

Towards a vision of goods transport in 2040: Dealing with volatility

*Jack A.A. van der Veen (j.vdveen@nyenrode.nl)
Nyenrode Business Universiteit, The Netherlands*

*Dick A. van Damme
Amsterdam University of Applied Science &
TNO Mobility & Logistics, The Netherlands*

Abstract

What will goods transport look like in the year 2040, and how can we prepare ourselves for what is to come? These are the challenging questions that will be addressed in this paper. By using the observations of the members of the Council for Logistics Knowledge of EVO (the Dutch shippers association), it is concluded that the world of freight transport is becoming increasingly volatile and that the traditional core methodology need to be changed from 'planning & control' to 'sense & respond'. Several ways to achieve the required changes are suggested.

Keywords: Agile, Sense & Respond, Smart products

Introduction

What will goods transport look like in the year 2040, and how can we prepare ourselves for what is to come, or at least keep tabs on developments to avoid surprises? These are the challenging questions that this paper will attempt to answer.

The research questions were triggered by an effort of the Dutch shippers association EVO as a stepping stone for deriving a strategic agenda for the future of logistics for their member organizations. In the vision of the EVO, logistics is all too frequently an operational effort and too many organizations are preoccupied with merely surviving the economic crisis rather than thinking about their future and their long term sustainability. Nevertheless, for the Dutch logistics sector as well as for shippers and Logistics Service Providers (LSPs) using the Dutch and European logistics network, it is of utmost importance to have clarity about their strategic development. By providing a path towards the future, policy makers at macro-, meso- and micro-level might be helped to set out their long-term policies, see also (Tavasszy, 2012). Looking at the far future of goods transport was considered one way of collecting the necessary information for such purpose. Furthermore, for the academic community such an effort can help setting the research agenda.

The basis of the EVO research was formed by a study of the Netherlands Study Centre for Technology Trends (STT) which sketches four scenarios for the social context of logistics in the year 2040. After that various groups of logistics experts were asked to outline the future for their own industry based on the STT study. This paper is the follow-up of the discussion that took place within the EVO Council for Logistics

Knowledge in response to the four future scenarios. This EVO Council is formed by representatives of shippers, LSPs, advisors and knowledge institutes.

Clearly, predicting the future is a tough job, and the further away that future, the tougher it gets. When considering what freight transport may possibly look like in 2040, a modicum of discretion will not come amiss. After all, in 2013 that future is still 27 years off. If we look back, it becomes evident that the past 27 years witnessed immense social, geopolitical, economic and technological changes. These changes have left their mark on our society, on industries and on goods transport. It is also interesting to note that a number of factors that currently determine the way we think and work had already started back then. Individualization, increased mobility, internationalization and environmental awareness did not just suddenly happen overnight.

When thinking about the distant future, the only starting point can be the present; after all we cannot know what we do not know yet. The only certainty is that the future will bring us things that are inconceivable in today's mind. What's more, expectations are that the uncertainty will increase and that the predictability will decrease. Due to the increased interconnectedness of and blurring boundaries between organizations, networks, systems, and countries, changes will have much more impact (Van Damme, 2005). Enterprises will therefore have to prepare themselves for unpredictable changes with a lot of impact, so-called 'black swans' (Taleb, 2010). However, we may also expect a number of existing trends to continue, particularly if those trends are based on a certain underlying logic. This paper will therefore investigate the trends and their underlying patterns in order to see which of the emerging developments of today might fundamentally affect the future of freight transport.

The remainder of this paper is structured as follows. The next section will discuss the trends relevant to goods transport and their direct effects, after which the consequences of these trends for supply chains will be looked at. We will then outline a view of freight transport in the future. Finally, we will draw a number of conclusions.

Trends and direct effects on goods transport

Below a rough sketch of the various general trends and some consequences that are relevant to goods transport is given. The trends discussed below are a summary of the projections of the members of the EVO Council for Logistics Knowledge.

Demographic trends

There is no doubt that the western world will increasingly have to deal with declining population numbers and increasing average age. This is the direct consequence of the increasing levels of wealth and continually improving medical science. This also implies that in the western world, even more so than currently is the case, products and production will be replaced by services; cf. (Pink, 2006). For freight transport this means that logistics services will become even more important than logistics itself. In other words: 'services will overtake wheels'. In contrast with the rich western world, the rest of the world faces explosive population growths. This involves the creation of major new goods flows as well as a gradual shift of existing goods flows.

Economic trends

Ever since the Berlin Wall came down in 1989, the world has seen a steady expansion of its capitalist market economy. Due to such factors as the disappearing contrast between East and West, the abandoning of the absolute communist planned economy by superpowers such as China and Russia, and the liberalization of world trade, new, powerful economic centers are appearing all over the world. It is highly likely that such

superpowers look for control over the products, natural resources and the logistics infrastructure. Furthermore, it is generally assumed that the BRIC countries will be followed by many others; especially the African continent seems to offer many unexploited opportunities.

In an economic sense, this trend can be explained on the basis of classic economic models such as Adam Smith's 'invisible hand' and David Ricardo's 'law of comparative advantage'. What it boils down to is that, if entities all focus on their own specialties (or core competences) in a free trade situation, all will benefit. In other words, a situation of free trade involving as many participating countries as possible will in the long term result in a better economic situation for all the participating countries (win-win).

There are, of course, many factors that can disrupt this economic pattern. Protectionism, opportunism and/or the moral disapproval of other regimes (e.g., former USA president Bush's 'axis of evil') will ensure that the world remains divided into compartments and will fail to reach its full economic potential.

What at the macro level applies to states and economies, at the meso level applies to regions, and at the micro level to organizations. Stimulated by increasing urbanization, strong metropolitan regions will grow and gain importance, witness the rapid development of for example Silicon Valley and Shanghai, each with its own specific strengths. It is possible that these regions together will form a network between which for example green lanes could be established. Urbanization could lead to reduced accessibility of densely populated regions, increasingly turning the supply of these areas (urban distribution, the last mile) into a challenge.

In addition to an increase in globalization, on a regional level a certain degree of return to 'local for local' may take place; see also trends like 'urban farming'. Again China can be considered as an example. Its tumultuous growth will cause its internal market to grow as well. This has several effects. In the first place, more of its production capacity will have to be used for the internal market, leaving less capacity, at least in relative terms, for export. This effect could be reinforced by the fact that a larger proportion of employees will no longer want to do factory work. In the second place, the cost of labor will rise, reducing the discrepancy in labor costs between China and, say, Western Europe. The trade-off between producing in China (global) rather than in Europe (local) for the Western European market will have to be reconsidered. This trade-off will be further affected by the rise of transport costs due to the increasing cost of fuel.

At the enterprise level, we will see a continuing development towards core competences, i.e. doing just what you are good at, and outsourcing all the rest. The result will be that supply chains will become increasingly long and complex; cf. (Friedman, 2005).

The effects of economic liberalization and specialization at various levels will be profound for the goods transport industry. It may be expected that most countries, regions and companies will be unable to go at it alone and will increasingly start to collaborate in groups or in supply chains. As a result, the number of international flows will increase. Consequently, freight transport will become an increasingly small link in an increasingly long and complex chain. In addition, it is to be expected that goods transport will increasingly be outsourced to specialist companies, i.e., the LSPs.

Ecological trends

Even though new discoveries are still pushing the end-date ahead, there is no denying that our natural resources of raw materials are being exhausted. By the year 2040 this

effect will be noticed much more than is now the case. 'Cradle-to-cradle' is likely to be a necessity; recycling of materials is expected to become 'big business' and can be expected to change the industrial landscape; see e.g. trends like 'urban mining'.

With increasing world-wide economic activity and also increasing wealth, environmental awareness will gain importance. Any environmental impact as an external factor of economic activity (the 'externalities') will become increasingly difficult to accept.

The goods transport industry will also be affected by these ecological trends. Different carriers, new fuels and more efficient connections and transshipment points will contribute significantly to meeting the increasing number of environmental restrictions. With increasing re-use, new goods flows will emerge that will easily outgrow the concept of return logistics.

Sociological trends

The increasing level of wealth will also cause people to adopt an increasing level of social detachment and focus on personal freedom. Traditional classifications according to religion, social class, nationality or ethnicity will become less important. These trends are often collectively referred to as 'individualization'; persons who are all seeking to satisfy their individual needs. Clearly, individualization is not the same as isolation. However, people will no longer want to be confined to the stifling traditional subgroups, and they will continually be looking for kindred spirits, increasingly forming part of a large number of different social groups. Even so, it is not set in stone that the trend of individualization and convergence of cultures and groups will continue. Some counter-movements can also be observed. Nationalism is on the rise all over Europe, there is an established anti-globalist movement, and more recently the 'Occupy Movement' managed to attract quite a lot of attention and followers.

Whatever the scenario that will develop at the macro level, at the micro level individualization will undoubtedly continue to develop, in particular in the increasing number of rich and more highly developed countries. The freight transport industry will increasingly find itself facing a wide range of requirements and demands, which is why fine-meshed, made-to-measure logistics services can be expected to have the future.

Technological trends

Of all the developments in recent years, that of the information and communication technology (ICT) must be the most formidable. It would appear to be certain that the trend of increasing numbers of steadily improving means of communication has not run its course yet by a long chalk. Thanks to the internet, connecting the world in real time has ceased to be a dream.

Social networks may have only just started to exist, but they are already affecting the way we go about our lives. This applies to the individual level (the new communities) as well as to the macro level (e.g., the recent revolutions in the Arab world). Companies will therefore increasingly have to take into account what customers think about them. Before you know it, someone's opinion could become a trending topic on Twitter. All in all, it is only to be expected that just like the mass media have changed the world, the social media will do so too.

ICT also affects the way we work, with office work no longer restricted by place and time. Thanks to portable communication technology, everyone can be in the office 24/7 and ready to do business anytime, anywhere. The main consequences for freight transport are twofold. In the first place, more flexibility will be required in terms of delivery time and place. In the second place, goods transport is a perfect example of a

process that is tied to a particular time and place: the transport and its driver need to physically be in the right place at the right time. This requires employees who not only are prepared to accept the more traditional way of working, but actually enjoy doing their job. When observing today's younger generation, i.e. those who will be working in the organizations of 2040, we need to ask ourselves how we can make this kind of work really attractive to them.

ICT might also create a new way of working. Traditionally there is a trade-off between on the one hand the large scale top down planning and on the other hand local awareness and the ability to adopt to ad-hoc circumstances on the work-floor or in the field. With the easy-to-carry smartphones and other devices, people in the field are not only able to observe the situation at hand but can also interact with the overall planning system.

Another ICT trend to be expected is the capability to make individual products 'smart'. Furthermore, organizations are increasingly reluctant to be dependent on large operating systems. One can only hope that in 2040 the current generation of extremely restrictive ERP systems will be a thing of the past, so processes can once more lead the development of ICT rather than the other way around. Individual products will be fitted with intelligent microchips that will enable them to find their own optimized route from sender to recipient in real time, rather like the way people today arrange their personal transport. Every product on-line to the internet in real time, that's where the future lies.

Geopolitical trends

Geopolitics has always been a major force to reckon with, and this is not about to go away. The emergence of new economic super powers will cause the world's balance of power to shift. For example, China and India will increasingly be claiming their position on the world stage. The increasing shortages of natural resources, both in raw materials and fuels, will make the suppliers increasingly powerful.

Also the western world is in flux. Within the Europe Union, political developments go in fits and starts, with unpredictable results. Will nationalism win, or will we become real Europeans?

It is not difficult to predict that all these factors will play a role in the future, but at the same time we cannot foresee how these political games will develop.

It is evident that the freight transport industry is highly dependent on geopolitical developments. In many cases, customs and tax regulations affect transport flows even more than the economic rules of effectiveness and efficiency, as they are subject to the fickleness of politicians.

Considering the trends outlined above, a number of opposing forces can be observed. Wealth leads to individualization, but future wealth is anything but a given in large parts of the world. Economics laws tell us that internationalization is forthcoming, but the extent to which it will occur depends for a large part on the opposing forces resulting from sociological and geopolitical developments.

In spite all the unpredictability, there appears to be a single important constant: the world is becoming increasingly volatile, i.e. changeable, short-term variable and unsettled. The uncertainty is increasing, and predictability is decreasing. This trend towards volatility is likely to have major consequences for the goods transport industry, see also (Sanchez-Rodrigues et al, 2010) and (Klaus, 2011). We will discuss this in more detail in the following sections.

Effects of volatility on supply chains

Before we take a look at freight transport in the future it is useful to first discuss the effects of the trends we have spotted on supply chains. After all, goods transport is not a goal in itself; it always forms part of a larger process, a group of activities that add value for an end user. And all these activities, including goods transport, are performed by the different organizations which together form the supply chain.

If we extrapolate the past based on the trends for the future as discussed in the previous section, the tempestuous developments that supply chains have found themselves subject to for so many years are bound to continue for a long time yet, see also (Melnik et al, 2009) and (Stank et al., 2011). Both the demand side and the supply side of chains will be deeply affected by these trends.

The demand side of supply chains will become increasingly volatile. This is due to an accumulation of developments. Increasing individualization and internationalization will result in a growing demand for, and supply of, new personalized products. New markets will become increasingly important, and product life cycles will become ever shorter. ICT will ensure that contacts between consumers all over the world will improve, which will make it increasingly difficult to separate distribution channels. A fast and flexible response to an ever changing demand will become increasingly important. In logistics terms: due to the volatility on the demand side, supply chains will need to become increasingly responsive.

The supply side of supply chains will also become much more volatile as a result of accumulating trend effects. The tendency towards specialization will cause supply chains to become more and more international, and extensive outsourcing will result in scattered chains. As a result of this and of the increasing internationalization of supply chains, the risks will increase, since the end result is the sum of the parts, and the greater the number of parts, the greater the risk.

As described in the previous section, it is difficult to say which direction social and geopolitical development will take. Changes in prices of raw materials, ever-changing duties and excise taxes combined with the possibility of disrupted international relations will directly impact the supply side of chains. The same goes for any technological breakthroughs resulting in new products and services. Technology breakthroughs, e.g. in nuclear fusion technology, super efficient solar panels, or lightweight and sustainable batteries will immediately create a new situation. Developments such as 3D printing, urban farming, in vitro production of meat, and virtual reality could also create a world of difference.

Longer and more complex supply chains are also more vulnerable. They suffer more from external influences such as pandemics and other diseases affecting humans, animals and crops, or calamities such as earthquakes. The result of the increased volatility on the supply side is that supply chains will be forced to prepare themselves even more to absorb positive and negative risks. In other words, they will have to become more resilient, (Lammers et al., 2009).

To illustrate the effects on chains of the developments outlined above, the framework in (Lee, 2002) can be applied, see Figure 1.

Historically, supply chains operated within a combination of low supply uncertainty and low demand uncertainty. Today, the bulk of the initiatives in the logistics management field are still aimed at reducing costs, i.e. at creating an even more efficient supply chain. However, due to the increased volatility on the demand side, it is gradually becoming more important to respond quickly and flexibly to the diversified customer demand. As the demand volatility increases, efficient chains must yield to

responsive chains. In fact, demand-driven chains have already become the norm rather than the exception.

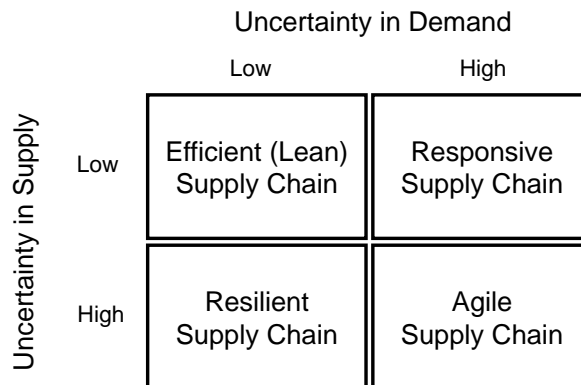


Figure 1: Effect of volatility on the supply side and the demand side on the design of the supply chain (Lee, 2002).

Supply volatility forces supply chains to improve their protection against risks. An incident anywhere in the world will have an immediate impact on all the parties in the supply chain. Recent events emphasize the need to cover such risks; just think of the effects of the recent EHEC outbreak in Europe, the tsunami in Japan, the volcanic eruption in Iceland and the credit crunch that escalated to world proportions when Lehman Brothers folded. Figure 1 demonstrates the need for an agile supply chain whenever a quick response is required to the unpredictable needs of customers while simultaneously there is a possibility of supplies becoming disrupted.

So what makes a supply chain agile? Perhaps the most important part is to do away with Planning & Control and replacing it with Sense & Respond. Once anything becomes unpredictable, forecasting and planning simply become too complicated and inadequate at best. The new keywords are ‘visibility’ and ‘transparency’; the key issue of the future is to know at any given time what the exact situation is on both the demand side and the supply side, so disruptions and changes to the pattern immediately become apparent. An accurate response to changing circumstances requires that the foremost supply chain competencies, efficiency and reliability, be joined by speed and flexibility, see also (Braunscheidel & Suresh, 2009) and (Hummels & Schaur, 2010).

It is evident that the ICT developments outlined in the previous section will bring considerable improvements with regard to Sense & Respond capabilities. But before ICT can work its magic, the chain partners must first be prepared to be candid and share information. For a supply chain to become agile, it is essential that the various chain partners get together and work towards a common goal, which is to meet the requirements of the customer to the best of their abilities. It is not just a single party’s performance that counts, but that of the entire chain or network. In other words, establishing an agile supply chain requires a high level of supply chain collaboration. The same can be said about horizontal collaboration as in the case of different LSPs working together.

Goods transport in the future

The developments and their consequences for supply chains as sketched in the previous sections have a major impact on the organization of freight transport in the future. After all, it is transport that maintains the connections between the links in the supply chain and between the supply chain and the consumer.

From the sketched developments, it seems obvious that freight transport in the future should be organized on a footing that is entirely different from today's. Three speculative views on this subject will be discussed below.

Subway-type network for intelligent goods

Production logistics have taken up assemble-to-order on a large scale, because it is an ideal combination of efficiency and flexibility (customer-specific customization). Modules can be produced efficiently and assembled to meet specific customer orders. Much of today's transport takes place on a make-to-order basis, with trucks delivering freight at a certain destination at the customer's request. In e-fulfillment for example, this would appear to be a strategy that has run its course. Transport flows are becoming too 'thin' and the empty return kilometers keep mounting. Given the trends outlined in the previous sections, the obvious solution would be to adopt an 'assemble-to-order' strategy in the freight transport industry too.

The increasing volume, the wide variety of customer requirements, and the demanded robustness without planning could be supplied by a kind of 'subway service for goods transport', sometimes referred to as a Frequent Transit Networks. If the goods become 'smart', i.e., are fitted with intelligent chips, and information is shared on-line and real-time, a system is conceivable in which the goods find their own way through a finely meshed network without any planning, just like passengers can be carried quickly, efficiently, and flexibly by the London Underground network. As in public transport systems, ships, trains, trucks, vans or other transports depart at regular intervals from one place to another. Missed your train? Not to worry, there will be another one along in fifteen minutes. The services (the modules) are efficient and perfectly planable, reduce congestion and spare the environment. At the same time, the number of shipper to customer combinations is almost infinite. In other words, the logistics and supply chains of the future are dealing with smart products and as a result also are becoming smart, see also (Butner, 2010).

That the idea outlined above is not just a fantasy is demonstrated by three projects that the Dutch Logistics Top Team recently put on the research agenda executed by Dinalog (Dutch Institute for Advanced Logistics), i.e. Synchronomodality, Main Ports' Management Role, and Cross Chain Control Centre (4C). The essence of *Synchronomodality* is that it should be easy to change a shipment to another transport mode on the basis of real-time information. The Dutch *Main Ports* (Schiphol and the seaports of Amsterdam and Rotterdam) are seen as major hubs in the subway-type network. A *Cross Chain Control Centre* can be seen as the control tower of the underground freight transport system.

Professionalized goods transport specialists

Following the economic laws of specialization, it can be expected that there will be an increasing demand for professionals in goods transport. Some scholars including (Hagel & Singer, 1999) envision a future world with only three types of organizations:

1. *Retailers* who know the requirements of customers better than the customers themselves, and who can combine different goods and services to create a unique portfolio with one-stop shopping for end users.
2. *Designers* capable of combining the customer requirements and their know-how (both technical and otherwise) to continually create new and innovative products and services.
3. *LSPs* who handle production and transport at the request of the retailers and designers.

Specialization enables each of these three types of organizations to become better at what they do to create added value. At the same time each of the three parties needs the other two because they cannot operate without each other. For the LSPs such a development will require an extreme form of professionalization. In order to compete, an organization will need to have the best people, follow the latest developments, use the latest technology, et cetera. This requires considerable investments in people, production means, time and money. Such investments can only be afforded by large organizations, which is why considerable consolidation and internationalization (either traditionally through mergers & acquisition or through forming aligned networks) of the logistics industry would also appear to be on the cards. Such large organizations will probably not be managed in a very strict hierarchy following a traditional Planning & Control regime.

Services and management

The concept of a LSP is a bit of a contradiction in terms. On the one hand the logistics services provider, driven by resource management, must try to maximize the utilization of the transport means at its disposal. On the other hand, driven by the service concept, there is a need to adapt flexibly to customer demand, even if that means running a half-empty truck. It would therefore seem logical if transport companies in the future are split up into purely transport specialist (logistics) companies on the one hand, and on the other hand, companies without transport means or storage locations that specialize in managing the logistics of their customers, i.e. real service providers. Following this line of thought, 4PL companies will gain an increasingly important role.

One type of service that will be increasingly in demand is one in which customers can indicate their own preferences. For example, one could be given the option of the same product but with different types of service at different price levels. Using a 'logistics menu card' customers would be able to choose between, e.g., fast delivery at a high cost, or slower and cheaper delivery. This concept can also be used to realize 'individualized logistics', as is already starting to be implemented by combining different distribution concepts, for example by ordering goods over the internet and picking them up at a nearby petrol station.

Conclusions

The main research question of this paper was: what will goods transport look like in 2040, and how can we prepare ourselves for what is to come? As stated in the introduction, it is practically impossible to find a straight answer; the event horizon is simply too far off. Nevertheless, some indications of the direction in which the freight transport industry could well be developing seem to be surprisingly clear. From the various trends outlined in the second part we can deduct that uncertainty and unpredictability will increase. It was concluded that the supply chains of the future will therefore need to become increasingly agile; has the capability to adapt rapidly to changing circumstances. The major benefit is that an agile supply chain can be used in any of the future scenarios and is not depending on the exact course of future developments. In other words, an agile supply chain will be 'future-proof' whatever that future may bring. The major challenge is therefore in making logistics chains both agile and efficient.

Having such a clear path to the future does not mean that the freight transport industry does not have a long way to go. In the last part of this paper various aspects of future goods transport systems were discussed, including major improvements in service levels, management, professionalization and innovative capabilities. For today's

industry the motto is innovate or perish, join or give up, collaborate or fall behind. From the observations in this paper, the choice would seem clear.

For the academic community, many new research opportunities become visible. Creating a future of freight transport that is focused on, e.g., sense & respond, specialization, logistics menus and smart products poses many challenges to policy makers at macro-, meso- and micro-level. Moreover, such questions require collaboration between the various levels (e.g., public-private partnerships), the various organizations in the supply chain (e.g., supply chain partnerships), LSP Networks (horizontal collaboration) and multi-disciplinary collaboration between functions (marketing, R&D, operations) and between disciplines (IT, economics, sociology, psychology). For the field of logistics, which is traditionally economic cost driven, short term and using a mathematical type of logic rather than focused on value creation, sustainable competitive advantages, centered around people and their believes and using a combination of logic and creativity, this will be challenging, yet exiting times.

Acknowledgment: An earlier version of this paper (in Dutch) was published in “EVO Jaarboek 2012”. The feedback of many have contributed to the quality of this version of paper and is highly appreciated.

References

- Braunscheidel, M.J. and Suresh, N.C. (2009), “The organizational antecedents of a firm’s supply chain agility for risk mitigation and response”, *Journal of Operations Management* Vol. 27, No. 2, pp. 119–140.
- Butner, K. (2010), "The smarter supply chain of the future", *Strategy & Leadership*, Vol. 38 No. 1, pp.22 - 31
- Friedman, T. (2005) *The world is flat: A brief history of the globalized world in the 21st century*. Allen Lane, London.
- Hagel III, J. and Singer, M. (1999), Unbundling the Corporation. *Harvard Business Review*, Vol. 77, No. 2, pp. 133-141.
- Hummels, D.L. and Schaur, G. (2010), "Hedging price volatility using fast transport", *Journal of International Economics* Vol. 82 No. 1, pp. 15-25.
- Klaus, P. (2011), “Preparing logistics for the age of volatility”, *Logistics Research* 3, pp. 177–178.
- Lammers, B.; Ploos van Amstel, W. and Eijkelenbergh, P. (2009), *Risicomanagement en Logistiek – Kan uw bedrijf tegen een stootje?* (‘Risk management and Logistics – Can your company take a knock?’) Prentice Hall, Benelux.
- Lee, H.L. (2002), Aligning Supply Chain Strategies with Product Uncertainties. *California Management Review* Vol. 44 No. 3, pp. 105-119.
- Melnyk, S.A.; Lummus, R.R.; Vokurka, R.J.; Burns, L.J. and Sandor, J. (2009), “Mapping the future of supply chain management: a Delphi study”, *International Journal of Production Research*, Vol. 47, No. 16, pp. 4629-4653.
- Pink, D.H. (2006), *A whole new mind: Why right-brainers will rule the future*. Riverhead Books, New York.
- Sanchez-Rodrigues V., Potter A. and Naim M.M. (2010), "Evaluating the causes of uncertainty in logistics operations", *International Journal of Logistics Management* Vol. 21 No. 1, pp. 45-64.
- Stank, T.P.; Dittmann, J.P. and Autry, C.W. (2011), "The new supply chain agenda: a synopsis and directions for future research", *International Journal of Physical Distribution & Logistics Management* Vol. 41, No. 10, pp. 940-955.
- Taleb, N.N. (2010), *The Black Swan – the impact of the Highly Improbable*. Random House, New York.
- Tavasszy, L. (2012), Scenario’s voor Nederland als logistieke hub: kansen en bedrijgingen (‘Scenario’s for The Netherlands as a logistics hub: opportunities and threats’), *EVO Jaarboek 2012*, pp. 27-39.
- Van Damme, D. (2005), Naar een grenzeloze logistiek: Amsterdam logistiek knooppunt in beweging (‘Towards boundless logistics. Amsterdam logistics hub in motion’). Amsterdam University of Applied Sciences, Amsterdam.