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USE OF SMARTPHONE'S POSSIBILITIES IN CONSTRUCTION OF LOGISTICS SYSTEM OF VENDING MACHINES

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Abstract: Article presents a case study of logistics system implementation based on smartphone's possibilities. Authors indicate new opportunities, those modern mobile technologies and equipment offer in construction of cheap and integrated logistics systems. Case study shows usage of a smartphone in the system of a vending enterprise's logistics as an example of integrated and cheap logistics systems and settlements build on revolution of the mobile communication (which is crating by smartphones and tablets). Article proposed calculation of effects of the implementation of presented system, which helps to prepare budget for other implementations.
Key words: mobile technologies, logistics, vending, vending machines, GSM.

1. Introduction

The purpose of this article is to present new opportunities offered by modern mobile technologies and equipment in construction of integrated and cheap logistics systems and settlements, based on an enterprise operating in vending machines sector. Vending is a form of sales of food and industrial products in vending machines.

2. Business model and vending machines sector

Polish market of vending machines includes about 50 thousand machines. Vending market in Poland consists of three main sectors:

- operators of vending machines,
- manufacturers and/or suppliers of equipment and technical services,
- manufacturers and/or suppliers of products sold in vending machines [1].

Business model is based on operator's relation with:

1. owner/user of premises where the machine is located (Contract Location),
2. service engineer/caregiver, physically handling a particular machine,
3. supplier of machines,
4. supplier of products sold in vending machines.

Figure 1. presents this relations. Each of them may occur in various contractual relationships with different ranges of functions.

Operator may be an owner of premises or lease an area for machine. He can also operate in form of joint venture with an owner of premises sparing profits of percentage of turnover or lease a machine with/or without a supply of products.

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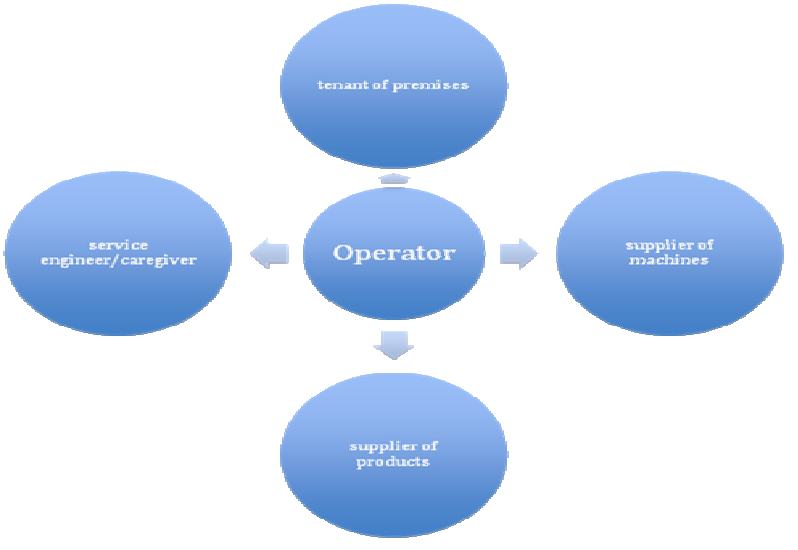

Figure 1. Business model
Source: author's own elaboration

Situation of service engineer or/and caregiver looks similarly. They may be employees, may operate as micro-firms or sign a general outsourcing agreement with selected enterprise.

Similar distinction can be presented to other operators in this business.

The problem of vending enterprise management is dissipation of cooperating entities and difficulties connected with control (including possibility for fraud) and high costs of errors (mostly related to the cost of next transport and employees time – service engineer/machine's caregiver).

According to that, from a functional point of view an operator have to arrange following logistic systems:

1. logistics of automation (purchase, storage, delivery to premises, technical and sanitary services, replacement, product recall, sale, elimination),
2. logistics of products sold in vending machines (purchase/receipt from a supplier, completion, delivery to premises, line filling of machine),
3. cash logistics (supply of cash to give a change, receipt and counting of cash from machines, supply of cash to the bank),
4. logistics of accounting documentation (for location contracts: location contracts, location agreements appendices, accept of products, receipt of cash, accounting documentation according to the valid agreement, invoices; for assistants/repairers: delegations, calculation of costs documentation, salary calculation along with commissions/bonuses) (Figure 2.).

Traditional information systems supporting these processes – based on paper, telephone and mail documentation are expensive both in the aspect of producing source documentation, its processing, time of availability, generated mistakes, which elimination consumes a considerable part of resources of a vending enterprise. Of course backing up

logistic systems with mobile devices is possible, but inappropriately expensive, what results from costs of dedicated mobile devices and their dedicated software.

A system was created on the basis of existing enterprise, which is able to adopt outsourcing services in vending machines from other operators.

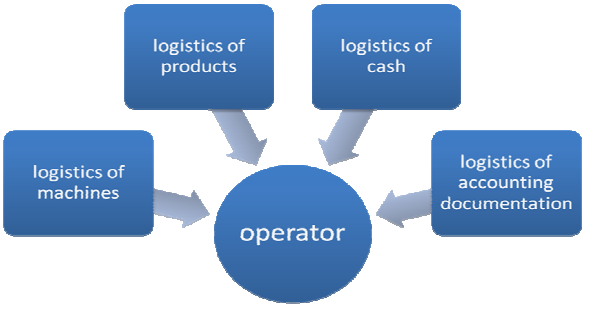

Figure 2. Logistics systems in vending enterprise
Source: author's own elaboration

3. Smartphones and tablets revolution of the mobile communication

Smartphones and tablets are devices which suit needs resulting from proliferation of the mobile Internet. It is estimated that at the beginning of 2013 6 million of them were in hands of Poles and to the end of 2013 the amount of used smartphones will probably grow up to 13 million [2]. The main advantage of smartphones and tablets are applications [3], location functions based on GPS systems are also significant. Applications implemented on smartphones divide on commercial and free of charge. They are already backing up almost every functionality, which can be supported by a smartphone or tablet. Both from the scope of information, entertainment and of work. It causes, that a smartphone and tablet are a focal point of the communications revolution we are going through.

Smartphone is a new PC. Smartphones are generally cheaper than computers, more convenient because of their portability, and often more useful with the context provided by geolocation [4].

With its equipment (alternatively supplemented with appropriate peripherals) a smartphone with the appropriate software is able to replace a lot of devices and systems, not to say (through its universality) to create brand new systems. A system of automatic recognition of accidents can be an example of using a smartphone as a substitute of existing dedicated solutions [5]. An example of using them to the road situation analysis presents an unique usage of smartphones (formation of traffic jams places, a programming of a fast ride or of detour of a traffic jam) [6]. These works indicate abilities which smartphones give as mass and mobile devices with geolocation, giving the information a new dimension for her dynamics, mobility and statistics in real time.

We can single out two models of disclosing data on mobile devices. First of them are specially written applications individually for each of systems, including the Android, Apple or Blackberry. The second one is using a solution through a dedicated web page.

Regardless of a model of disclosing data access to the system from a smartphone's interface, it is an effective solution both for logistic, as well as production, or service

enterprise. Only a way of the access to chosen ERP functionalities changes, but everyone get benefits in a form of e.g. remote alteration and looking documents through.

4. Using GSM systems and smartphones in logistics

The first applications of smartphone's systems in logistics involved the localization of vehicles (GPS module and trig) for the purposes of coordination of the transport network with logistic and protection against the theft of the vehicle.

A comparatively great value of the vehicle, geographical dispersion and a number of potential users of the service caused a creation of many competitive systems [7], next developed for diverse functionalities associated with an aggregation of additional information.

At present, mobile systems as interfaces of information systems of logistics are an object of implementations in diverse applications. Above all, in communication systems with the customer (tourism, courier services etc.) mainly in the mobile forms of already built www interfaces. Interfaces of the ERP class are a subject of offers of IT companies and probably of first implementations (smartphone type devices became widespread in Poland in 2012). In the field of using smartphones to real-time logistic systems it is possible to present proposals of information systems of the bus time of journey, whether finally an information letting limit the CO2 emission [8]. As can be seen, a smartphone as a device has a lot of possibilities by using it in logistics.

Today a smartphone as a device is an universal (cheap) alternative to expensive dedicated devices used so far in the logistics. It allows for a mass scale:

1. to eliminate or to limit a paper documents flow (what reduces costs of the paper system and mistakes generated by it),
2. to create direct, full, double-sided and practically correct communication,
3. what's behind it improves service quality (correctness promptness),
4. improves efficiency,
5. lowers costs (which gives a possibility of price's reduction),
6. saves the attended time,
7. limits cost of the new user of the system to – at the worst – a purchase of a smartphone ,
8. integrates logistic system in internal and canal meaning,
9. full access to information about tasks performed by employees – fast respond to the needs of a customer,
10. shortening the time from the operation of the service up to the moment of its accounting,
11. immediate access to information of commissioned tasks, to information about goods (i. a. availability, price) and customer (history of the cooperation, balance of settlements, discount politics),
12. correction of mistakes (wrong part, wrong goods) by applying the technology of automatic identification,

Figure 3. shows an example of increased effectiveness of systems with applying devices of mobile communication in relation to traditional systems

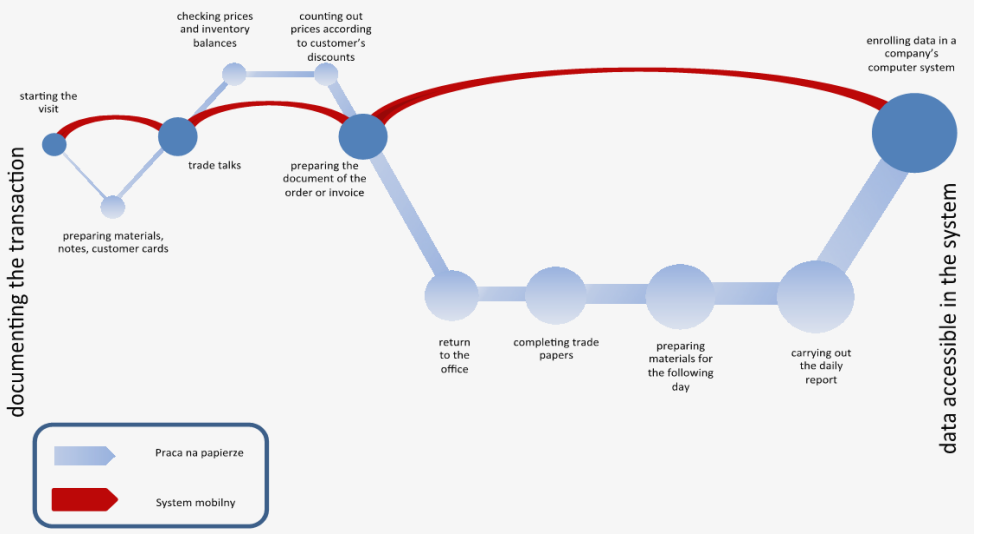

Figure 3. Differences between the traditional work and the work in mobile system on the example of the work of a salesman

Source: http://www.bcspolska.pl/produkty/karta-produktu/art,54,bcsarrow-zarzadzanie-praca-w-terenie.html

The picture above shows possibilities of the mobile system and its role in the process of building market position of the enterprise basing its development on mobile employees, like service engineers or sales representatives. A demand for given services or products are dependent largely on them. As persons, which have the most frequent contact with the potential and permanent customer they influence the popular view about an enterprise. The possibility of marking changes in real time, placing orders or for instance analyzing the story of contacts on the spot, in the residence of the customer, gives them a completely advantage over others.

5. Case study of using a smartphone in the system of a vending enterprise's logistics

Implementation of the system conditions: vending enterprise operates in the entire country, has a few hundred locations and about 1500 acting (active) of vending machines.

Making a decision to implement such an innovative solution must be a result of an analysis of internal and outside conditions of functioning of the enterprise, in particular of requirements put by recipients [9]. Effects, which an enterprise wants to achieve through the implementation of the system [10] and a scope of a support of the management board for the project implementation should be defined.

The management board of this company was determined to conduct changes in logistics of machines what resulted from partial loss of control over logistics of machines. Repeated stocktaking – i. a. due to the quantity of machines – did not bring satisfying effects. In these circumstances the management board decided to use the outside consultant, which purpose was a set, creation and implementation of the inventory system. At this stage the management board was not aware and consequently had no plans for the conduct of procedural profound changes, which in consequence turned out into strategic ones. The

consultant obtained articles of a top-manager and a right to appoint a team of designers in order to create an effective method of stocktaking of machines.

6. Settlement of the system of the logistics of machines and implementation of it

After the preliminary problem analysis the consultant offered a conduct of a secondary unique identification of all machines by marking them with bar codes and creation of electronic dispersed filing system based on smartphone devices.

After the approval of the preliminary concept a team of designers was appointed.

A result of the work of the team was an extension of the formed system for information about:

1. geolocation of machines,
2. their technical conditions,
3. keeper,
4. conditions of settlements with the place, in which the machine worked,
5. photograph and
6. service documentation and
7. commercial documentation about a given machine.

Moreover the system had to have principles of acceptable behaviors (procedures), responsibility, rights and obligations of users. A model of creating the dedicated application up to the Android and Apple systems was chosen and simultaneously the referential list for devices was prepared.

Setting up the project required:

1. Defining magazines, operating zones (places where the machine could be opened) and principles of acceptable transfers
2. Developing the encoding method:
   a) of the machine
   b) of the keeper
3. Defining the procedure of the technical check-in
4. Developing the programming model
5. Developing modules of the ERP software along with the interface software for smartphones.
6. Primary stocktaking of devices
7. Implementing procedures along with the execution of liabilities of rights and obligations of subjects participating in the system

Conducting this project required – due to preparations, the amount and spatial dispersing of machines, 12 months of works.

At present every keeper has a full liability for machines entrusted to him and reports not more rarely than one time in the month.

This system took control of relations of the operator and keepers of machines.

7. Development and implementation of assumptions of the system of logistics of settlements with owners of restaurants

Developing this system required including location agreements into the system (which machines are standing in) and became a natural developmental stage already in the course of introducing the system of the logistics of machines.

Due to great dynamics of amendments to location agreements (resulting from the need of maintaining points and consequently of sales) and the geographical dispersion numerous accounting mistakes had been reached, which resulted from:

1. amendments to location agreements unregistered in a computer system of the operator,
2. technical and accounting mistakes in invoices written out by hand.

These mistakes were enough numerous, that estimated essential time needed for its removal took out 50% of the entire working hours of the department of settlements.

A team of designers suggested:

1. implementing the standard and modular agreement, where the agreement was built through choice of appropriate options, models of settling accounts and quantificable values for the chosen model,
2. assumption with a system of annexes to agreements mentioned above,
3. attaching the module of arrangements to the system interface in a keepers' smartphone,
4. confirming a contract described with new system via authenticated accepting returnable e-mail sent by the owner on the base of already agreed formula,
5. attaching to the system interface in smartphone of a keeper the module of accounting data – appropriate to the signed agreement (extorting system),
6. implementing of the system of electronic invoices available by the module of accounting data on a smartphone of a keeper and delivered via e-mail to the owner of the restaurant.

Standardization, modularity of agreements and their electronic confirming (signing) along with the accounting module connected with a computer system of the operator and the electronic invoice practically eliminated accounting mistakes.

8. Effects of the implementation

As a result of implementing systems is that the operator had 1500 active machines throughout the whole area of Poland with the location in the central part of Poland. He employed 150 keepers, 8 service engineers and had 650 locations.

Design department (computer) employed for the project submitted from 4 computer specialists, which cost in the period of one year amounted 360 thousand PLN.

For the project 2 model smartphones had been purchased, one with the Apple system and second with the Android. All keepers and service engineers received a set application on smartphones owned by themselves.

The full cost of the implementation of the system amounted 450 thousand PLN.

The cost of the mobile alternative system would be almost 3 times higher.

Table 1

Costs of the implementation of a traditional mobile system and a smartphone-based technology system

	sum	**traditional mobile system**		**smartphone mobile system**	
		individual price	*worth*	*individual price*	*worth*
GPS bar code readers	158	3 000,00	474 00,00	–	–
software	158	1 500,00	237 000,00	60 000,00	60 000,00
headworks	1	200 000,00	200 000,00	200 000,00	200 000,00
implementation works	1	70 000,00	70 000,00	70 000,00	70 000,00
maintenance costs (5 years)	5	30 000,00	150 000,00	–	–
development of the system (5 lat)	5	30 000,00	150 000,00	24 000,00	120 000,00
full cost of the system			**1 281 000,00**		**450 000,00**
cost of the next set				**0,00**	

Source: own study

Table 2

Savings in service costs after implementing the new system

	old system	**new system**	**savings**
Average number of repairs of machines per year	2	2	
rate of repeating	33%	10%	
amount of machines	1500	1500	
amount of additional service exits	990	300	
cost of a service exit per one machine	230	230	
costs of additional exits	227 700	69 000	158 700
average amount of days of the stoppage of the not-repaired machine	4	4	
income to the machine per day	150	150	
loss of the income for reasons connected with stoppages tied	594 000	180 000	414 000
Savings generated by the system (in the period of one year)			572 700
General savings in the period of 5 years			2 863 500
Profit from the investment in the period of 5 years			2 413 500

Source: own study

The mobile system still had one function, for which traditional readers are lacking, and which are a norm for smartphones – a camera. He fulfilled documentary and location functions. He let not only substantiate destructions, damages, technical condition etc., not only in the form of the document with the determined location of the place of making documentation and the date. That kind of functionality considerably raised the productivity of service engineers – because the trip was preceded by analysis of the photograph in order to determine the grade of taken damage. What's more, costs of the delegation had been reduced and satisfaction of the customer, for whom the inoperative machine is generating the losses associated with the category of loss of the benefit, increased.

Similar behaviors (photographic documenting and sending as data) took place between owners of restaurants and keepers. Here economical effect multiplies oneself due to the number of relations keeper (150), owner of the restaurant (650). An improvement in management information, which in that kind of system has a character of current information (online), is also significant, which considerably improves the effectiveness of managing and consequently raises economic indicators of the enterprise.

9. Conclusion

At this place arose a concept of the assumption with smartphone's communicative possibilities of all remaining logistic systems and other managerial systems using a computer system of the enterprise on the part of completing information as well as for its using.

The scale of positive changes was so great that the operator started considering an assignment a company doing only a service of vending enterprises, and in the future other automotive (online stands, flippers, gambling machines etc.) seeing the possibility of achieving success by reducing costs, the high quality of services and the scale of activity.

An interesting result of implementing the correct and timely information system is and improvement qualities of data to such an extent, that at this quantity of machines the managing through a statistical analysis is possible, what gives the next development potential connected with e.g. the restriction of frauds, a better allocation of machines etc.

Smartphones' possibilities in building systems of assisting the management up are still unknown, because as every revolution also that one changes the paradigm and creates solutions earlier unknown, or enters new solutions into old problems. That subject describes i. a. Christian von Spreckelsen, Patrick Bartels and Michael Hans Breitner in their study Geschäftsprozessorientierte Analyse und Bewertung der Potentiale Nomadic Computing, Elias G. Carayannis, Stephen C. Clark in their work Do Smartphones Make for Smarter Business? The Smartphone CEO Study [12] or Victor GREU in a work Smarter information and communications technologies for smarter people [13].

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