Chapter 2: Navigating the Technology Landscape

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Industry 4.0 - A Brief Overview

To say that digitisation is bringing about a fourth industrial revolution may be an overstatement. After all, we are already in a digital age characterised by electronics, IT and automation. Whether you see it as a revolution or evolution, 'Industry 4.0' describes a distinct phase in manufacturing arising from the confluence of many digital technologies - some already adopted by industry and some not yet ready to be implemented.

These disruptive digital technologies include big data and advanced data analytics, the Cloud, 3D printing, the Internet of Things, augmented reality, and advanced robotics. They are introducing change in business models, based on the digitisation of products and services and each of the links in the manufacturing value chain. In an age of connected and collaborative manufacturing, Industry 4.0 sees technology applications connecting with machines and people on the shopfloor. The goal is to achieve seamless supply chain automation from the moment a sales enquiry is recorded, right through to the final despatch of a product, and even field service performance monitoring.

Industry 4.0 will witness the creation of smart and intelligent factories, where cyber physical systems monitor physical processes, creating virtual copies of the physical world to make decentralised decisions. They will connect and communicate with each other and humans in real time over the Internet of Things, providing instant business critical data, which can be used to make more immediate and effective decisions across the digital supply chain.

Enterprise Resource Planning

Enterprise Resource Planning is coming of age and has an increasingly important role in Industry 4.0, particularly as ERP technology has created a foundation for smart and connected factories, forming the backbone of business management and security.

The technology enables strong supply chain models to function, helping businesses integrate the value chain, better understand customers, enhance automation, become more responsive, and facilitate a transformation to factories of the future.

As early as the 1960s, software was coming into use for very specific applications, such as automating laborious financial computations. Materials Resource Planning (MRP I) systems were later developed for inventory control, linked to production schedules. They evolved into MRP II systems, which could optimise manufacturing processes by starting to integrate accounting functions and customer ordering data.

- **Client / Server Technology:** This is now very familiar system architecture, in which client computers are wholly separate from the server. In this technology the client computer initiates a request, which the server computer accepts, processes and then generates a response back to the client. Different parts of the software are hosted by the client and server computers. This allows hosting of resources like databases in central locations and distributing resources like user interface and reporting services to other locations. Typically, in a client/server environment, PCs are connected using networking devices like hubs and routers to centrally located servers like database servers, application servers, print servers and file servers.

In many manufacturing organisations however, client/server architecture has largely given way to more distributed, internet-based schemes that allow access by mobile devices on a global scale.

- **Database Systems:** ERP systems use relational database management systems (RDBMs) to store data and, with, the software efficiently managing and maintaining data integrity. Modern database systems provide features such as structured query language to access data directly from the database, a transaction mechanism to enable concurrent access to the database, stored procedures to enforce business logic, triggers to initiate actions and security to limit user access to chosen features of the database.

- **Development Tools:** Development tools such as Visual Basic.net or C# enable programmers to create a major part of the ERP software application with the exception of the database. These tools have features to quickly create data entry forms, client side validations, programs to implement business logic, programs to interact with the database and programs to communicate between different parts of the application.

- **Cloud ERP:** Cloud ERP solutions bring the benefits of full functionality that ERP software has to offer without purchasing and maintaining an entire IT infrastructure. Remote, mobile use is facilitated so that multiple site operations can be consolidated without a central site ERP system. Cloud ERP also offers a high degree of data security and permits subscription usage, with options such as SaaS (Software-as-a-Service).

In addition to these core elements of ERP development, many more specific technologies have arisen as supply chain models have changed. For instance, in the 1990s there were companies that outsourced their logistics by partnering with third-party logistics providers (3PL), as well as outsourcing production to contract manufacturers. As part of this mix, technology has developed to harness extranet and intranet models to meet the demand for managing these complex systems. Furthermore, business models, especially in manufacturing, are continuing to shift and evolve with the advent of Robotics and Automation, which also has an impact on supply chain models.

Robotisation, Automation, Machine Learning and Artificial Intelligence

Machines possess artificial intelligence (AI) if they can perform work that would require us to use human intelligence. This is a simplistic definition that could even include some of the earliest examples of automation. But in the context of future digital supply chains we should consider AI as the facility of machines to learn and then modify their actions as a result.

Self-learning computer technology in the Industry 4.0 era means that machines will be capable of controlling their own production and logistics. They will connect with the Internet and interact with their environment, adjusting their operation to suit prevailing situations. As a consequence, production will be in real time, decentralised and individualised – down to batches of a unique item. Decision making will be done without human intervention, optimising production and managing all of the supply chain logistics.

Automation and the use of production robots generate considerable savings in the cost of labour and products. Once the preserve of the motor industry, robotic machines are beginning to be implemented in shop floors across the UK. At face value, the argument for robotics and automation is a strong one; they do not require annual salaries, they don't need leave or sickness days, and they can start up immediately, on demand. In many cases, manufacturing plants already have robots on the shop floor connected to their ERP systems, enabling them to begin production the moment a sales order is finalised, in order to deliver instant service to the customer.

Simply investing in robotics and automation, though, is not enough for a manufacturing enterprise to thrive during Industry 4.0. They need to be integrated into the wider business strategy and into a smart, Big Data environment. They should be there to solve a problem in the business, often a manual, admin-heavy task; robots should not end up being supplemented by more manual work. In this regard, we can begin to create smarter factories where people collaborate with robots, tedious business processes are automated and people are being empowered by machines to make better decisions.

Obvious amongst the downsides of robotisation is the impact on jobs, education and skillset requirements and social change. There is a huge task in managing the necessary change, with potential for loss of workforce morale, disengagement and labour relations issues.

However, robots and automation can also create jobs. This may seem counter-intuitive, but robots improve productivity, which boosts competitiveness, improves revenues, generates economies of scale, and therefore improves overall margins. This creates demand for more design and engineering jobs to innovate and create new products and services, in turn, opening up more sales opportunities.

Cloud Based Technology

For most of us, cloud computing is accessed every day when we use an internet search engine, web email, or open a web page. For manufacturing companies, tapping into remote computing power can extend to accessing all their business management IT, including ERP systems, as a managed service over the internet.

The shift towards mobile devices has been a significant driver in the development of cloud computing. Users can access software and retrieve their own stored data from any location with internet access and this can be done in a 'private cloud', through secure network connections – the equivalent of an intranet. In this way all participants in a digital supply chain can have authorised, 24/7 access to information and software applications, wherever they are.

Cloud services differ according to client requirements but the most common form is known as SaaS, which we previously mentioned in regard to ERP hosting. This is effectively renting IT applications, storage capacity and server hardware in a flexible, secure facility for an ongoing cost. The headline pros and cons of basing company IT systems in the cloud are:

Pros

- Greatly reduced costs of hardware and network infrastructure.
- Decentralised, global accessibility.
- Simplified supply chain data sharing.
- Pay-as-you-go service managed under service level agreements.
- Flexibility to expand IT services\ is Scalable
- Rapid response to rising or reducing IT requirement.

Cons

- Full dependency on an external service provider for continuity, security and performance.
- Operating costs could be higher in the long term than an in-house system.
- Total reliance on internet connection for speed and availability of service.

Commentators are in agreement that cloud based systems will be integral to digital supply chain operation, providing networking between big data analytics, automated manufacturing, logistics and the Internet of Things. Cloud based systems should therefore be considered when benchmarking your business operation and planning for Industry 4.0 capability.

MIND THE GAP: THE STEP FROM DIGITAL SUPPLY CHAIN TO DIGITAL SUPPLY NETWORK

Chapter one	What is a Digital Supply Chain	27th October
	What do we actually mean when we talk about Digital Supply Chain? How is this going to change business process in the manufacturing and engineering sectors?	
Chapter Two	Navigating the Technology Landscape	2nd November
	Important terms and phrases and technologies you need to understand if your company is to be ready for Digital Supply Chain Networks.	
Chapter Three	Are You Ready? Benchmarking Your Current Position	8th November
	How to know if you are ready to take the next step to become Digital Supply Chain ready. It is not only the OEMs and Tier 1s who should be benchmarking their progress.	
Chapter Four	Beyond the Horizon: What's Next?	14th November
	What is next for manufacturing companies working on Digital Supply Chain Networks? How will the industry change as manufacturers start to truly embrace Industry 4.0 and the Digital Supply Chain?	

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