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Digitalized Supply Chains: Building the Future One Step at a Time

Professor Omera Khan

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A brave new world

Digitalized Supply Chains
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at Skill Dynamics
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Perhaps ironically, this paper discusses something that largely doesn't yet exist: the end-to-end digitalised supply chain. But that isn't to say that end-to-end digitalised supply chains won't exist, or that they don't already partially exist.

Quite simply, end-to-end digitalised supply chains will one day exist. And that day may not be far off. For the building blocks in many cases exist. It has taken generations, but information flow along supply chains is now faster—and richer—than ever before. What was unthinkable even a few years ago is now commonplace.

How are supply chain organizations addressing this challenge? What motivates them? What are the barriers that they face? And—crucially—what are the skills that will be required in order to overcome those barriers, and bring the vision to fruition? The paper you are reading addresses these issues.

So, if you believe that end-to-end digital supply chains are part of your organization's future, then I believe that this paper is essential reading.

Prof. Dr. Omera Khan –
Executive Strategic Advisor at Skill Dynamics

“We supply chain professionals know full well—the real goal is - true end-to-end digitalised supply chains,

where information technology is used not just to enhance one particular part of a supply chain, but the entire supply chain”

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In Rwanda, when health workers in certain remote clinics and hospitals urgently need particular medicines or blood transfusion supplies, they use a mobile phone to send a text message to a distribution centre. Inside, the items in question are picked and packed, with careful attention paid to maintaining cold-chain and product integrity. An electrically powered fixed-wing drone, capable of carrying up to 1½kg of supplies a distance of 75km, then flies the supplies to their destination, cruising at 110km an hour.

On getting there—perhaps only 30 minutes after the original request was received—the shipment is then dropped by parachute into the medical facility's grounds, to be collected by staff who have been pre-warned of its arrival. The drone then returns to base.

Thousands of miles away, in Austria, Magna Steyr's vehicle assembly plant in the city of Graz is what's known as an automotive contract manufacturer: it builds vehicles for Daimler, BMW, and Jaguar Land Rover. Contracts to assemble new models—specifically, BMW's 5-series, followed by Jaguar's E-PACE and I-PACE models—meant that Magna Steyr had to go further afield for components.

Instead of relying on a network of local suppliers, most of which were located within 20km of the plant, supplying it on a just-in-sequence or just-in-time basis, the sourcing decisions of the marques in question meant much longer just-in-sequence transit distances would inevitably result.

"Suppliers were no longer close to the plant, but 400km, 600km—right up to 1,200km away, and in a couple of instances even further away," Alfons Dachs-Wiesinger, Magna Steyr's director of logistics services explained. Even so, maintaining just-in-sequence material flows was an important requirement.

The solution: equipping all the plant's incoming and outgoing trailers with GPS communications facilities, so that real-time location and status updates would be available. This would provide Magna Steyr with not only the desired track-and-trace capability, but also the ability to proactively optimise routes so as to reduce fuel consumption and CO2 emissions, as well as improve on-time delivery performance and reduce the need for expedited shipments—benefits all subsequently achieved within weeks of going live.

Or consider trading platforms such as GXS Trading Grid, SAP Ariba, and Infor Nexus, which provide businesses with access to enormous Cloud-based marketplaces, along with full procure-to-pay capabilities and supply chain visibility. Infor's Nexus platform, for instance, connects over 65,000 trading partners, who collectively carry out over $1 trillion of trade each year, and through which some $50 billion of payments flow, backed by all the necessary trade documents—purchase orders, advanced shipping notifications, and invoices.

Described as the world's leading network for multi-enterprise supply chain orchestration, it connects businesses to their entire supply chain, from suppliers and manufacturers to brokers, 3PLs, and banks, in the process powerfully blending both physical and financial supply chain processes on a single Cloud-based platform.

A generation ago, much of this would have been the stuff of science fiction. Yet even more exciting technological developments lie ahead. And lie ahead, what's more, very arguably in the near future, rather than in some remote far-off future.

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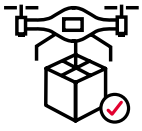

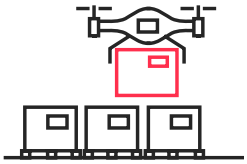

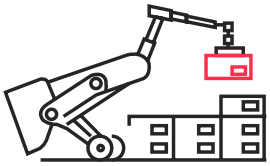

At the Fraunhofer Institute's Dortmund-based Institute for Material Flow and Logistics, work is well advanced on a number of autonomous logistics and materials handling technologies—the very technologies, in short, that make up much of the 'glue' of supply chains.

Intelligent storage bins, for example, capable of not only storing components, but intelligently making decisions about reordering, sequencing, traceability, and monitoring the environmental conditions experienced by those components.

Swarms of autonomous AGV-like 'shuttles', capable of deciding for themselves what must be done to meet a given set of tasks at a warehouse picking face or materials replenishment facility.

And autonomous drones built to fly around warehouses at night, updating perpetual-inventory cycle counts.

And speaking of drones, in the United States, retail giant Amazon.com has received approval from the Federal Aviation Administration to begin flying its fleet of Prime Air autonomous delivery drones, intended to deliver 'same-day' packages to consumers in areas with a low population density—perhaps in as little as 30 minutes after those packages were ordered. While 'live' deliveries are still some way away, the approval to operate is a significant milestone, enabling Amazon for the first time to conduct its test-flying out of sight of an operator.

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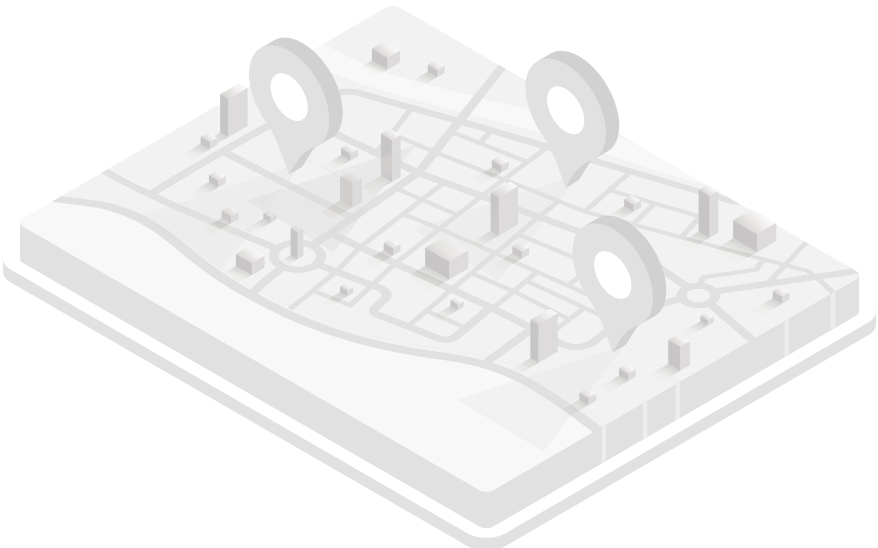

The goal: end-to-end information

Taken together, all of these are different manifestations of the same thing: supply chains digitally enhanced to bring about capabilities once considered almost unimaginable.

By leveraging digital information technology, the companies in question have made considerable improvements to their performance, transforming their supply chains to make them more resilient, more agile, more responsive, and faster. Often, there are cost savings too, delivered through either productivity improvements, better sourcing, less waste, or simply better insights into both demand and the underlying operation of supply chains.

And the examples above, it is important to realise, are just that: examples. Plenty more examples exist of still other aspects of digital information technology generating improvements in the operation of supply chains. Shipment-level real-time GPS-based track-and-trace technology, for instance, often augmented with environmental condition monitoring. Data analytics. Blockchain. Predictive modelling. Advanced planning and scheduling. 'Guided' buying, and chatbots. Robotic picking faces and materials handling equipment. The Internet of Things. Automation-enhanced 'last mile' same-day delivery, 3D printing. And so on, and so on.

Yet all too often, such examples are standalone instances of information technology at work. They are 'islands of excellence': initiatives where information technology has been harnessed to improve one particular aspect of a supply chain. Whereas—as supply chain professionals know full well—the real goal is something much bigger and bolder, namely true end-to-end digitalised supply chains, where information technology is used not just to enhance one particular part of a supply chain, but the entire supply chain.

Getting there won't be easy, or straightforward. But—as the examples above show—progress is undeniably being made. Granted, some aspects of the task are easier than others.

End-to-end information flow in respects of sourcing, ordering, and exception notification is already in the near future, for businesses that care to make the investment. End-to-end supply chain visibility and track-and-trace is however another matter. So too with robotics, advanced analytics, drones, and several other pieces of the jigsaw. Even so, the technology road map is clear enough: for companies with the will, and the determination to overcome the inevitable hurdles, significant advances towards true end-to-end digitalisation are possible.

And the prize is well worth the effort expended, say those with insights into the journey. Martin Christopher, emeritus professor of marketing and logistics at Cranfield School of Management, for instance, stresses the competitive advantages accruing from increased responsiveness, for instance.

"It is becoming increasingly apparent that being able to move quickly—and more quickly than your competitors—is a powerful advantage. Digitalising supply chains allows companies to do this, by enabling them to be more agile and flexible, and able to see things sooner, and respond more quickly as a result."

Vikram Singla, strategy director for digital transformation at enterprise software company Oracle, and a board member at the Chartered Institute for Logistics and Transport, points to digitalisation's benefits in terms of 'leaning' supply chains. So supply chains become more agile and responsive, to be sure—but also leaner, with less inventory, higher fill-rates and availability levels,

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Dr Martin Christopher
Emeritus Professor of Marketing & Logistics,
Cranfield School of Management,
Cranfield University

greater levels of customer satisfaction, and shorter lead times.

Frank Omare, a longstanding procurement veteran, fellow of the Chartered Institute of Purchasing and Supply, and senior director for spend management at enterprise software firm SAP, meanwhile, speaks to the benefits of digitalisation for supply chain and procurement organizations. Instead of being a very manual, paper-driven process, digital information flows enable online collaboration, digital RFPs, sourcing events, increased spend-under-management. Efficiencies and an improved user experience then accrue throughout the entire Source-to-Pay process, he stresses, freeing people up to focus on the more strategic aspects of procurement's role, such as looking to suppliers for innovation, or building a more resilient supplier base.

In short, the appeal of the end-to-end digitalised supply chain is intuitively obvious: it delivers a wide range of benefits, many of them undoubtedly strategic. Why then aren't more businesses further ahead with developing them? For certainly, not every supply chain calls for whizzy new technologies such as drones, robotic pick faces, and GPS-enabled track-and-trace capabilities. In many cases, the less-lofty goal of end-to-end digital connectivity would also be transformative, delivering significant strategic benefits.

It's a question to which there is no easy or simple answer, say supply chain insiders. Cranfield School of Management's Martin Christopher, for instance, speaks of the risks and difficulties associated with the need for businesses to—in effect—disrupt their own operations. If things are working well, why do something radically different, instead?

"It's a mindset thing: being willing and able to make that radical change," he sums up.

Justin Sadler-Smith, general manager for the UK and Eire at procurement software company Basware, draws parallels with automobile pioneer Henry Ford's observation regarding the weakness of market research: that if he had asked people what they wanted, they would have requested faster horses.

"Vision is absolutely essential to the development of end-to-end digitalised supply chains, because businesses and people don't understand the art of the possible," he notes. The solution? Culture, leadership—and courage.

Misplaced enthusiasm is another barrier, adds Len Pannett, managing partner and board member at global management consulting firm Visagio.

"A lot of the time, people run to the shiny things," he notes. "They run straight to 3D printing, or blockchain, or the Internet of Things. They're not first asking themselves what they are trying to achieve, and what the objective is. They're rushing to run before they can walk, cutting corners, hoping for the best, and papering over the cracks. Because – for example – if blockchain is the answer, then what's the problem that blockchain is trying to solve? It's not obvious, most of the time, and there are many instances where blockchain is not the right solution".

So what is it, then, that companies should be trying to achieve? The real answer, Pannett suggests, is something that is much, much more basic: better, timely, and accurate information.

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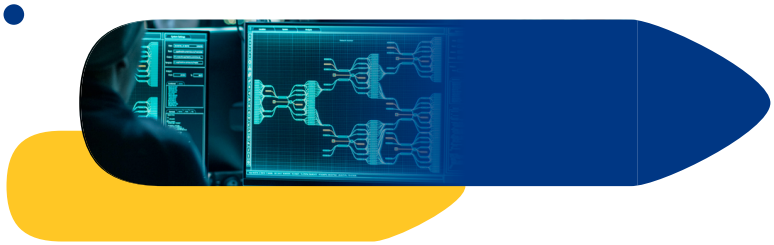
Justin Sadler-Smith, General Manager
UK & Ireland Eire, Basware

Information, information, information: how we got to here



Extended supply chains aren't new. Even as far back in the 1700s, Europe's supply chains already extended to Asia, Africa, and the Americas, delivering cotton, coffee, spices, tea, and other commodities. During the 1800s and early 1900s, global trade expanded significantly, with commodities such as oil, rubber, and grain flowing in one direction, and manufactured goods in the other.

What was different was the speed of information flow along those supply chains. Before the invention of the telegraph in the 1830s, information quite literally flowed at the speed of sailing ships and horse-drawn carts and carriages. Wells Fargo, these days thought of as a bank, was in its early years a stage-coach company, operating a twice-weekly mail service between St. Louis and San Francisco, taking 25 days to traverse the 2,757 miles.

The telegraph revolutionised communication. Remarkably, an undersea cable crossed the Atlantic Ocean as early as 1857, although that first cable only operated successfully for a matter of months. But other, more durable, cables would quickly follow. By 1870, telegraph lines connected Britain to India, crossing the English Channel in the process. The telephone and the Telex machine duly followed, further revolutionising communication.

But telegrams—and even Telex messages—aren't necessarily legal documents: for most practical purposes, purchase orders, invoices, bills of lading, and letters of credit still relied on paper. It wasn't until the 1930s that regular long-distance air mail services began operation, with Europe directly connected to India in 1929, and then onwards to Singapore and Australia by 1934. Even so, the jet age had yet to dawn, and the journey to Australia took around 12 days.

Yet by coincidence, at the same time, the computer age was just dawning: the academic paper by pioneering mathematician Alan Turing which heralded the era of the computer was published in 1936. By the 1950s, computers were a practical—if expensive—proposition, in use within government agencies, the military, and universities, but only sparsely by industry.

During the 1960s, computers were taken up more widely by businesses, as their power, ease of programming, and affordability improved. Materials Requirements Planning—what today we would call MRP—was first put to use by tool manufacturer Black & Decker in 1964. By the mid-1970s, several hundred companies had followed Black & Decker's lead, and by the early 1980s an explosion of use was underway: one estimate has over 8,000 companies using MRP by 1981. One of the editorial team involved in this present paper was using IBM's MAPICS MRP software in 1983, on an IBM S/36 minicomputer within an electronics company formerly spun out of American industrial conglomerate ITT.

These early MRP systems had limited capabilities. Supplemented by reorder point inventory planning systems, rudimentary purchasing systems, and basic forecasting systems, they essentially carried out two key roles: planning and scheduling, and the calculation of net new requirements at the component level—'net', in other words, after taking into account stocks on hand, work in progress, and purchase orders placed but not yet delivered.

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The capacity planning and scheduling, moreover, was somewhat idealised in that it was 'backwards infinite capacity scheduling'—in other words, planning on the basis of ignoring any capacity constraints in the form of labour, machine capacity, or the availability of tooling or materials. It was not until later in the 1980s that what we now call 'constraint-based' planning and scheduling systems, working on the basis of forward finite capacity planning, began to be more widely available. Again, one of the editorial team involved in this present paper recalls using one such system, OPT, developed by a company called Creative Output, which was associated with Dr Eliyahu Goldratt, the originator of the bottleneck-based Theory of Constraints.

Increasingly capable though all these systems were, they had a common failing: they provided an 'enterprise only' view of scheduling and materials requirements. Any calculated material requirements were recommendations: they needed to be either printed-out and then entered into a procurement system to be turned into purchase orders, or where an integrated procurement system co-existed with the MRP system, passed to it in order to be turned into purchase orders. Typically, those purchase orders were then mailed out to suppliers. Within large vertically integrated manufacturing companies, where one plant's materials requirements were met by other plants within the larger enterprise, computer tapes would be mailed or couriered between plants.

Even so, lack of responsiveness was another issue: for all its ability to compute requirements in a massive amount of detail, MRP hardly lent itself to agility. With the computing power available at the time, a complete so-called 'fully regenerative' MRP run was a significant consumer of computing time and resource. Monthly MRP runs were common; weekly MRP runs became the norm only slowly. In many cases, fully regenerative MRP runs were the rare exception, with companies relying on the faster—but less accurate—practice of 'net change' MRP runs instead.

The rare exception to this? Those industries—those few industries—where Electronic Data Interchange (EDI) was in use. EDI makes use of standard transaction formats to facilitate the exchange of messages electronically and started to gather pace in the 1960s and 1970s with companies exchanging these standard transaction formats over Telex lines and the primitive computer networks in use at the time. Various EDI standards and standards bodies soon emerged to promote the uptake of EDI—ANSIX12, Odette and EDIFACT, for instance—and by the late 1980s, roughly 10,000 companies were using EDI.

The rise of so-called 'value-added networks', such as the one operated by GE-owned GEISCO, further popularised the uptake of EDI, with the value-added network acting as a central switching point for the exchange of EDI messages. Even so, EDI was costly and complex, and beyond a few industries—automotive, aerospace, and grocery retailing, for instance—where major customers were big enough to mandate its use, traditional EDI often struggled for traction.

Yet change was coming, with the arrival of the Internet, and web-based communications. Unlike relatively costly EDI value-added networks, the Internet was cheap and ubiquitous: any business with a dial-up line and a modem could get Internet connectivity, with Ethernet-based leased lines and (later) broadband adding further to both speed and bandwidth.

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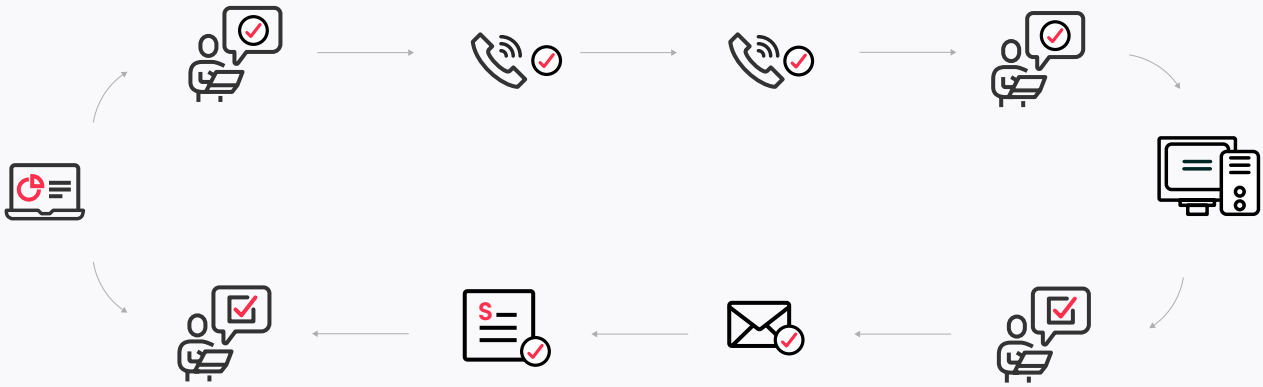
Traditional data Interchange



Electronic data Interchange

A transmission protocol called AS2, which emerged first in the retail industry, made EDI readily possible over the Internet by essentially creating a wrapper around EDI files. This not only enabled them to be sent over the Internet, rather than over a proprietary value-added network, but also provided security and encryption capabilities. Here at last was a means of cheaply and easily tying together huge numbers of businesses, enabling them to exchange supply chain information—purchase orders, order acknowledgements, advanced shipping notices, invoices and much more.

With this lingua franca in place, it was finally possible for MRP to break out beyond the enterprise. MRP-derived supply chain planning software – as opposed to factory-level planning software – had been around since the early 1990s: the difficulty lay in communicating those plans to trading partners in a timescale that was fast enough to be meaningful.

"Plans were often stale and out of date by the time those plans reached the parts of the supply chain tasked with executing those decisions," recalls supply chain veteran Anne Robinson, chief strategy officer at supply chain software company Kinaxis. "There was simply too much latency, and too much cycling between extremes—with too much inventory in one part of the supply chain, and too little in another."

Now, finally, here at last was the means of enabling that information flow to take place at a meaningful speed. Better still, the Internet also enabled supply chain planning software to evolve into true supply chain execution software, with planned actions (or exceptions to those plans) taking place in one part of the supply chain being then instantly communicated to other parts of the supply chain, triggering fresh plans and further actions.

The future, in other words, had started to arrive.

Brave new world

And this is where we stand today. In short, the evolution of supply chains—and supply chain information flows—which goes back to the days of sailing ships and stage-coaches through to the MRP and EDI era, is about to move forward to its next phase: true digital supply chain integration.

Rich new software capabilities, online marketplaces, powerful enterprise-to-enterprise integration capabilities, powerful computer technologies—and looking further ahead, technologies such as drones, robotic picking faces and materials handling equipment, the Internet of Things, and GPS-leveraged track-and-trace add even more capabilities to the mix. In short, 'the art of the possible' is fast turning into 'the art of the do-able'.

"Undeniably, change is underway: pieces of the supply chain are being transformed and digitalised," notes Emel Aktas, professor of supply chain analytics at Cranfield School of Management. "But what's often missing is the connection between those pieces. As consumers, it's like when we buy something over the Internet from a traditional retailer that has embraced selling online: when you telephone them with a query, they have to make phone calls to provide you with an answer, as the systems aren't in place to provide the answer in any other way. You are unlikely to get this with a retailer such as Amazon or Ocado, which have had the luxury of being able to build their systems from scratch."

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Prof Emel Aktas
Professor of Supply Chain Analytics,
Cranfield School of Management

Even so, the required transformation won't happen overnight, concedes Kinaxis' Robinson. There is still preparatory work to do, and ground to be cleared. But the goal of seamless supply chain planning and execution is today much closer to reality than at any time previously, she insists.

"There are still too many legacy solutions out there, which bring inadequacies and latency," she points out. "And technology isn't the only problem: vision is also an issue. Too many people—and too many companies—are too used to doing things in a particular way. That's not to say that those ways are wrong, but to say that you also need other things as well."

Visagio's Pannett agrees, pointing to the chaos that always results whenever supply chain simulation games such as 'The Beer Game' are played. Whenever it's played, The Beer Game always follows a predictable path: despite rock-steady levels of end-consumer demand, beer production and inventories further up the supply chain oscillate wildly.

"There needs to be a better understanding of the entire end-to-end supply chain: people must understand where the levers are, and what those levers do," he argues. "Skill sets are too functionally-centric — focused on manufacturing, procurement, logistics and so on — without a solid enough sense of the overall supply chain. As supply chain leaders, we all need to be better at seeing the whole picture, communicating exactly why things need to be done differently, and precisely which benefits will result."

Others make the same point. Oracle's Singla, for instance, stresses the importance of leadership skills, and change management skills, and influencing skills. It's the so-called soft skills that need to come to the fore if the challenge of digitalising the end-to-end supply chain is to be met, he emphasises: the 'hard' skills are either mostly already in place, or simply not as relevant.

"The goal isn't to digitise the business processes that are already in place, with an objective of—say—reducing transaction costs, but instead to transform the operation of the supply chain by developing entirely new business processes. That's going to call for being able to envision things working in a different way, and then being able to successfully sell that vision so that the vision becomes reality."

Basware's Sadler-Smith concurs: when digitalising the end-to-end supply chain, it can be difficult for people at all levels of the organization to grasp the sheer scale of what has to be achieved. And communicating that scale calls for skills that simply weren't on supply chain leaders' radar screens a few years ago.

"It's the soft skills that matter: collaboration skills, change management skills, the ability to sell and influence, the ability to drive initiatives—these are what matter. Traditional professional education and certification bodies don't 'get it': they teach buyers how to negotiate, for instance, but don't teach them how to collaborate, or innovate."

The final word goes to Cranfield School of Management's Martin Christopher. Supply chains and supply chain leaders, he suggests, well understand the need to invest in supply chain talent and have a good track record of investing in skills. But the future, he stresses, now calls for a re-evaluation of supply chain education: yesterday's skills aren't the same as tomorrow's skills.

"Of late, there's been too great a focus on 'left brain' skills: analysis, analytics, formulae and so on. We now need to invest in 'right brain' skills, such as understanding connectivity, thinking in terms of complex systems, and understanding that the whole is greater than the sum of the parts. That's the challenge that lies ahead."

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