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Using Smartphones in Supply Chains

1. Introduction

Mobile phones have settled in our lives for good. Over the last decade or so we have seen them evolving towards more versatile devices. The last years were the period of the most dynamic changes. It was then that mobile phones changed beyond recognition. At the moment they are miniature computers with significant computing capability, working in multi-tasking environments and assuring access to various network services, capable of opening and saving documents in popular office formats and equipped with built-in converters (accelerometer, magnetometer and gyroscope), controlled by a touchscreen, offering many multimedia functions (built-in digital camera and camcorder). Such devices are now referred to as smartphones[1]. Not only did the cellular devices develop, so did the network itself. The latest, third generation, including the most popular UMTS standard, focuses on fast data transmission. Owing to such solutions as HSDPA (*High Speed Downlink Packet Access*) and HSUPA (*High Speed Uplink Packet Access*), a mobile phone can now be used as a terminal connected

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1 One may say that they combine the functionalities of a mobile phone and a palmtop.

to a wide-area computer network. This opens new opportunities of its application, both in everyday life and in business.

Cellular networks are pivotal for the development of the wide range of mobile devices. Mobile devices belong to the ICT segment, which uses wireless communication between devices in such standards as, e.g. WLAN (*Wireless LAN*), Bluetooth, NFC (*Near Field Communication*). At the end of 2012 almost ¼ of Internet traffic was generated by mobile devices, which is up 84% against the previous year and 283% (!) against data recorded almost two years ago (Siwicki 2013). This is a very clear trend. Owning a smartphone has become a lifestyle. In the USA popularity of smartphones among mobile phone owners exceeded 50% (Lewis 2012). In Poland every fourth cellular phone is a smartphone (Kreft 2012). These technologies are becoming widely used in business. The earliest and most visible application was in (mobile) marketing which is still developing and becoming increasingly innovative (Persaud and Azhar 2012), which is surely stimulated by the aforementioned tendencies demonstrated by potential consumers. The pace at which mobile technologies, together with applications supporting the particular field service management areas, enter supply chains is slower and less spectacular. The said areas include most of all transport management, purchasing, sales and repair services (Szymczak 2013). Smartphones are the most popular mobile devices used in supply chain management (Napolitano 2011). Surely, as versatile and multi-functional devices, they will gain even larger share in the implementation of business tasks in the foreseeable future.

The purpose of this paper is to describe the potential areas in supply chain management smartphones can be used in, compared to the current trends. The specified examples of application will be used to draw conclusions regarding the expected effects of use and most promising areas of implementation. These deliberations will be put in a wider, social context. This is inevitable, if we are to treat the consumer not only as the personification of the final place where goods are consumed, but also as the last link in the supply chain, which, through its demand, becomes the causal factor in all flows of goods. We have become accustomed to remote access to data, mobile banking, mobile TV, Internet shopping or contactless payments made using a smartphone. This has a certain impact on the possibility to carry out innovative strategies in supply chain. The general trends visible in the development of this ICT segment cannot be overlooked in the discussion on the functioning of modern supply chains.

2. Mobile technologies in supply chain management

Today we can speak of the dawn of the mobile supply chain management era. The case study analysis and success stories help pinpoint a number of factors which drive considerable interest in the application of mobile technologies in supply chain management and which stimulate their implementation. The most important include (Ruhi and Turel 2005, pp. 101-106):

- the need for internal integration of business processes (within a specific organisational unit),
- the need for external integration of business processes (between various organisational units),
- globalisation, which often requires action where there are no fixed telecommunications links, wired fixed networks or earth-based telecommunication systems,
- the need for real-time information management and related need to acquire and transmit data directly from process location,
- service of new business processes which is related with the implementation of process innovations,
- limitations of legacy systems,
- reduction of business costs.

Tablets and smartphones replaced laptops as devices commonly used by salesmen and service technicians. They are also supported by cloud-based applications, e.g. Salesforce.com. Cloud computing owes its dynamic development largely to the popularity of smartphones. There are still many problems to be solved, which relate to quick loss of energy when using location-based services, mobile cloud convergence[2] or connection handover between access points and various networks (Wi-Fi/UMTS) (Choi, Park and Jeong 2011). Smartphones can be integrated with ERP software (*Enterprise Resource Planning*). The leading suppliers of such software (e.g. SAP AG) offer their integrating solutions, in particular in the CRM area (*Customer Relationship Management*). The operations performed by field service employees are confirmed using the smartphone and automatically registered in the company's ERP system. Smartphones can also be used to gain access to databases and draw up requests regarding, e.g.

2 The idea is that tasks which require considerable processing capacity should be performed in cloud, and other tasks should be carried out using the smartphone. In extreme cases, smartphones can be used to handle only processes related to user interface. This is also important in the energy-saving aspect.

orders, inventories, account balance or to download data regarded products sold or serviced. A growing number of enterprises make an effort to optimise their intranets for mobile device access, although these numbers are still not great. At the same time, smartphone manufacturers boldly look towards business customers (White 2010, p. 246).

The popularity of mobile solutions in supply chain management is already so high, that the term „mobile supply chain management" has been coined. Large retailers contributed to the promotion of this idea, as they actively use the RFID (*Radio Frequency IDentification*) and mPOS (*mobile Point of Sale*) technology in their businesses. Also systems used in other supply chain areas are ready to implement mobile technologies, e.g.: warehouse management, inventory management, shelf management or shop-floor management (Pan et al. 2013, p. 175). The development of the mobile supply chain management idea is faced with the issue of environmental heterogeneity in terms of operating systems of smartphones[3] and the available indoor and outdoor network services. In the first case, the solution is to develop an application for each system or create W3C-based web applications available through a web browser. In the other case the aforementioned connection handover is required in terms of data transmission and the integration of Wi-Fi (indoor) and GPS (outdoor) location-based services. As the performed studies show, enterprises should keep a close look on the behaviour of buyers, as using smartphones and tablets for shopping drives the implementation of mobile technologies by enterprises. This is also caused by building long-term relations with business partners, which provide the basis for the incentive system and joint investments designed as an encouragement of implementation (Pan et al. 2013).

3. Where in the supply chain are smartphones used?

Modern smartphones, equipped with multi-core processors offer computing power of desktop computers or laptops of previous generations. The number of tasks performed to date using computers which can be efficiently carried out by such devices is growing. On the other hand, the relatively small screen (however, with increasing resolution), may make service harder.

According to the research performed by ARC Advisory Group, smartphones are used in supply chains mainly to scan bar codes, take and send photos

3 At the moment they include primarily the three systems: Android, iOS and Windows Phone, as well as BlackBerry.

of supplied products. As much as 22% respondents performed each of these tasks using a smartphone (Cooke 2011). On the other hand, smartphones can be used to send the proof of delivery or to verify signature – the recipient puts his or her signature using a stylus on the smartphone screen or the signed hard copy of the proof of delivery is scanned. These functions are increasingly often used by enterprises which develop dedicated applications (e.g. courier companies). Full registration of the delivery using a smartphone (signed proof of delivery + possible photo documentation) and the possibility of instant transmission to the company facilitate real-time response and considerable increase in productivity and customer service level, particularly in the face of potential discrepancies in supply. A smartphone also makes it possible to gain access to performance dashboard and reports, delivery tracking, concluding transactions in TMS/WMS systems, handover of the shipments to carriers and purchase of transport services. At the moment, these tasks are rarely carried out this way. The significant obstacle in the application of smartphones in industrial environment, e.g. in a warehouse, is the sensitivity to humidity, changes in temperature, dust, impact and the fragility of the device itself. This limits the number of applications, as consumer devices turn out to be insufficient and it is necessary to purchase dedicated and more resistant devices which are much more expensive (DC Velocity 2013). Smartphones are used to control the work of machinery, e.g. on production lines, which is the first symptom of the implementation of mobile production management systems. Smartphones are used to make humanitarian aid supply chains more efficient. Their use in these regions of the world, where the earth-based telecommunications infrastructure is poorly developed, is of key importance for mission success. Under the USAID | DELIVER PROJECT, smartphones are used in Tanzania, Ghana, Liberia and Zambia to collect data on demand for medicines and medical supplies and to check inventory levels (USAID 2010). The communication with proper government agendas and institutions also helped set up a system for early warning against problems with the distribution of medical aid based on the GSM service.

Also the access to social networking services via smartphones cannot be overlooked. According to statistics, one in five smartphone users stopped using computers to access social media and switched to mobile devices, and in 40% of cases access to social media is gained through mobile devices (Marketing Charts 2013). As early as in 2008 social media generated 41% of network traffic and in the USA, South Africa and Indonesia this share exceeded 60% (Cellular-News 2008). This determines the marketing potential of social media, which is well-known and widely used. This has an impact on supply chains, as the

consumer is the last link, and the most important one, when considering the purpose of the chain. Social media help maintain contacts with people and thus contribute to knowledge building in the supply chain. At the moment, however, one can see a further reaching trend to integrate social media with ICT and inter-organisation platforms supporting supply chain management. Facebook and Twitter are becoming tools for creating knowledge repositories devoted to consumer needs and grounds on which they make their choices. Such feedback from involved consumers stimulates innovation in the supply chain and helps in better adaptation of actions to their needs (Jorgensen 2012). Each signal from the consumer leaves a trace and every decision-maker in supply chain has access to this piece of information in one place, without having to search through isolated communication channels: e-mail, EDI etc. Ashcroft (2010) indicated a number of areas where social media can potentially be used in supply chains. They include: people engagement, extended supply chain management[4], risk identification, functional integration. Using social media through smartphones offers the possibility to carry out the above tasks individually by anyone, anywhere and almost anytime. A good example of using social media for core business management, in this case transport, is Con-way Multimodal company, member of Menlo Worldwide Logistics group. The company uses its Twitter account (@ConwayTweetLoad) to update information regarding available shipments: where from, where to, delivery date and quantity (Con-way 2010). The carriers cooperating with the company may use the information to plan transport and use resources more efficiently. Surely it also adds to customer service and corporate image.

4. Homeplus (South Korea) case

The technology which makes it possible to implement innovative business models also impacts the way one handles routine activities. The best example of this is the Homeplus virtual store (owned by Tesco[5]), opened in June 2011

4 Consisting in the integration of data generated by the flow of resources (e.g. tracking flow using RFID) and data provided by people (e.g. their views, assessments, observations). Such a combination may trigger the synergy effect, shorten cycles, reduce costs and multiply effects.

5 British Tesco is a leader in the virtualisation of shopping using new technologies. The chain, together with Keytree company, developed a virtual store one can navigate using a 3D TV set and Microsoft Kinect motion-sensing controller (a Microsoft Xbox 360 input device) and shop from home (Prigg 2012).

at a subway station[6] in Seoul, where customers may shop on the go using a smartphone (ExhibitMag 2012). Posters showing real-size store racks were put up on the pillars and screens at the platform. These virtual shelves house app. 500 food products, sanitary and office products and consumer electronics. Under each product a QR matrix bar code is placed. Customers must install a dedicated application on their smartphones and then scan the code with the built-in camera to buy a specific product. Such a method of sale meets the consumer needs. They can shop for first-need products on their way home from work, without having to visit the shop or plan additional shopping trip, with a guarantee of a swift delivery on the same day, e.g. shortly after getting home. This is also comfortable. One can forget about the crowd and queues to the checkout counter, heavy cart, having to unload the products at the counter, load them to the car and unload them again at home. The products are delivered to the customer's home from the nearest Homeplus store. Each store makes deliveries every two hours, 10 times a day. The delivery fee depends on the time of day and at the peak period amounts to KRW 4000, i.e. app. USD 3.6. Homeplus held the position of the second retailer in South Korea in terms of sales after E-Mart[7]. The virtual store in Seoul helped the company gain the leading position without having to increase the number of retail outlets.

Tesco's idea was the first such concept for a virtual store which reaches out to the consumer. The success of the idea was determined by huge popularity of mobile technologies in private life and that people were willing to use smartphones while commuting to work by public transport. The idea has been picked up by many companies. Other retailers followed in Tesco's footsteps. New such initiatives were started in 2011, and in 2012 there were over 300 such stores in the world[8] (Markovski 2012). There are seldom referred to as *virtual stores*, rather *QR code stores* or even *shopping walls*, in analogy to the similarly sounding traditional *shopping malls*. These stores offer various spatial arrangements (one large location in public space; many locations; a small window in a shopping mall or even

6 This is the Seolleung station, which, according to research carried out by MOLIT (*Ministry of Land, Infrastructure and Transport*) in 2011 is the fourth busiest public transport stop in entire South Korea. (The Chosun Ilbo 2012).

7 E-mart discount stores, established in 1993, are owned by Shinsegae corporation, a Korean retailer since 1930. In 2006 Shinsegae took over the Korean division of Wal-Mart. There are 140 E-mart stores in South Korea (Shinseage Corp. 2013).

8 This trend dynamizes dehumanizing of trade, adds to vanishing interpersonal contacts when making everyday shopping. A critical analysis of this phenomenon is a topic for a separate paper.

a window in own store allowing quick shopping from the street, without having to step into the store), temporal arrangements (permanent; temporary – stalls; pop-ups; occasional – e.g. during Christmas) and various arrangements in terms of product range (many product ranges; a small number of products ranges; only a selected and limited range). The latter group includes specific product retailers, offering cosmetics, toys, apparel or electronic devices. The most interesting *QR code stores* include: Snap2Get in Malaysia, Yi Hao Dian in China, Jetshop in Sweden, Toys'R'Us in the USA, Ahold/Peapod in the USA, Well.ca in Canada, Aliqua/Budnikowsky and Snipes in Germany, Woolworths in Australia, Cold Storage in Singapore, John Lewis, Ocado and eBay in the UK, Sorli Discau in Spain, Jimm's in Finland or Foreshore in the Netherlands. The abundant crop of such stores is also an effect of better availability of IT tools which help in relatively easy development of complete store software from scratch: seller's application for store management and smartphone consumer applications. They are offered by, e.g.: the Malaysian Snap2Get and the Dutch Shop2Mobi. In Poland the „Mobilny konsument" (Mobile Consumer) project is being carried out in the Poznań agglomeration by the Institute of Logistics and Warehousing (idea, methodology), and „Piotr i Paweł" chain stores (store integration, service and delivery). The core of the idea is the free mobile application RockPay, which helps in drawing up the shopping list and making a payment (Portal Spożywczy 2012). It seems that in Poland there is adequate infrastructure to run virtual stores on a large scale. More and more Poles own smartphones. There are places in the public space (including newly developed modern space) through which a lot of potential customers pass every day, suitable for virtual stores to be installed in. However, in the next few years or so, one cannot expect the take-off of this type of stores in Poland, although the first such store was opened on 5th November 2013 at a subway station in Warsaw with the offer of more than 150 products at bargain prices. What acts as a brake on their development are the current buying habits (IAB Polska 2013) under still not as very sharp time constraints of everyday life as they are seen in Korea, as well as the lack of suitable logistics resources of retailers. Though the latter is quite easy to overcome.

5. Total Quality Logistics (USA) example

The above example shows that smartphone applications are dedicated primarily to consumers. In the context of supply chain operation, one may indicate not only applications which allow shopping but also track and trace the delivery or shipment. Such applications have been developed by DHL, FedEx, TNT Express

or UPS. Business applications are not so popular, therefore Total Quality Logistics (TQL) company clearly stands out. Its Freight Finder application for Android and iOS operating systems has been developed for cooperating vehicle owners, carriers and logistic operators. It complements the corporate IT systems allowing out-of-office work (TQL 2011a; TQL 2011b). Searching shipments through the application is very easy. Search criteria include mileage radius, trailer type, load date and destination city. The application grants access to all shipment data in the IT systems, including the phone number of TQL broker handling the case. The use of the application is made easier by integration with location-based services, as almost every smartphone today is equipped with a built-in GPS receiver[9]. Therefore, the application may automatically find free shipments located nearest the smartphone user, then the user touches the phone number displayed on the screen to call with TQL representative - after all a smartphone is still a phone. Thanks to this solution, after unloading the shipment, the driver may easily assure he loads another shipment for the way back. There are many opportunities for the development of this idea. The driver owning a smartphone and transporting the shipment could automatically provide data regarding the status of the transport to the TMS system (*Transport Management System*). On the other hand, many TMS functions could be carried out using the smartphone. The first mobile TMS applications are being developed. Both specialised IT companies (e.g. MercuryGate) and large carriers or logistic operators are involved (e.g. C.H. Robinson). This type of mobile solutions will be implemented in Poland as a piece of logistics systems equipment of multinational logistics service providers who are already present on the Polish market and where their partners are located. Acting globally, they develop single logistics systems supported by uniform ICT standards. How soon will these solutions appear in Poland depends solely on the will of the providers, their propensity to invest and their strategies.

6. Conclusion

Mobile technologies are definitely gaining importance in supply chains. Supply chains need tools that are not fixed to the physical ICT infrastructure.

9 At the moment, two global range satellite navigation systems are available for civilian purposes: the American GPS and the Russian Glonass (since 2011). New navigation devices may use both these systems.

It is required by many processes which are dispersed or which are controlled in a dispersed manner. Multifunctional smartphones have become the most popular tools used in the supply chain mainly to scan bar codes and take quick photo documentation of shipments. Smartphones have become objects of everyday use, indispensable terminals of a modern man allowing the use of many various services. They have changed and are still changing our lifestyle. The observation of these trends translated into various types of initiatives focused on the development of increasingly inventive mobile applications. They are mostly targeted at consumer markets, but business applications for in-house use in organisations are becoming more popular. As the examples specified herein show, they may support supply chain management or even change the way supply chains are managed.

According to Canalys, 2.61 billion mobile devices will be marketed in 2016, which is up by 35% against 2012. Smartphones will be the major beneficiaries of this growth as their sales are expected to grow each year by 17.9% and to double the figures of 2012. It is also projected that smartphones will gain half of total share in the mobile device market (1.34 million pieces) (Pasławski 2013). Soon smartphones will surely become business tools of everyday and common use. The popularity of consumer applications will help develop new innovations in customer service which will have major consequences for supply chain management. One may expect growing interest in the NFC technology in this area also in virtual shopping. Today more and more smartphones are equipped with the NFC technology. Solving technical problems indicated herein, in particular related to working in various environments and mobile access to corporate IT systems and growing opportunities to use smartphones itself will contribute to the development of integrated mobile systems for supply chain management, which go beyond the boundaries of individual enterprises. In the next few years this will be probably the most promising area of implementation, yielding results which will be primarily the responsiveness to market factors, resistance and simultaneous control of operating costs.

One should remember, however, that the success of supply chains is based on relations building, process design, development of organisational models and solutions supported by ICT solutions. The technology only facilitates taking advantage of opportunities, strengthening predispositions of individual supply chain links and the chain as a whole and therefore makes it possible to gain the intended goals or follow innovative strategies faster.

Summary

Using Smartphones in Supply Chains

Mobile phones have settled in our lives for good. The technological development made them actual miniature computers with significant computing capability and many diverse functions, which earned them the name „smartphones". They create new possibilities of application, also in business environments. As it turns out, already today smartphones are the most popular mobile devices used in supply chain management. Surely, as versatile and multi-functional devices, they will gain even larger share in the implementation of business tasks in the foreseeable future. The purpose of this paper is to describe the potential areas in supply chain management smartphones can be used in, compared to the current trends. The specified examples of application will be used to draw conclusions regarding the expected effects of use and most promising areas of implementation. These deliberations will be put in a wider social context, which is inevitable if we are to treat the consumer as the last link in the supply chain which, owing to the reported demand, is becoming a causative factor in all flows of goods.

Keywords: *supply chain, supply chain management, smartphones, mobile technologies.*

Streszczenie

Wykorzystanie smartfonów w łańcuchach dostaw

Telefony komórkowe na dobre zagościły w naszym życiu. Ich rozwój doprowadził do tego, że obecnie stanowią one zminiaturyzowane komputery o sporych możliwościach obliczeniowych i wielu rozmaitych funkcjach, zwane smartfonami. Otwierają się nowe możliwości wykorzystania tych urządzeń – także w biznesie. Jak się okazuje już dzisiaj smartfony cieszą się największą popularnością pośród urządzeń mobilnych wykorzystywanych w zarządzaniu łańcuchem dostaw. Z pewnością jako wszechstronne urządzenia wielofunkcyjne zwiększą one jeszcze swój udział w realizacji zadań biznesowych w tym obszarze w najbliższych latach. Celem artykułu jest charakterystyka potencjalnych obszarów wykorzystania

smartfonów w zarządzaniu łańcuchem dostaw na tle aktualnych tendencji. Przywołane przykłady wykorzystania posłużą do sformułowania wniosków na temat spodziewanych efektów implementacji i najbardziej obiecujących obszarów wdrożeń. Rozważaniom będzie towarzyszyć szerszy, społeczny kontekst, co jest nieuniknione jeśli traktować konsumenta jako ostatnie ogniwo łańcucha dostaw, które poprzez zgłaszany popyt staje się czynnikiem sprawczym wszelkich przepływów rzeczowych.

Słowa kluczowe: *łańcuch dostaw, zarządzanie łańcuchem dostaw, smartfony, technologie mobilne.*

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