision-making (BehrTech Blog, n.d.)

It is estimated that by 2025 IoT will have an economic impact of 11 trillion USD, and 40 percent possibly being acquired in developing economies (Statista, 2022b). Although the collection of real-time data is a challenge, SMEs greatly benefit from this type of data such as having the ability to look into a customer purchase history allows for the delivery of high-quality customer service.

2.2. Data Science

Data science encompasses AI, machine learning and data mining, uncovering patterns in large sets of data without the need for human interaction. By collecting every piece of data an SME generates will help with efficiency between customer and service supporting better decision making in reaching a wider network and ultimately gaining sales. The extraction of data interconnects all of the I4.0 technologies but it is the predictive aspect of data science that is most valuable. This interdisciplinary method uses a scientific approach to analysis strategies, algorithms, processes and infrastructures to remove insights and apply significant data knowledge from an expansive scope of user areas. From a society perspective 80 percent of people have a digital presence on the internet, consequently tracking a plenitude of online data from digital interaction (Schwab, 2016), so using machine learning algorithms can help to push content to new users that a company wouldn't have had the opportunity to reach otherwise.

Building a data science team within a business would include analysts and data scientists evaluating the impact of the internet's algorithms, moving away from the pre-existing echo chambers and diversifying the target market. Consideration should be spent on the business policy and potential boundaries set around the sharing of content, as this will bring clarity and demonstrate transparency that provides reassurance for both customer and business. The observation of behavioural patterns through data will give the company an advantage on competitors and will help build an impact report supporting any outcomes, this can include case studies, survey results, online statistics, testimonials and feedback, etc.

SMEs often operate with a small budget so investing in data science and mining can have a positive impact on individual profiling and the development of targeted advertising. For example the online personal styling service Stitch Fix are reshaping the retail sector by changing the way people search and shop for clothes, the company employed 150+ data scientists and engineers to work with innovative algorithms and data science to showcase tailored garments for the customer based on size, budget, and style (Stitch Fix, n.d.).

Comparing current processes against how future adaption of supporting I4.0 for both new and existing customers will highlight opportunities and challenges. Social media is a helpful tool when looking at customer patterns, for example purchases made via social media product channels generate an abundance of data that can draw on conclusions. Having a procedure in place for identify theft is vital when storing personal data, consideration of privacy surveillance is acknowledging where current data is stored, how easily accessibly it is, and who controls and owns it.

2.3. Cloud Computing (CC)

This on-demand computing service is the most developed I4.0 technology delivering servers, digital storage, databases, networks, software, analytics and intelligence over the internet, offering rapid innovation, resource flexibility and scalability in utilising resources. CC can optimise Information Technology (IT) performance for SMEs that have limited financial resources with the freedom to only pay for what is used without the need of added servers when accessing specific softwares, tools and applications.

Businesses need to understand and potentially hire the skills of an external service team instead of a customary IT department, to avoid attacks from bad actors because of the high risk nature of storing data.

The energy company E.ON reported on SMEs in the UK and 39 percent admitted to not having any knowing of what the cloud is, 60 percent are concerned about their energy consumption, and nearly 90 percent aren't aware of the cost savings and energy footprint reduction by moving to the cloud. These figures show that the biggest factor is due to the lack of knowledge SMEs have about CC technology efficiency (E.ON, 2012). By using the internet to its advantage and moving away from physical servers is flexible and a more effective way of managing paperwork, for example maintaining current accounting systems. From a sustainability perspective, the consideration of Green Cloud Computing (GCC) methodology helps to calculate costs for cloud services, reducing energy consumption and scaling down the carbon emissions to the ecosystem with scheduled algorithms.

Another CC model is Intelligent Cloud Computing (ICC), adopting platforms and solutions driven by AI that can then be powered to digitally assist businesses and individuals to support with productivity. ICC has made a positive social impact in facilitating humans with strategy and planning goals through achievable solutions to increase efficiency.

2.4. Cybersecurity

Cybersecurity protects systems and networks from data theft or information corruptions via software or services that a business provides. A good level of security needs to be implemented due to the increasing risk of digitalisation expansion, with smart systems in place cybersecurity is fundamental for the operation of I4.0 in SMEs. With SMEs handling customer data and Personally Identifiable Information (PII) they are at risk of being an easy target for cyber-attacks, consideration and caption of threats is important to minimise vulnerableness. When this level of security is not considered there is a higher risk for a business having a disadvantage from the competition with the lack of trust in storing customer personal data. In 2021, 43 percent of SMEs were involved in data breach and of which 30 percent reported phishing attacks as the highest threat (Verizon, 2021).

From an economy and social perspective, the collective reporting of cyber-attacks help to accumulate data and can diminish risks of repeated threats. Some SMEs might not have the knowledge about network security, for example using strong passwords and changing them often, patch management prompts, Principle of Least Privilege (PoLP) to perform job functions, use of Wi-Fi Protected Access (WPA2/WPA3), two step authentication and the ability to revoke user access when not needed are some processes an SMEs should invest in with the applicable training (NCSC, 2021). An increase and demand for new job roles within cybersecurity will evolve from implementing these strategies for accordance to avoid bad actors. The data protection for the employee is as important as the customers, handling this information must be done with a high-quality standard of care.

2.5. Blockchain

Blockchain can be a fundamental pillar in I4.0, described as a decentralised trusted mechanism distributing digital currencies such as Bitcoin, Litecoin and Ethereum, helping to transform businesses and industries around the world. For SMEs in particular this technology is hugely beneficial when it comes to protecting sensitive data, enhancing accountability and bridging the gap for payment solutions in the virtual marketplace. Currently the problem with purchase management is the lack of verifiability, traceability and the single point of failure, which could result in data being lost.

The World Bank Enterprise identified a lack of financial support for SMEs in the unconventional economy that will have an impact on operations and growth when expanding to reach new audiences (The World Bank, n.d.). As a result, The World Economic Forum have created the Crypto Impact and Sustainability Accelerator (CISA) aiming to accelerate processes of projects, learning and leadership around energy, social and governance (ESG) targets for crypto ecosystem, thus shaping an integrated understanding about how crypto sectors can lead in contributions to ESG (World Economic Forum, n.d.).

From a sustainability perspective, the blockchain Solana (SOL) was built for scalability and is one of the fastest blockchains in the world, as well as the fastest growing ecosystems with a positive environmental impact in cryptocurrencies. Solana's 2021 energy report revealed that the network is incredibly energy efficient, each SOL transaction takes less energy than two Google searches and uses 24 times less energy compared with charging your phone (Solana, 2021). All transactions are helping to create the building blocks of Solana's global state machine and has resulted in the network not being dependent on energy usage.

By moving away from traditional databases businesses, governments and the society can benefit from multiple entities that allows data to synchronise numerous associates as everyone in the network is considered as important as the next. Blockchain underpins how cryptocurrencies perform revealing transactions and packaging that information into a block, which is then utilised by an algorithm to generate a key for a new block. This technology can provide SMEs with sustainable and efficient value creation through data exchange beyond the limits of analysis and strategic algorithms, as well as boosting economic growth with new job formulation.

2.6. Digital Artifact / Non-Fungible Token (NFT)

NFTs are the most recent I4.0 technology innovation with the possibility to shakeup the digital marketplaces with the intriguing bridging of both physical and virtual spaces. Digital transformation of economies have advanced since the COVID-19 pandemic with consumers wanting to gain ownership for digital assets. For SMEs NFTs can contribute towards the necessity of data analysis and collection for scalability and business growth via the blockchain infrastructure. Software and ownership needs to be considered, making sure acceptable rights are associated with the NFT (Rajan, 2022).

SMEs are limited to the amount of finance, research and development (R&D), third party benefits and extensive data available, which is why there are many advantages with this unique identifier of an NFT. The advantages of this decentralised database is the transparency association that might attract investors, the predicted analytic approach with real-time transactions and a global consumer base. Creating an NFT for businesses will allow for a digital record on the blockchain and can help an SME in applying AI to a product or service that is favourable and can offer customised guidance enhancing the user-experience. The skills within a company to execute this technology would be needed especially whilst NFTs are in their infancy, environmental alternatives are being created and should also be considered. This unique validated asset has huge economic impact giving businesses the ability to manage and sell their goods in the digital ecosystem, and exchanging assets as part of a joint value creation process.

NFTs are being used as a new type of media asset, for example The National Basketball Association (NBA) has set up a joint venture with NFT creators bringing people together by formulating a space where NBA, NFT and collectible enthusiasts can come together in trading tokens of their favourite teams, players and sports Moments. A Moment is a piece of NBA video footage attached to a NFT with an authentic serial number, which can be sold on or kept like a trading card minted on the blockchain. The success of this virtual platform has meant that 1.1 million registered users have traded 800 million USD in NFTs and helped drive attention for NFTs (Thomas, 2022).

For example The DO Lectures could use NFTs to issue tickets for an event or educational course with this unique cryptographic token that cannot be replicated. Although NFTs are not a physical item they are tokenised and can be easily transferred anywhere across the globe, which is why they are successful for ticketing at events tracking who has access.

Utilising previous customer data to associate, upgrade and mechanise significant promotional content will build the interconnection that will lead to increased sales. By expanding customers knowledge about an organisation's admin will take into consideration open information development and the ongoing dynamic that will decrease any intricacies. With the support of a third-party platform, a company can create a unique NFT giving a customer unique validation for attendance. Interest and request will be made when great substance is conveyed, as this will draw in the right clients to the place to checkout.

2.7. Big Data and Analytics

Big data and analysis is the infrastructure of a successful I4.0 innovation as it presents valuable information for key factors such as market direction when distinguishing what will be most profitable, this is rudimental for strategic decision making for the expansion of any business. Constantly questioning the process demonstrates a forward thinking attitude and will identify any opportunities or challenges to help the company work with machine learning systems in reaching a goal.

For SMEs the successful collection of big data to understand customer motivators means that both new and existing customers will have a better user-experience by improving current processes, optimising business systems, identifying areas of inefficiency, and overall improved decision-making will help advance the service being delivered. Some businesses will already be collating market research in basic form either by sending out online surveys or organising in-person focus groups to discuss feedback. Carrying out market research is valuable in helping a company understand the desires of the customer and community, by implementing automated processes to speak directly to the customer about their experience in the simplest and easiest way. An SME could offer a role within the company to utilise big data technologies for consumer profiling, service personalisation, predicting analysis and demographic targeting to improve existing frameworks that will have a positive social impact on new job categories.

The investment of improving service design to enhance the user-experience and develop a marketing strategy to attract quality leads thus increasing conversation rates has proven to be successful. For example the audio streaming platform Spotify relies on big data to enhance user-experience by applying algorithms to favour the customers music genre to discover new content. Spotify uses this resource for personalised marketing campaigns such as Spotify Wrapped, an end of year report based on each users interaction with the

application, which is then presented to the user for either their own pleasure or to share with their community on social media (Sletten, 2021). Incorporating ingrained ego-boosters allows for customised data to be presented in a simple and enticing format making the customer feel unique and validated. This engagement for the company is a great long-term making strategy.

From a sustainability perspective, this new analytical approach to source data can regulate progress on the Sustainable Development Goals (SDGs) that is both comprehensive and equitable. Using big data to utilise customer information to automate, streamline and optimise significant marketing content building the interconnection of leads and eventually drive sales in supporting economic growth. Educating the customer about services the company offers will take into consideration open data innovation and real-time decision making reducing any complexities. This marketing enhancement can be done through targeted advertisements or digitalising personalised content as explained previously with the example of Spotify Wrapped.

3. Impact

In conclusion I4.0 technologies depend on one another to deliver an efficient integration. Machine learning feeds off of big data and analysis, which is gathered when the right frameworks and platforms are in places to support it. Adaption depends on the SME and what is most achievable, all employees of the business must be onboard for this technology change allowing for the strategical thinking to work effectively. Outlining the aims and objectives in how a goal can be achieved must be clear at the start so that everyone can follow, looking at the business model from both a granula and abstract angle can help understand each phase of the funnel.

3.1. Economy

I4.0 is revolutionising the framework of the world economy. The adaption of economy growth with these technologies comes from decentralised decision-making, information transparency, interoperability and technical assistance. This impact is effecting gross domestic product (GDP), investment, consumption, employment, trade and inflation. SMEs have an advantage over larger companies due to their flexibility and innovative decision-making allowing for changes to be made quicker.

The world population is predicted to grow to 8 billion by 2030 leading to increasing demand (Schwab, 2016), so productivity is an important motivator of long-term growth. SMEs looking to expand globally can gain wider access by introducing blockchain as a service (BaaS) that outsources technology aspects allowing the company to focus on core jobs rather than setting up framework facilities. Faster innovative technologies are influencing the future of job creation and categories.

The current economic challenge is the protracted effect of the COVID-19 pandemic recession. For example, since the two year period of the population being housebound the subscription streaming service Netflix has seen a drop of 100 billion USD in market capital, a loss of 200,000 subscribers and over 70 percent of their stock prices are down (Nasdaq, 2022). As a result, Netflix are undergoing digital transformation exploring online gaming for future growth and retracting from the plateau of demand services.

3.2. Society

This increasingly connected world is more linked with our physical life than ever before, which is a significant motivation to move towards I4.0. These technologies are creating solutions for challenges within current society such as energy effectiveness, metropolitan creation and the changing of demographics. Adapting to such change requires a holistic approach that envelops inventive and feasible framework arrangements. Consideration of how AI is affecting society and how private information is managed needs to be thoroughly treated allowing the customer and public to have trust in the data.

The importance of having a data-driven team with specialised skills means challenges within the technology such as ethical implications, algorithm battle and trusting the data can be tackled. Improving collaboration across all departments to connect people with digital technology will help build trust with the customer by understanding their motives, thus developing a market-strategy that engages quality leads to increase conversation rates. For example, the delivery of predictive marketing messaging will improve user-experience and positively impact socioeconomic factors.

Another useful and increasingly common technology helping SMEs is the human cloud, a platform connecting businesses and skilled individuals for a specific project or job. For example, Fiverr is a successful business solution designed as an online marketplace for teams all over the world streamlining the process of hiring and getting hired. By eliminating the go-between helps to keep costs low and skills on demand.

3.3. Sustainability

Technology innovation has previously tormented sustainability efforts thus now turning into a partner towards building a greener planet. Whilst the I4.0 model is the foundation of other industrial revolutions with greater innovation and integration, Environment Management 4.0 is supporting future predictions that may affect environmental degradation. For example, IoT is valuable for Environment Management 4.0 when lowering energy consumption (Ortiz, 2020).

SMEs can look at how other organisations are adopting and implementing I4.0 technologies to lower their impact on the planet. Sustainable solutions will require investment for software setup, but finance opportunities are available in supporting the company's green growth especially for SMEs. I4.0 can expand productivity and assist with the achievement of a circular economy model if SMEs fully embrace the transformation in these positive climate actions.

This essay has explored options to reduce the environmental impact of a service with footprint data scope and identifiable analysis. In leveraging greater efficiency by grouping together analytics and providing pertinent data can reduce resource consumption. Tree planting programs are becoming a popular technology solution to monitor effectiveness. For example Ecosia's tree-planting projects have 15 millions users planting over 120 million trees for free, by users simply searching the internet. Their business model to make money is by displaying online adverts alongside search results, and with every click-through the company gets paid. Ecosia have also invested in their own solar panels so twice as much energy is being produced to power each search with renewables (Gottlieb, 2021). Although the trees are rooted on the ground, they are made in the cloud.

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