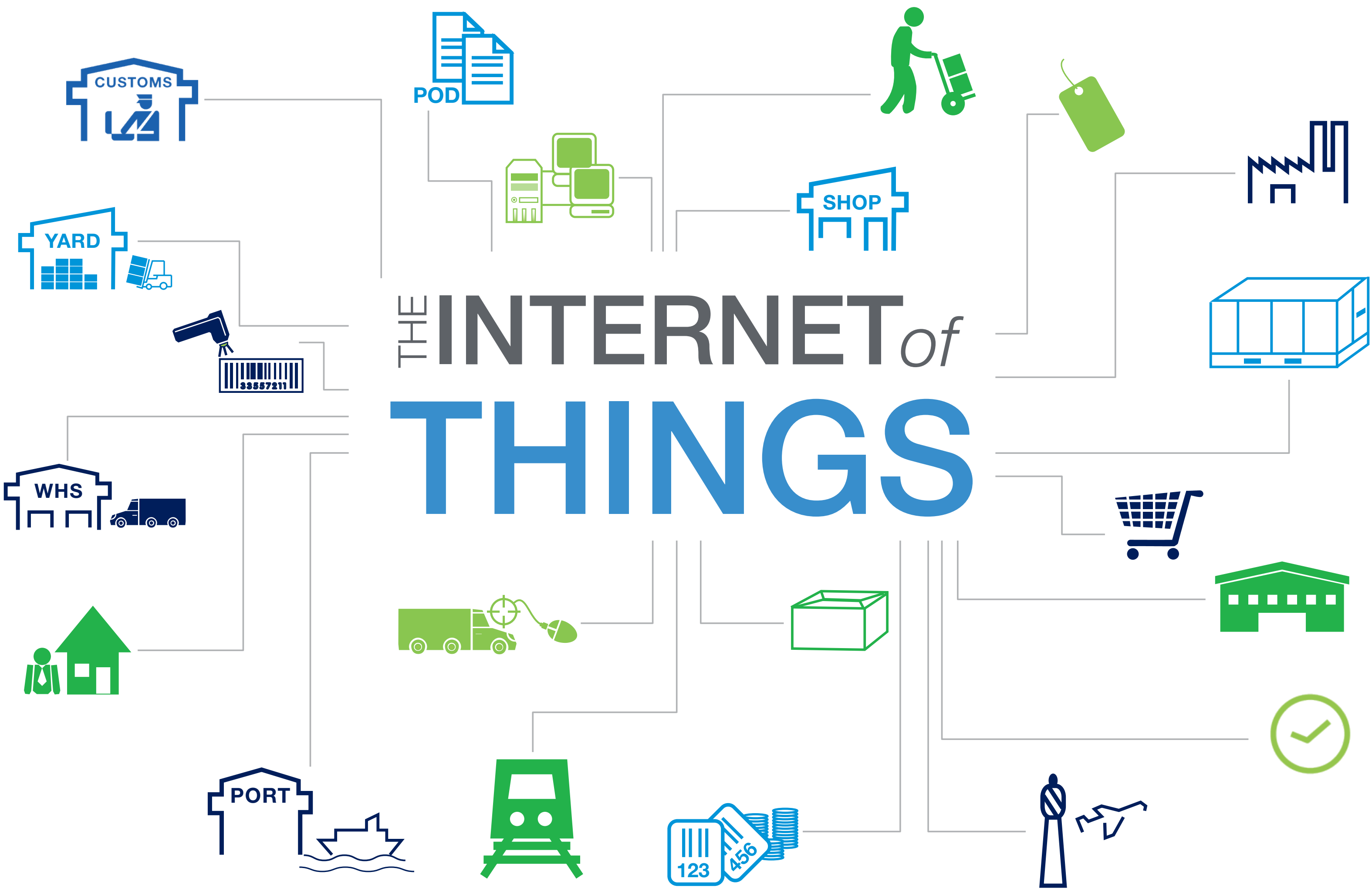

Damco eGuide

HOW THE INTERNET OF THINGS WILL CHANGE LOGISTICS

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01. **INTRODUCTION**

The term 'Internet of Things' is supposed to have been first coined in 1999. Now, IoT is rapidly becoming a reality, and we may not be too far from a 'tipping point' after which IoT becomes universal. But what is this 'Internet of Things', and what, in particular, are the implications for supply chains and the logistics industries that support them?

The concept

At first glance, IoT appears to be merely the further extension of established technologies such as RFID tagging, remote monitoring, GPS tracking, and telematics generally. Although there will be many further developments, the necessary technologies already exist.

What IoT promises is the ability to share and process much more data from an almost infinite number of sources, to adapt the sources and uses of data to changing circumstances, and all without significant investment at the company or supply chain level. Under IoT, the sources of data, the forms in which data is presented, and the ways in which data can be processed, simultaneously, in many different systems, are almost infinitely flexible.

This is achieved because every 'source' is Internet-addressable. Every IoT device has in effect its own Internet address – it can not only upload data to other IP devices and systems, but also download new instructions and parameters: for example, the 'rules' for a process such as temperature control.

IoT devices are not confined to physical discrete items, cartons, pallets, trucks, ships – the objects we currently tag with barcodes or RFID. IoT can include sensors, monitors, recorders and also completely intangible objects such as systems and processes. A pallet of goods can interact with an accounting package, and a human resources package, and warehouse and transport management systems, in a simultaneous and coordinated fashion. Even human operations could, through 'wearable' technology, be part of the traffic.

We face a near future in which almost unimaginable quantities of data are being generated by, and shared with, equally unimaginable numbers of devices and processes. Increasingly, entire systems will become autonomous: that is, they (at least within defined parameters) will make their own decisions, initiate their own actions, account for their own operations, and perhaps act 'heuristically' (they seek out almost optimal solutions to problems that are not analytically soluble, and for which humans typically rely on experience and intuition).

Cautious forecasts by Gartner suggest the world will be using 6.4 bn Internet-connected devices by 2016 (up 30% from 2014) and 26 bn by 2020; Cisco have placed a marker of 50 bn by that date: other analysts have bid as high as 1.5 trillion by 2020. These are unimaginable numbers, but a 2015 study by Dimensional Research for Jabil suggests that already 53% of electronics equipment manufacturing companies have, either in production or development, IoT enabled equipment. This is serious investment – IoT is past the 'hype' stage of the technological cycle, and is rapidly becoming a reality.

02. **HOW DOES THIS WORK IN THE REAL WORLD?**

The smart domestic fridge is the example often used in the media. This would monitor groceries in and out, along with sell-by dates, its own refrigerating performance, rates of use (accounting if required for peaks like weekends or holidays and 'learning' typical usage patterns). It will advise disposal of expired products; it will predict reorder times and quantities, perhaps 'negotiate' with shops and on-line retailers on price and availability, arrange delivery to the householder's destination of choice, liaising with the householder's electronic diary. The vendors are enabled to preposition goods with (because there are many, many users in that area on the system) very high confidence so that fulfilment can be in minutes rather than hours. Simultaneously, real demand signals are sent back up the supply chain to carriers, wholesalers, manufacturers and so on. (All this is technically feasible - the fundamental problem is that, beyond certain basics and staples, people don't necessarily want to eat next week what they ate this week and the week before).

In healthcare, there is great interest in IoT monitoring chronic conditions, and varying formulations, dispensing and despatching them, in accordance with the monitored signs, which would create a more orderly supply chain out of, at present, random presentations to a doctor's surgery, with the time lags and (dare it be said) human errors involved. This could also reduce the wastage of expensive but time-limited drugs.

Aero-engine manufacturers are committed to the long term support of their engines (that is actually where they make most of their money). Aeroplanes already have a multiplicity of condition sensors and recorders. It is a relatively simple step to extend this to alerting 'the system' that a part or component, while still safe, is beginning to deteriorate, or is due for planned replacement. With IoT, the engine can interact with the airline's plane and crew scheduling systems, arranging in advance to land at a base where the parts and labour required have already been pre-booked.

Motor cars could do the same thing – monitoring their mileage and condition, setting those against scheduled service intervals, interacting with one or several service centres to book a slot that is cost-effective, convenient to the vehicle owner's diary and location, with parts and labour, and the courtesy car, pre-booked.

Generally, any area that requires constant response to a large number of factors and conditions is an obvious candidate for IoT, and so many of the benefits of IoT are likely to appear first in logistics and the supply chain, rather than in a direct consumer experience. (McKinsey predicts that only a third of IoT applications will be directly consumer-oriented).

03. **SUPPLY CHAIN BENEFITS**

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IoT shouldn't be just another set of islands of automation – it really does have the potential to link the primary manufacturer with the end user, and with every link in the chain in between. And that very linkage will have profound effects on many aspects of supply chain operations.

Security

Simply as an extension of current practices such as RFID tagging and track and trace technologies, there is potential for improving the security of items in store or in transit against theft, malicious tampering, and 'diversion' of goods onto the 'grey' market or through smuggling. This also suggests stronger protection against counterfeiting. Simpler, faster and more robust Customs and clearance procedures also become possible. It is relatively easy to fake a bar code or other item-level ID – it is much harder to create a complete 'history' for a product right back to original manufacturers and component/material/ingredient suppliers.

Safety and condition

Currently, many goods in store or in transit generate records of condition and experience – temperature, shock loads etc., but typically these are downloaded at fixed points. IoT offers the opportunity for continuous monitoring so that remedial action can be taken before the shipment has to be scrapped, rejected, or discounted. Shipping lines are already introducing vessels equipped to monitor their cargos continuously.

Asset utilisation

If every asset from reusable transit packaging, pallets, roll cages, up to containers, trucks, ships, is IoT enabled, operators have a real-time view of where these assets are, what they are doing (if anything), what is available to move to a point of greater need, and so on. In the case of road transport, in particular, the combination of on-board IoT with IoT deployed across road networks may allow more efficient operation. The IoT system might optimise for best transit time, or for lowest carbon emissions, or for avoiding built up areas in hours of darkness, or other criteria, while automatically negotiating a delivery slot if it is running late.

Inventory and warehousing

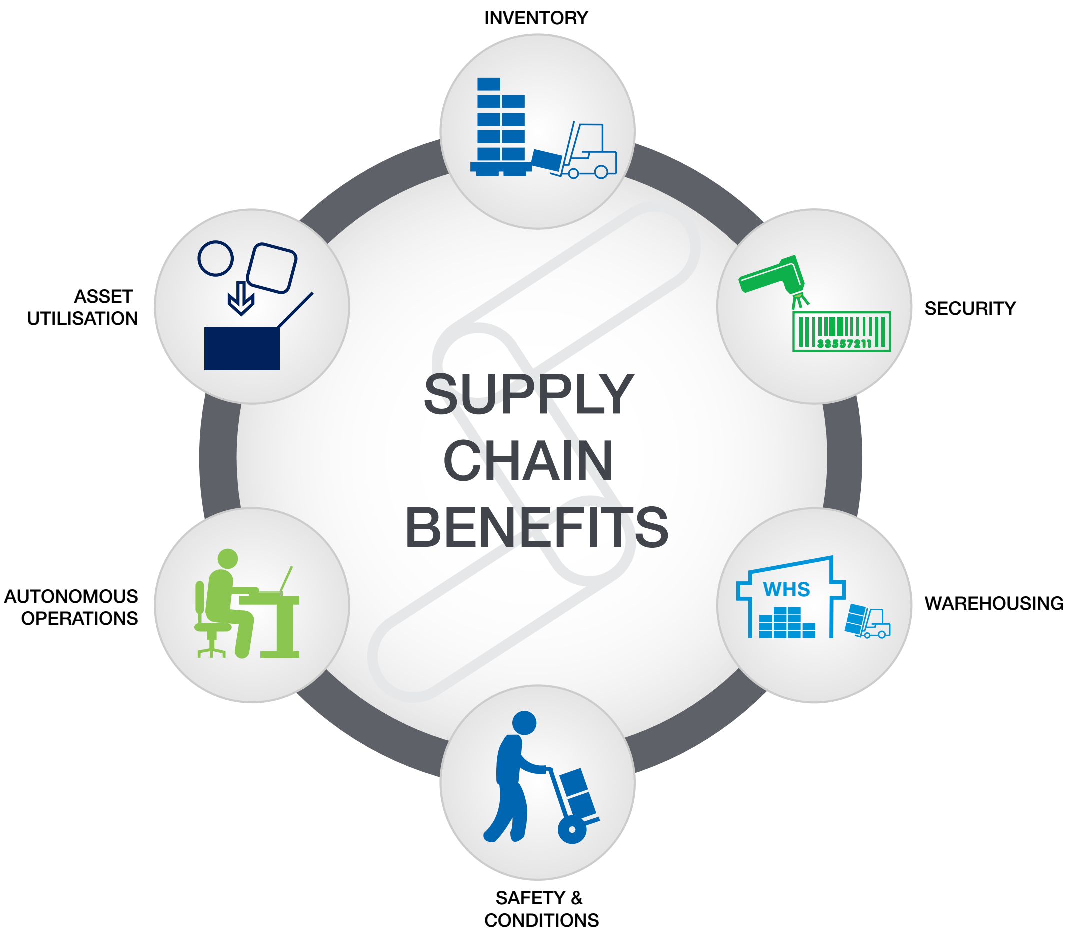
IoT can automatically respond to stocking events and generate appropriate actions such as re-order, replenishment, picking, scrapping, or identifying faster and slower moving lines, reconfiguring warehousing, and directing the trucks or automation accordingly. Procedures for effective handling of returns could particularly benefit – managing an unscheduled event with multiple actions such as unpacking, assessment, refurbishment, repacking, put-away and adding to active stock files, plus financial reconciliations, all of which have to be done in quick sequence if the value of a fast-moving, short life cycle product is to be maintained.

Autonomous operations

Consider the 'self-delivering package'. The item has been ordered, perhaps by an IoT device, this information generates a manufacturing instruction along with other actions such as materials orders or replenishment instructions, 'booking' necessary labour in assembly, packaging, despatch and so on. In highly automated warehouses, the 'package' may control its own put-away and picking by ‘talking’ to automated systems such as smart trucks or shelving. The ‘package’ could then book its own transport routes, searching for the optimal solution either on its own, or as part of a consolidation which involves many ‘packages’ talking to each other – even in a sense ‘voting’. Final mile delivery will be booked in by interrogating the customer’s ‘diary’. The delivery vehicle itself may be autonomous – even if a human is required to install the item, or to access difficult locations, he or she doesn’t necessarily have to be a trained driver

Note that IoT does not demand greater hard automation, although this may be appropriate. Also, IoT does not necessarily replace a human workforce – it is perfectly possible to manage human beings as IoT objects. But IoT can offer ways to reconcile competing demands and resource constraints at a level of detail with which mere human minds, whatever their IT support, cannot cope with consistently or reliably.

There are clearly great possibilities to drive efficiencies, improve economics, and enhance the customer experience by the deployment of IoT in logistics and supply chain. But progress is unlikely to be quite that straightforward.



04. **BARRIERS TO PROGRESS**

The factors that may constrain the the full-scale adoption of IoT are various – some are technical in nature, but social and cultural concerns may be more influential. We will look at these in turn.

Physical and technological

These are few. At the device level, many technologies already exist which are IoT compatible or are actively being made so.

In terms of physical hardware, one of the joys of IoT is that it is not dependent on major fixed investments. There is of course a huge investment in servers and the like but as with the rest of the Internet this will not generally be at the level of the individual company. Individual devices can be as crude or as complex as the information they are required to deal in.

In terms of hardware spending, consumer applications will amount to $546 billion in 2016, while the use of connected things in the enterprise will drive $868 billion in 2016 (see Table 2).

Table 2: Internet of Things Endpoint Spending by Category (Billions of Dollars)

Category	2014	2015	2016	2020
Consumer	257	416	546	1,534
Business: Cross-Industry	115	155	201	566
Business: Vertical-Specific	567	612	667	911
Grand Total	939	1,183	1,414	3,010

Source: Gartner (November 2015)

Overall system architecture is an issue that is being thrashed out – clearly it is important that a standard approach is adopted, given that many companies participate in multiple supply chains across several sectors or verticals. This is being addressed as is the development of appropriate 'middleware'. (This is the software that recognises what an IP message is and how it is supposed to be handled). It is quite likely that different industrial sectors will adopt slightly different approaches. There are currently several consortia proposing 'standards' – in the commercial and industrial field, All Seen Alliance and the Open Interconnection Consortium are just two, and there are several others vying to become de facto standards for consumer applications. EDI (Electronic Data Interchange) went through a similar evolutionary process some decades ago, so the issues are well understood.

In general, there are few technical barriers and, because much of the physical equipment already exists, pricing is already reasonably low.

Social

Greater barriers to the widespread adoption of IoT may arise from societal pressures.

Firstly, there is a fear that many jobs could disappear. In November 2015 Andy Haldane, chief economist at the Bank of England, suggested that over the next 20 years 15M UK jobs could disappear as a result of ‘increasingly creative, smart machines’ which clearly includes IoT. (That is almost half of the 33.7M jobs currently in the UK. In the US he reckoned up to 80M jobs are ‘at risk’).

Operatives may resent being ‘instructed by a machine’. This is seen already sometimes with technologies such as ‘pick by voice’ – although that can also be enthusiastically adopted by others, and is no more ‘machine control’ than is picking to a printed, but machine-generated, pick list.

Cyber-security is a big issue. In theory, every additional Internet device is a new potential avenue for accidental corruption or deliberate malicious hacking. Proper precautions and firewalls, and a degree of human oversight should be built in, but will they be?

The need to retain significant human intervention even in the scenario of autonomous operations may be fundamental because business is essentially about human interactions satisfying human wants and needs. As an example, IoT systems, using predictive analytics, heuristics and other clever stuff, may devise and implement a response to a problem that maximises the benefit or minimises the pain across the greatest number of customers. But, if amongst those customers is one who is negotiating a significant contract renewal, but won’t be too badly affected, as against several dozen who will be hit harder but whose accounts may be less significant, should that not be a human decision?

There are also many unanswered questions in the legal sphere. Where does the responsibility lie if an autonomous system goes wrong and damages or even kills someone? Who is liable - the system owner or user, builder, programmer – or any of the many suppliers of data? In the automotive example above, if the driver ignores the IoT-generated service summons, will that invalidate warranties and insurance? Similarly there are questions about who owns the data in what is largely a collaborative cloud? New and international legal frameworks will be needed but, inevitably, that will take time and lag the situation on the ground.

05. **WHERE DOES THIS LEAD?**

The last major technological change in supply chain was probably the widespread adoption of RFID. This was ultimately driven into popular use by the likes of Walmart and other retailers. It is not clear that retailers, who already have a wealth of ePOS data, have a great deal more to gain from being early adopters of IoT. Government and public services may be more likely candidates. Health provision has already been mentioned; traffic management is another, which offer potentially great benefits from relatively modest investment and has evident supply chain benefits.

For logistics operators themselves, IoT offers the possibility of complete and seamless third-party service of needs and assets. An Internet-enabled data rich environment can be exploited by multi-customer (and therefore even more data-rich) 3PLs and 4PLs to maximise efficiencies and eliminate waste throughout supply chains.

There is also the idea that in the near future assets, from consumer durables to industrial machinery and medical equipment, will increasingly be acquired and managed on a 'lease, maintain, update' model rather than of outright purchase. IoT would enable the asset providers continually to monitor condition, to measure usage, to determine service or replacement intervals predictively. This could be seen as a natural business expansion route for logistics service providers.

Alternatively, and perhaps also, IoT may enable some manufacturers and/or brand owners to reclaim 'added value' that currently goes to third parties. If a manufacturer, for example, can capture all the relevant data for themselves, and develop the systems to exploit this, models involving a more direct relationship between manufacturer and end user may become more viable, and this would be to the detriment, presumably, of 3PLs.

There is therefore much to play for, for logistics service providers and their customers. But where to start?

06. **THE WAY FORWARD**

Should the logistics companies, who 'see' most of the benefits even if they don't reap them, be driving the process? Or is it down to individual companies, or collaborations of firms in similar supply chains, to force the pace?

Within the warehouse or transport operation there are some obvious benefits to be had. Although it is unlikely that cans of baked beans will bear the cost of IoT at an item level any time soon, on the other hand, many high-end and fashion goods already carry RFID tagging and tracing, and a small initial investment to tackle even immediate issues (such as counterfeiting) could show an immediate ROI.

A key question will be what the revenue model is that any party can leverage. In theory, IoT comes almost free of investment cost to the user, but that presupposes that firms actually understand and have made investment in the systems they need to make full use of the data that IoT will offer. How is this wealth of data embedded in their digital business strategies – if at all? One role for 3/4PLs will be to leverage this further. Identifying the short-term gains and 'low-hanging fruit' does make several assumptions about existing capabilities in IT infrastructure and firms' abilities to manage even current volumes of data effectively. How many retailers, for example, currently make all the use they could of their ePOS data?

Nonetheless, early gains should be achievable especially in the areas of transport planning and routing (both inland and international), and in inbound, warehouse, and outbound operations. Opportunities are also clear in the areas of compliance and security. IoT should make it easier to monitor and measure – trusted and approved smart devices can self-report without expensive intervention from labour. Whether regulations and authorities will be 'up to speed' in the short term is questionable – law always lags technology – but it is quite conceivable that in a few years this sort of machine-based monitoring, reporting and verification will in fact become a requirement at some levels.

Logistics service providers have to see how mature individual customers are in terms of IT structure and business strategy, and what they want and expect in applying IoT to their operations. 3/4PLs certainly have a role as IT integrators between different parties in the supply chain, but merely enabling data to flow, connecting ports, containers, items, destinations, will not be enough. What more can logistics providers do with the data to add value? Already we see that 3/4PLs are gaining some of their success from taking responsibility for data management and use that 'pure' IT integrators do not. The value in the supply chain ecosystem will lie largely in the ability to 'predict to prevent', and to steer the supply chain in a different direction.

But, where is the added value from IoT in the supply chain? For some users the supply chain is a real differentiator: for others not so much. Transport/logistics costs are typically an element to be squeezed down: where is the balance between using IoT to drive out cost, and using IoT to optimise for customer expectations? Indeed, if logistics users have, and know how to use, all this smart technology themselves, are 3/4PLs perhaps redundant?

IoT presents both opportunities and threats for the current business models of logistics users and suppliers – all parties have to prepare for whatever impact it may have.

About the author

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