THE UNIVERSITY OF
MELBOURNE

CIPS
Chartered Institute of
Procurement & Supply

Digitalisation
in Procurement and Supply
2019

Research Team

Zahra is a lecturer in operations and supply chain management, and a research fellow in the Centre for workplace leadership at the University of Melbourne. Her research interests include Digital supply chain management, procurement, sustainability and buyer supplier relationships. Prior to joining academia, she worked in the manufacturing and automotive industries in procurement and category management roles. She holds a bachelor and a Master of Business Administration and received her PhD from Monash University in 2016.
Dr Zahra Seyedghorban

Danny is a professor of management at the university of Melbourne, where he heads the operations and supply chain management group. He has published a dozen books and over a hundred research studies on various aspects of management including particularly supply chain and operations management. He is founder and program director of the Master of supply chain management and he regularly conducts executive seminars and provide advice to organizations on matters ranging from business strategy to innovation capability development.
Prof Daniel Samson

Foreword

Industry 4.0 is the buzzword of our age as businesses and organisations scrabble to get ahead in the digital race. But take a step back and look at why digital is becoming so important and you'll realise that investment in technology is not enough.

There are vast digital capability gaps in all sectors so training and developing understanding is a crucial first step. Then being able to align digital transformation with business needs, involve all key departments in the planning and finally justification of ROI means that digital supply chain transformation has a greater chance to succeed.

Malcolm Harrison FCIPS, Group CEO, CIPS

Contents

Executive Summary

Firms increasingly invest in technology enablers to stay at the edge of the competition in this digital era. Yet, the nature of these technologies that can be used to increase efficiency and productivity is now changing at the dawn of the Industry 4.0, the fourth industrial revolution.

Though, the digitalisation of procurement and supply chain practices promises to bring walls down thereby create an interconnected and transparent ecosystem amongst firms, suppliers and customers, its current and planned use and implications are yet to explore.

The University of Melbourne carried out a global research in collaboration with the Chartered Institute of Procurement and Supply (CIPS) to gather intelligence on the level of understanding of the supply chain digitalisation and what this means for procurement and the wider business community. This collaboration primarily aimed at understanding the nature of digitalisation technologies managers have applied or intend to apply across their firm's supply chain practice, motivations and benefits behind pursuing digitalisation strategy, and challenges facing managers towards implementing supply chain digitalisation.

This global survey was conducted in mid-2018 with over 700 managers in more than 20 different industries from 55 different countries taking part in the study. Findings have revealed significant insights on how digitalisation is shaping the future of procurement and supply chain management.

The practice of procurement and supply chain is believed to be experiencing an information disruption, also known as digitalisation, that could lead to a transparent, flexible, agile, customer-centric, responsive and value creation system. Firms will no longer be trapped in physical procurement and supply chain routines; new digitalisation enablers will merge the physical world with the digital world. In the embryonic digital era, human interaction might soon be replaced by autonomous machine to machine communications. Thus, it is imperative to understand the implications of these inescapable changes and how they can shape the future of procurement and supply chain management practice and contribute to its further progression and development through this survey findings.

Key Findings

It seems that the majority of the firms surveyed are motivated by not only process and production costs saving associated with digitalisation strategies, but also by enhanced productivity and efficiency.

However, it is noticeable that the main obstacles for firms to pursue and implement digitalisation are expensive technical set up costs (46%) and long development times (42%). On the other hand, digitalising the practice of procurement and supply chain appears to be economically and operationally justifiable despite being expensive to implement and maintain as it would place firms in the position of competitive advantage.

Over
95%

of the firms have adopted at least one of the Industry 4.0 technologies with Cloud Computing, Internet of Things (IoT) and Big Data being the most popular ones.

90%

of the firms are primarily motivated by decreased operational costs and increased efficiency to pursue digitalisation strategies.

Around
60%

of the firms recognise transparency, cost effectiveness and being customer centric as key gains brought by procurement and supply chain digitalisation.

Around
40%
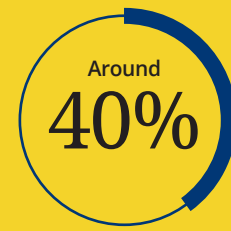
of the firms find technical setup costs, long development times, lack of coordination and ongoing support costs to be challenges when pursuing and implementing procurement and supply chain digitalisation.

Introduction

In the context of procurement and supply chain management, digitalisation, therefore, can be defined as "the practice of redefining models, functions, operations, processes, and activities by leveraging technological advancements to build an efficient digital business environment where gains (operational and financial) are maximised, and costs and risks are minimised."

The industrial revolutions can be characterized by four distinct phases of maturity and emphasis. These are mechanization (Industry 1.0), electrical (Industry 2.0), computerization (Industry 3.0) and now phase 4 is digitalisation (Industry 4.0). Firms are now starting to move beyond Industry 3.0 (an era of computer and the Internet) toward a more fully digitalised environment, referred to as Industry 4.0. Industry 3.0 arguably defined boundaries among different elements (e.g. product development, manufacturing, distribution) contributing to effective procurement and supply chain management, yet is constrained because of the low levels of connectedness that occurred between functional areas and tasks within and between organisations.

In the new era of digitalised workplaces, transfer of goods, services and information across these boundaries is feasible, with procurement and supply chain becoming a fully transparent practice to all stakeholders involved. There are major opportunities for supply chains presented by industry 4.0 technology, including

- Increased information availability
- Optimised inter-company logistics
- Supply chain visibility.
- Transparency through end-to-end real-time information access and control
- Operations efficiency
- Maintenance, integration and collaboration, innovation and product design
- Efficient inventory management

Industry 4.0, originally a German initiative to implement high-tech strategies, is characterised by cyber-physical systems with autonomous machine-to-machine communication which is merging the physical and the digital worlds. Cyber-physical systems are the transformative technologies that manage interconnected systems between firms' physical assets and computational capabilities. Autonomy reflects the systems that make decisions by themselves without further human mediation to function but, based on pre-defined algorithms, utilise expert systems or artificial intelligence. Machine-to-machine communication is where the machines communicate with one another and lead the production system, instead of leaving this activity to a central system or humans. Thus, Industry 4.0 can be seen as a paradigm shift from automated to intelligent production system.

Although Industry 4.0 might seem a vogue term amongst managers these days, little evidence is available to suggest its awareness and practicality in the business world. Firm's procurement and supply chain management entails a considerable portion of the total cost factor. More thorough understanding is required to realise opportunities brought by digitalisation technologies. To this end, The University of Melbourne and CIPS examined the use and planning of digitalisation enablers, motivations and obstacles, as well as its outcomes and performance measures.

Industry 4.0

Industry 3.0

Industry 2.0

Industry 1.0
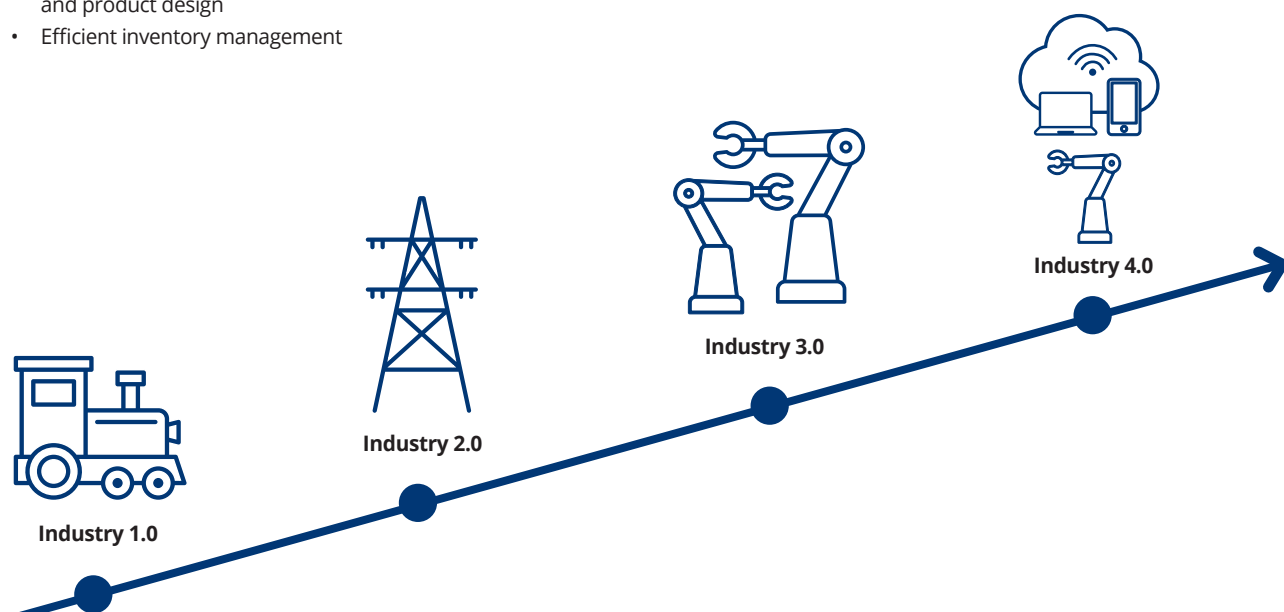
Digitalisation Technologies and Capabilities

11 digital enablers were identified that firms can predominantly use to change conventional practices of procurement and supply chain in production systems. These digitalisation enablers form the building blocks of Industry 4.0.

Digitalisation Technologies

3D Printing
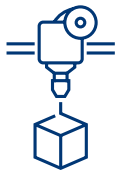
Artificial Intelligence

Augmented Reality

Big Data

Cloud Computing

Internet of Things
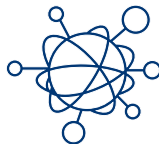
Omni Channel

RFID

Robotics

Sensor Technology

Simulation

Within procurement, if inventory levels are running short, sensors will detect the demand, decide the moment to replenish without external mediation, the buying firms computer will then order materials by itself without intervention from a human procurement representative.

3D Printing

3D printing is used to prototype, produce small batches of customised products and individual components, this helps to reduce the uncertainty about the return on investment before the firm procures. By 3D modelling a complex or critical part of a product such as automotive, aerospace and fire arms, firms can save large costs involved in the procurement process.

Artificial Intelligence (AI)

AI machines learn from experience, adapt to novel situations and perform human-like tasks such as visual perception, speech recognition, decision-making (data collection to analysis) and translation between languages. Procurement agents use AI to automate invoice processing and approve the proposed purchases from narrowed tasks to a wider range of unpredictable tasks. AI also recognises supply chain disruptions, supplier compliance issues and instances of fraud.

Augmented Reality

Augmented reality is the extension of physical reality by adding layers of computer-generated information to the real environment. Information in this context could be any kind of virtual object or content, including text, graphics, video, sound, haptic feedback, Global Positioning Systems (GPS) data and even smell.

Augmented reality is being adopted as an effective training application within the oil and gas industries.

Big Data

Big data is the collection and evaluation of data from different internal and external sources to support real-time decision-making. This technology supports analysis of massive data sets such as contracts, expenses, project portfolios, performance measurement and Virtual Machine System (VMS) data and combines them to manage complex outsourcing and supply chain operations efficiently. Implementing big data can support running enquiries faster, predicting demands accurately to solve sourcing challenges and potentially reducing operational costs.
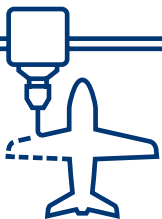
Air New Zealand is now 3D printing interior lightweight parts for its aircrafts saving money and avoiding delays with replacement parts delivery.

Augmented reality can help visualise data in different ways using technologies to present specifications and incorporate more information about a specific product in the procurement process.

Cloud Computing

Cloud Computing enables rapid data sharing with minimal effort across multiple sites. This technology can move procurement and supply chain operations away from complex ERP built tools, replacing them with new application driven user interfaces and cloud-based analytical platforms. This reliable and low-cost technology facilitates global sourcing and supply chain decisions at high speed. It also provides robustness to volatility with enhanced defences for supply chain disruptions.

Internet of Things (IoT)

IoT is a system of interrelated computing devices, objects and people supported by ubiquitous sensors, offering the ability to transfer data over a network without human intervention. It allows the physical world to communicate with computers to decentralise analytics and decision making, thereby enabling real-time responses by recognising business trends.

Omni Channel

Omni channel is a retailing/marketing tool which connects online shopping, through to bricks and mortar in store transactions, the technology connects the different shopping channels to provide a seamless experience to the user. This is a cross functional technology requiring the involvement of IT, procurement, marketing and sales as well as logistics.

RFID

RFID uses radio waves to read and capture information stored on a tag attached to an object. This touch-free technology can offer increased accuracy and real-time inventory tracking at low cost. More reliable and up-to-date information can also strengthen demand planning capabilities, potentially reducing out-of-stock and overstock situations with multiple options in procurement.

Robotics

Robots interact with one another and work safely side by side with humans and learn from them to perform complex and nonrepetitive tasks. This is usually introduced at the minor scale and expanded to the larger scale of automation.

Sensor Technology

Sensors detect events or changes in their environment and send the information to other electronic devices. The sensors provide data on the location and the condition of a company's supplies and products as they are transported around the globe. This technology can provide real time inventory tracking data and customer behaviour on integrated product designs whilst helping to optimise procurement activities.

Simulation Tools and Models

This technology mirrors the physical world in a virtual model that optimises the machine or service system settings before physical changeover. Simulation modelling helps users to determine optimal operating conditions by virtually examining an operation using different possible scenarios.

Digital Enablers in Procurement and Supply

In our sample, 97% of the firms use at least one of these 11 digital enablers. Firms mostly use Cloud Computing, Internet of Things (IoT) and Big Data, in procurement, operations/processes and logistics. This is mainly because firms can easily install these digital enablers.

Figure 1, 2 and 3 illustrate the status of applying digitalisation technologies in procurement, operations/processes and outbound logistics respectively.

Digital Technology Practices in Procurement

■ In Place   ■ Planned For (next 2-3 years)

Technology	In Place	Planned For
Cloud Computing	362	158
Internet of Things	355	109
Big Data	267	175
Simulation Tools and Models	198	140
Augmented Reality	150	124
RFID	150	116
Sensor Technology	127	101
3D Printing	125	86
Omni Channel	94	103
Artificial Intelligence	70	152
Others	44	14
Robotics	37	92

Figure 1: Digital Enablers in Procurement

Cloud Computing, Internet of Things (IoT) and Big Data are game changer technologies for procurement, operations and logistics
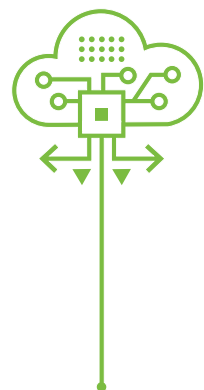
Firms' tendency to use Internet of Things appears as a strategic move to face the future procurement and production revolutions. 9-24% of the firms plan to implement each digital enabler in the next 2-3 years. Among these enablers, firms prefer to implement Big Data, Cloud Computing, Artificial Intelligence and Augmented Reality.

Digital Technology Practices in Operations/Processes

■ In Place ■ Planned For (next 2-3 years)

Technology	In Place	Planned For
Cloud Computing	375	142
Internet of Things	344	134
Big Data	286	170
Simulation Tools and Models	273	120
Sensor Technology	229	116
RFID	203	137
Augmented Reality	189	142
3D Printing	148	100
Robotics	109	110
Omni Channel	99	92
Artificial Intelligence	92	165
Others	42	17
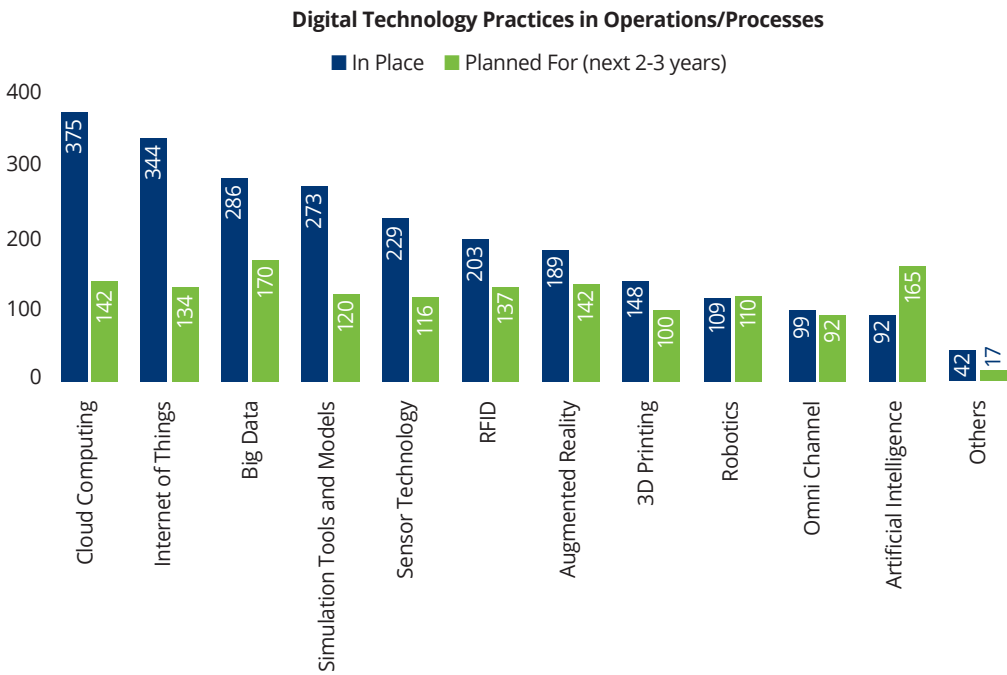
Figure 2: Digital Enablers in Operations/Processes

9-24%

of the firms plan to implement each digital enabler in the next 2-3 years.

Artificial Intelligence is the next turning point technology in procurement and supply

Digital Technology Practices in Outbound Logistics

■ In Place ■ Planned For (next 2-3 years)

Technology	In Place	Planned For
Internet of Things	275	100
Cloud Computing	241	127
Big Data	200	136
RFID	165	121
Simulation Tools and Models	159	101
Sensor Technology	150	106
Augmented Reality	135	109
3D Printing	91	68
Omni Channel	83	84
Artificial Intelligence	66	119
Robotics	45	91
Others	34	17

Figure 3: Digital Enablers in Outbound Logistics

Firms appear to have higher expectations from Artificial Intelligence in the near future given the higher number of firms are now planning for AI implementation in the next 2-3 years. It signals that firms encourage and invest in adaptive machines that learn and perform like humans in procurement and supply chain processes. Robotics, Omni Channel and 3D Printing are the three least used enablers by the firms in each department. This could be due to their applicability in certain industries.

Motivations for Digital Transformation

Firms that adopt digital enablers seek to foster new business models since they realise low labour rates and repetitive mass production are no longer a sufficient winning strategy.

Firms need to leverage autonomous technologies to stay competitive and flexible in their supply chains. As shown in Figure 4, 71%-90% of the firms are driven by these motivations. Firms prefer to use the digital enabler due to operational costs and efficiency, performance of the system and employee productivity. Making digital investments to reduce costs and remove complexity within the supply chain drives revenue growth. Firms are less motivated by consumer image, partner relationships and output volumes. Firms consider all these factors as important drivers to implement digitalisation in procurement and supply chain practices.

Motivations for Digitalisation

Motivation	Percentage
Partner relationships	72%
Volume of outputs	74%
Flexibility/adaptability of organisational activities	80%
Competitive advantage	76%
End to end conectivity	79%
Reductions in error and rework	83%
Employee productivity	84%
Operational costs/efficiency	90%
Consumer image of the organisation	71%
Return on investment	80%
Performance of the existing system	87%

Figure 4: Motivations for Digitalisation

Digital Procurement and Supply Outcomes

Firms that are already using digital enablers in procurement and supply chain practices mostly enjoy benefits such as transparency, cost effectiveness, being customer centric, agile and effective decision making.

Digitalisation has not been able to produce firms with high-level end to end integration (so far) as it has for other outcomes such as transparency and agility. Industry 4.0 formed by digital enablers successfully produces flexibility, customer centricity and economic outcomes improvement in operations, as shown in Figure 5. However, these enablers are still in the development stage to enhance end to end integration and mass customisation of production.

Digital Supply Chain Outcomes

■ Yes ■ Neutral ■ No

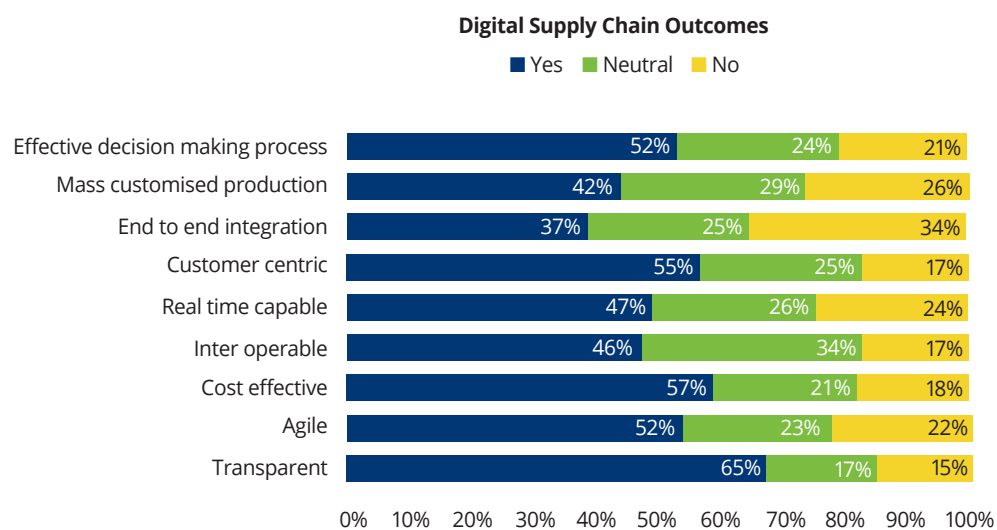| Outcome	Yes	Neutral	No
Effective decision making process	52%	24%	21%
Mass customised production	42%	29%	26%
End to end integration	37%	25%	34%
Customer centric	55%	25%	17%
Real time capable	47%	26%	24%
Inter operable	46%	34%	17%
Cost effective	57%	21%	18%
Agile	52%	23%	22%
Transparent	65%	17%	15%

Figure 5: Digital Supply Chain Outcomes

Challenges of Digital Transformation

Despite the growing interests in adopting digitalisation in procurement and supply chains, firms still find it challenging to implement it in their processes.

As shown in Figure 6, firms that decided to or already implemented digital enablers mostly are challenged by technical set up costs and long development time. Lack of coordination across sites and departments and lack of urgency are also significant inhibitors to implement digitalisation. Leaders could facilitate their employees with ongoing support and a clear strategic vision to overcome these obstacles by highlighting its importance to the firm and the entire supply chain. Measuring performance was found to be the least frequent obstacle in digitalisation because the digital enablers are equipped with autonomous performance measurement systems.

Inhibitors to Digital Supply Chain

■ Yes ■ Neutral ■ No

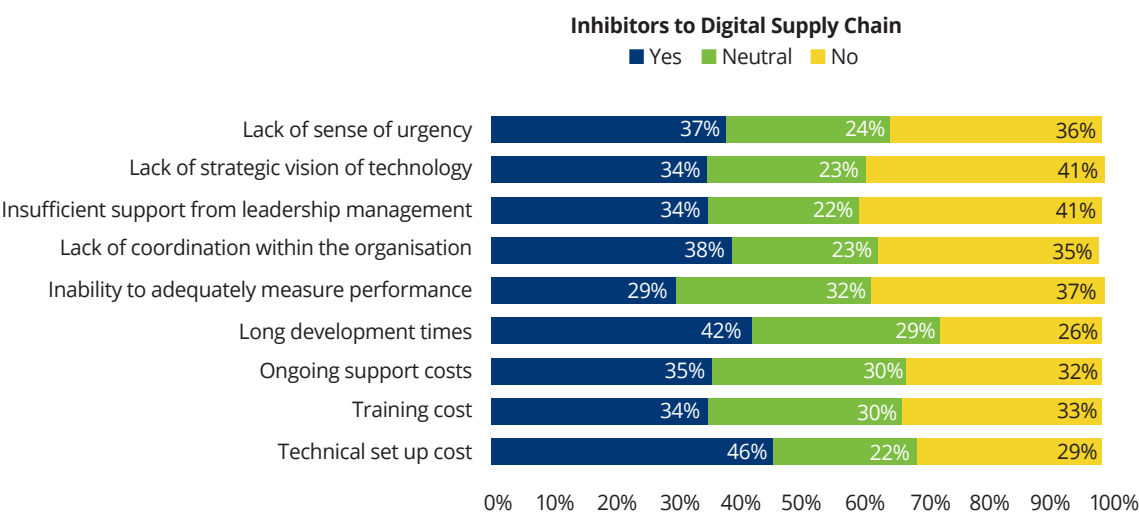| Inhibitor	Yes	Neutral	No
Lack of sense of urgency	37%	24%	36%
Lack of strategic vision of technology	34%	23%	41%
Insufficient support from leadership management	34%	22%	41%
Lack of coordination within the organisation	38%	23%	35%
Inability to adequately measure performance	29%	32%	37%
Long development times	42%	29%	26%
Ongoing support costs	35%	30%	32%
Training cost	34%	30%	33%
Technical set up cost	46%	22%	29%

Figure 6: Obstacles to Implement Digital Supply Chain

Technical set up cost and long development time are major obstacles for digital procurement and supply implementation

Firms' Competitive Performance

As with all initiatives, especially advanced technology investments, implementation can be led and managed very well or poorly.

Figure 7 shows that at the early stages of digitalisation, that performance impacts are mixed, and indeed this reflects that there are and will be winners and losers in this domain. Some 17%-19% of the firms reported performing better than major competitors in sales, profit, market share and investments.

30%-36% of the firms are performing in alignment with their major competitors, with digitalisation in procurement and supply chain practices implemented.

31%-36% of the firms reported to perform worse than their key competitors. They may be at the initial stages of digital transformation. However, they may be performing better than their previous sales, profits, market share and investments with the implementation of digital enablers.

Competitive Performance
■ Better ■ Same ■ Worse

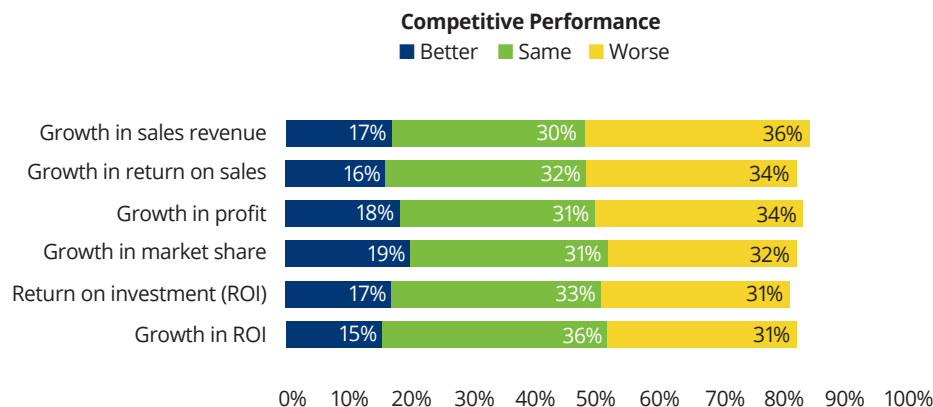|	Better	Same	Worse
Growth in sales revenue	17%	30%	36%
Growth in return on sales	16%	32%	34%
Growth in profit	18%	31%	34%
Growth in market share	19%	31%	32%
Return on investment (ROI)	17%	33%	31%
Growth in ROI	15%	36%	31%

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Figure 7: Competitive Performance

Conclusions and Managerial Insights

In this digital era, customers are more aware of lead time, delivery service levels, and product availability and reliability.

Hence, firms are determined to implement product, technological and administrative innovations to create added value for both the customers and themselves. Digitalisation can create opportunities for improving procurement and supply chain practices to deliver these values. Indeed, the fourth industrial revolution is happening now, and it requires from each firm a rethinking of how to implement and what to expect from the digital enablers.

The most affordable digital enablers that firms can implement are Cloud Computing and Big Data. These technologies bring competitive advantages to the firms considering the factors such as ease of application, low cost of implementation and ongoing support. Firms should also consider investing in Internet of Things (IoT) that automate the procurement and supply chain processes mainly to save costs. For instance, the automotive industry could save a considerable amount each year with embedded systems using IoT that detects and avoids imminent collisions. IoT integrates smart sensors throughout the supply chain which can help to decrease operating costs, increase asset efficiency, improve demand planning whilst being customer centric. Firms

could ensure end to end supply chain integration including procurement enabled by possible sensors such as audio, chemical, electrical, environmental, image, motion and touch or touchless sensors.

Further, businesses could plan to invest in technologies such as artificial intelligence and augmented reality which could likely become more popular in the next couple of years. These digital enablers promise the creation of new products, services and business models that bring profits in all industries. For instance, artificial intelligence-based platforms can identify hidden patterns in seasonal demands and utilisation of historical data. This technology can automate demand planning and optimising supply chain flows and routines to reduce costs, sales cycle times and increase efficiency. Augmented Reality which is a live view of a real-world environment where elements are augmented by computer-generated inputs will be a powerful tool in procurement. It can simultaneously generate information such as products' costing, contract data, specifications and demand trends to make effective real time decisions.

Firms have less frequently implemented robotics, omni channel, 3D printing because they are specific to certain industries and situations. Omni channel is a retailing tool which is more popular in fashion industries. 3D printing is mostly used to prototype complex, critical and expensive components before the actual production and purchase. Robotics can automate and integrate end-to-end supply chain processes involving forecasting, planning, warehousing, procurement, production, supply and performance measurement which is a potential tool in future. It is more popular in terms of driverless vehicles, crewless cargo ships and drones.

Firms could find it difficult to adopt digital enablers mainly due to the technical set up costs and long development times. However, they can consider low cost and easy application choices such as big data and cloud computing as a starting point. To sustain themselves in this digital transformation, firms need certain leadership traits and experiences. In order to execute the change, leaders must include the digital transformation into their strategic vision reflecting what to expect and how to differentiate from conventional processes. They should provide ongoing support for experiments. Both managers and employees should first recognise the level of urgency within the firm and the supply chain.

Digitalisation potentially produces benefits such as
- Transparency
- Cost effectiveness
- Interoperability
- Customer centricity

Firms also entertain the agility of operations and effective decision making to improve performance. They get least benefits in terms of end to end integration and mass customised production which need more preparation and dedication to achieve.

Based on the global survey results, more than 50% of the firms that adopt digital technologies can perform better than or at the same level as their major competitors in terms of profit, sales, market share and investments. Since most firms are still at the early stages of implementation of digital enablers, their competitive performance will require further study. From the survey responses, however, it is clear that firms that adopt industry 4.0 with digital enablers can potentially gain economic and operational benefits.

Respondents' Profile

Following figures show respondents' profile including industry they are working with participating in this research, business nature, annual turnover, number of countries their supply chain pass through and the dispersion of responses by region.

Responses by the Industry Type

Industry	Value
Energy and Utilities	99
Manufacturing and Engineering	75
Professional and Business Services	50
Healthcare	44
Transport, Distribution and Storage	42
Government	33
Construction	32
FMCG (Fast Moving Consumer Goods)	31
Retail and Wholesale	30
Education	30
Banking, Finance and Insurance	23
Pharmaceuticals and Life Sciences	19
Defence	18
IT	17
Agriculture, Forestry and Fishing	16
Telecoms	13
Marketing, Advertising, PR, Media and Communications	8
Hotels and Catering	4
Property	3
Sport	2
Arts, Entertainment and Recreation	1

Responses by Region

- 41% Africa
- 35% Europe
- 12% Oceania
- 7% Asia
- 4% America

Annual Turnover

- 25% Under £10 million
- 13% Between £10 and £20 million
- 9% Between £20 and £36 million
- 11% Between £36 and £100 million
- 15% Between £100 and £500 million
- 27% Over £500 million

Business Nature

- 28% Global
- 36% International
- 36% National

Number of Countries Supply Chain Passes Through

- 37% 1–3
- 19% 4–6
- 8% 7–9
- 13% 10–19
- 23% Over 20