Mobile Business in the Vending Industry

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MOBILE BUSINESS PROCESSES IN THE VENDING INDUSTRY

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Abstract

The business of operating vending machines substantially changes by the use of telemetry via wireless technologies. This technology enables operators to change their business processes from a fixed periodical to a needs-based operating and maintenance, generating efficiency and effectiveness added values. In addition, significant advantages can be achieved by real-time error reports, by analyzing and optimizing the product range and the profitability. The paper provides a general introduction in the vending market and the operating process. Based on this, drawbacks and opportunities of the use of mobile communication techniques in vending machines for a business process reengineering are discussed and criteria for the choice of telemetry-equipped vending machines' locations are developed. The feasibility of the proposed concepts is examined with regard to the current technical state-of-the-art. Finally, conclusions are drawn and an outlook on the future of mobile vending is given.

1 Introduction

Vending machines are very common in a lot of countries. It is almost impossible to imagine everyday life without them: (parking) tickets, beverages or even cash – each of these is obtained at vending machines day and night. However, the effective operating and maintenance of these machines requires a remarkable logistic effort.

This paper results from a four-month project with a major German operator of vending machines. The aim is to show that the usage of telemetry via wireless technologies may not only support the operating in a simple way but also provides the opportunity for new, innovative business processes.

We define *telemetry* as the measuring, triggering and controlling over spatial distances. In this contribution we will focus on telemetry via wireless technologies: The opportunity of using telemetric functionalities for electronic and electrical devices of all kind by using different sorts of wireless communication on sides of the releasing and/or the implementing equipment is one of the characteristics of mobile solutions. Therefore, we talk about the *Mobile Added Value* of *Command and Control Functions* [TP03, pp. 184ff, 159]. This means, that on the one hand a central unit has remote control over local stations and on the other hand local stations send data to the central unit to inform about their current status. Telemetry is of special importance when greater distances have to be bridged or machines are in a position difficult of access. Thus, telemetry is applied whenever the distance between installation and surveillance station is too long for a fixed wire, or if a fixed wire is not appropriate or possible [Zo02, p. 15]. In a most advanced version, a process can be automated in terms of

total (remote) control by IT-systems. In that case, we talk about device-to-device (D2D)-Communication[1] [TP03, p. 2; Ro99, p. 2; Le02, p. 2].

The opportunities through an effective and efficient telemetry deployment are shown in this contribution by the example of the operating of cold beverage and snack vending machines. Processes concerning other vending machines, e.g. for cigarettes or hot beverages, can not be compared with this in every detail. The presented experiences refer to findings made during the project cited above.

The following section 2 provides a general introduction in the vending industry and the operating process with special regard to the conditions on the German market (to which the study refers). Following upon that, section 3 will reveal the opportunities and benefits of supporting the operating process by the use of telemetry. Section 4 develops criteria for the choice of location for telemetry-equipped vending machines from a technical and economical point of view. Section 5 examines the feasibility of the proposed concepts with regard to the current technical state-of-the-art, weaknesses and potentials for improvement are shown. Finally, conclusions are drawn and an outlook on the future of *mobile vending* using the full potential of mobile business processes is given in section 6.

2 The Vending Market and the Basics of Operating

2.1 Market Overview in Germany

The German market covers several millions of machines. The market is usually classified into three groups, according to the machine type:

Entertainment machines serve for leisure activities and different kinds of entertainment. This category summarizes all kinds of sports machines, pin balls and gambling machines; it counts nearly 409,000 machines in Germany [Vi03, p. 13].

Service machines offer diverse kinds of services and non-tangible goods like parking tickets or admissory control. The number of machines which belong to this category is difficult to measure and reliable data is not available.

Vending machines sell all kinds of tangible goods like food, cigarettes or other goods of daily consumer needs; they represent the largest group of automatic machines with about 1,200,000 machines [Bt03; Bv03].

In opposite to any other type, vending machines offer tangible goods which have to be transported and stored in the machine. After 120 years of vending machine history it is not possible to count all the different products, which are sold by these loyal workers. However, upon now the largest group of the vending machines in Germany are the 810,000 cigarette-sellers which by far form the most important distribution channel for the tobacco industry [Bt03]. The second largest group with an amount of 421,000 units are the beverage and food selling vending machines [Bv03]. Both industries fight with recessions, new laws and increasing competition. Therefore the total number of cigarette-sellers in Germany fell in the year 2002 for the first time ever. Also the industry of beverage and food supply could not fulfill the prognosticated turnovers in the last few years. While 1998 Roland Berger consultants predicted a doubling of the vending market until the year 2003 [Be98a; Be98b; Be98c], the actual market shrunk at the same time by almost 25% from a yearly turnover of 1.85 to 1.4 billion Euros [Mo98, p. 799].

While the huge German cigarette market is ruled by a few tobacco wholesale companies, the business of beverage and food vending machines is not that clear and transparent. About 800 SME operate machines on own account. Beside the operators, further market participants are [Eu03; Bv03]:

- manufacturers of vending machines,

[1] D2D is also referred to as Machine-to-Machine (M2M) communication.

- manufacturers of vending machine equipment,
- producers of the consumer goods
- wholesale and in-between dealers.

An also substantial influence has to be asserted with those who own and provide the locations of vending machines to operators. They are necessary whenever an operator is not able to install and operate a vending machine on his own property [Sc88, p. 21]. Typically, these are either interested in the installation of the machine (e.g. a company whose employees are to be catered for) or they act in order to gain profits. In the latter these are individuals or organizations with strongly frequented, publicly available settings (e.g. pubs, railway stations, property management companies). The rent of the location depends on the attractiveness of the locality and can occur either as fixed cost (fixed location rent) or as variable cost (participation in turnover).

While the named details can be applied for all vending industries we have to differentiate the cigarette and the food market in other aspects. Especially in the operating process there are significant distinctions, the same is true for hot beverages which cause special requirements. For that reason we focus in this study only on vending machines which sell snacks and cold beverages.

2.2 General Operating Process and Potential for Optimization

The business of an operator is it, to provide the consumers a clean, working and filled vending machine. For this mission an operator normally employ fillers for refilling and technicians for repairing. While the fillers have their fixed routes – which mean they inspect the vending machine in a determined cycle – the technicians are called only by occurred errors. Although fillers have their set routes and works in an inflexible scheme they have to take count of several points. Especially open hours of offices, holidays or other special events which relate the vending machine location must be regarded. If the filler don't know such happenings ineffectiveness or loss are the results. For a better understanding, the following illustration shows the procedure of filling a vending machine.

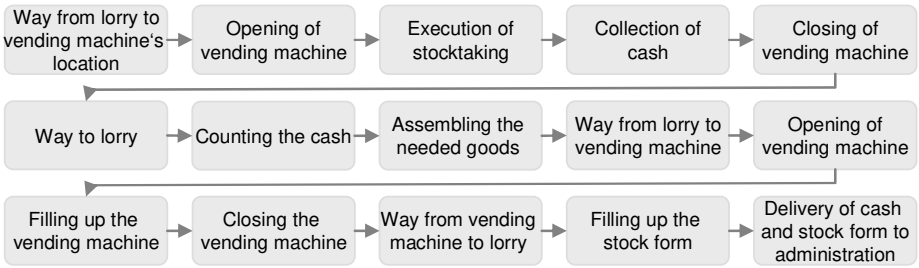

Figure 1. Conventional operating process

For the demonstrated procedure there are three main optimization possibilities:

(1) Since the filler knows the vending machine' locations and the related cycles he is able to forecast the requirements of his tour. This qualifies him to arrange the needed goods at his car and spare the unnecessary first turn to the vending machine.

(2) Instead of taking the inventory by counting the not sold goods, it is now a day possible to replace the manual execution with electronic stocktaking. Special mobile devices are able to read out data from memory of electronic vending machine components like the cash system or mobile payment system. Normally this works over an infrared or a Bluetooth interface. The use of wireless communication conducts two advantages. First advantage is that the filler must not open the vending machine and the second is that he could replace the paper based statistics with digital data. After a route the filler only have to replicate his mobile device with the main system at the headquarter [Ve02, p. 3; To03].

(3) The complete process is supported by mobile devices with telemetry functions. This possibility is examined in the following section.

3 Business Process Reengineering Potential with Telemetry Usage

Up to now the fillers had the showed problem that they have to guess the actual stock of a vending machine before doing the inventory. But these estimates are based on individual experiences and are made under uncertainty. The following example shows, that this method is risky and very inefficient: A vending machine with cold beverages – placed at a railway station – is maintained on Monday every week. Already on a following very hot Tuesday the water and coke cans are sold out. When the filler visit the vending machine the next time it was nearly one week empty and had lost turnover every single day. The result: lost revenues and angry customers. Same results occur if a defect prevents a vending machine [To02, p. 4f]. A contrary case happens when the fillers come to a full, ready for use vending machine, whose filling is not necessary. Both cases are linked with costs: In the last case unnecessarily spent work time and travel costs, in the first case losses by not realizable revenues.

The process represented in Fig. 1 consists of two parts, the stocktaking and the filling. The use of the mobile values of the telemetry functions [TP03, p. 159] make it now possible to separate the stocktaking and the filling and execute this activities over spatial distance. This gives the operator the opportunity to fill vending machines need-based and not because the time table says. Thus this value contains a radical change of the business process in the understanding of [KPW03]. With mobile communications the fillers mustn't guess the stock of the vending machines; he knows the actual status.

The report of the vending machines' status could work thereby in two different ways. A need statement can function either to the pull principle by a time-dependent inquiry (e.g. daily at 5 a.m.), or according to the push principle by an event-dependent message (e.g. a message because the stock fell under a limit of 30% or a defect occur).

Apart from the optimization of the filling process the function of the defect report promises high cost savings. Special telemetry solutions for vending machines report not only the occurrence of a defect, but also send error codes (e.g. door open, power failure). Thereby the technician knows which disturbance happened and which spare parts are necessary to repair the error. Smaller electronic defects can be repaired by remote control without visiting the machine itself [To02, p. 4f]. Same applies to software updates, which are transferred via air [Vc02, p. 3]. The described functions also reduce expenses because work time and travel costs are saved.

Another benefit represents the transmission of transactions data like sold goods and the amount of paid money. With this data it is now possible to make analysis and get to know which products are the most popular ones and generate the best profit. With this an operator could also verify the profitability of the vending machines' location. According to this transaction data prosper to react flexible to rush hours and customer preferences and to ensure an optimal supply. Tab. 1 summarizes the identified potentials.

Table 1. Potential of telemetry usage at vending machines

Telemetry function	Potential	Possible results
Defect messages	• Recognizing defects • Identifying defect types • Remote Control	• Reduction of maintenance and adjustment costs • Reduce of downfalls • Increasing of availability
Transaction messages	• Avoidance of empty vending machines • Avoidance of still filled vending machines • Need based planning • Verification of the locations' profitability • Transaction transparency	• Increasing of revenues • Saving service turns • Product-portfolio optimization • Abbreviation of the filling process and in the administration • Supervision of the employees

Remote control function	• Price changes • Change of summer- and winter-time • Elimination of errors	• Reduction of maintenance and adjustment costs • Increasing of availability • Saving service turns • Abbreviation of the filling process
Transfer of payment information	• Transfer of electronic payment amounts • Transfer of electronic payment data to clearing department	• Verification of the revenues and supervision of the fillers • Cost saving in administration • Rent/tax benefit
Connection with ERP-Systems	• Automatic linking of revenues and sales in electronic formats • Supporting real time decisions with payment data for a better calculation	• Cost saving in administration • Improved possibilities for analyzing • Unified data

The employment of telemetry in vending machines not only increases turnovers; a telemetry solution can also lead to cost lowering. Cost reduces in context to repair and maintenance was already shown. Further saves promise the optimization of operation process itself. The filling procedure is with the travel to the location the time-most intensive within the operating process. With the reading of the telemetry data the operator has knowledge of the sales and can calculate the actual stocking of the vending machine. This knowledge qualifies him to pack the needed products before reaching the location [Vc02, p. 3]. Double steps in the procedure like move to the location, open door, stocktaking, close door and move back to the vehicle to arrange the necessary products, could be saved. Process optimization is particularly interesting at those locations, where the fillers are faced to barriers like security checks (e.g. enterprises, airports) or open ranges and long ways from the car to the locations (fairgrounds, skyscrapers etc.).

Much higher cost savings than the optimization of the operating process could be realized by changing administrative procedures. Especially the input of the paper based filling sheets into the ERP-systems is an extremely costly process and conduct transfer errors. However, present telemetry modules are until now not able to substitute mobile devices or replace written sheets, because these modules send so far only sales and turnover figures (see section 5). Hence the operator have to equip his fillers with mobile devices such as PDA, whose data could be transferred electronically into the computer systems [Vc02, p. 3; To02, p. 4f].

A further result is the advantage that operators are able to supervise the fillers. These employers normally work independent and visit the headquarters just once a week or twice a moth to refill their stocks and to deliver their filling sheets. For the operator it is hardly to pursuable whether his fillers doing their jobs well and complete the assigned routes or not. The telemetry data makes it clear, whether the bad performance of a vending machine is justified by the location, or by the filler, who maintained these only once in the month.

In addition telemetry solutions can support the paying systems of the vending machine. This is important to online authorizations of transactions (only typically with higher amounts) on the transmission of payment data to the operating headquarter as well as wallet-based or mobile payment procedures. Due to the missing standards in the electronic payment industry this function has no relevant meaning.

The sum of all these advantages has a huge cost cutting and profit increasing effect. We proofed the identified benefits while our project at the operator (see section 1) and calculated an amortization period for the telemetry solution of only 37 months. The incomes arose in our case mainly as a result of avoidance of empty and full vending machines as well as advantages of won transparency. The spending rises mainly of necessary fixed cost (acquisition of the terminals and cost of their installation) as well as variable costs (data communication).

4 Location choice

We have seen that the using of telemetry with wireless communication technologies could bring benefits and cost cutting potentials. But before an operator install a telemetry system he should examined whether the usage of telemetry data brings his company and his locations the anticipated effects. For that reason, we defined four criteria which examine suitability of vending machines' locations.

(1) Vending machine is technically suitable

The use of electronic units such as telemetry modules depends on the technical construction of the vending machine. Three categories are differentiated: mechanical, electromechanical and electronic vending machines [Sc88, p. 84]. Mechanical vending machines are in low budget areas still common (e.g. chewing gum vending machines), but in most areas they are very seldom. They are usually very old because their function is completely mechanical (coins are examined mechanically and the products are delivered mechanically). Because of the mechanical functions this type of vending machine must exclude from the employment of telemetry: There are no data which can be read out. Instead of these it is possible for a telemetry module to read out data from electromechanical and/or electronic automats. They have electronic units such as coin dispensers with processors and caches.

(2) Use of wireless communication is possible and necessary

The vending machines' location must be suitable for the employment of mobile communication technologies. Is it an operator willing to use GSM as communications technology, he first have to check whether a connection to mobile network can be made (e.g. in the cellar of a building this connection is may be not possible). Additionally he needs a permission of the location owner; enterprises like hospitals or chemistry companies generally forbid the employment of wireless communication. Is one of these points not solved, this criterion is not fulfilled and the use of telemetry is not possible. But on the other hand there are other ways to get data from the vending machine which replace the telemetry systems. Often the owner of the vending machines' location provides a connection to its LAN or the internet. When the costs for the mobile communications are higher than the use of the offered LAN the operator should realize the wired solution.

(3) Filling and maintenance cycles are suitable

The employment of telemetry proceeds from the operator and increases his costs. According to this he will only implement telemetry to locations, where benefits are predicted. Especially in locations with long operating sequences telemetry is very interesting. At large customers such as universities or huge enterprises the vending machines are refilled at least twice a day. For those locations the operator normally orders his fillers to maintenance only these vending machines. The use of telemetry is a those locations very limited.

(4) The operating process is sufficiently complex and expensive

The use of telemetry rises proportionally to the expenditure for the operating of a location. At locations with high barriers like security checks (see section 3) is the stocktaking via telemetry particularly meaningful.

For the selection of locations these criterions are to be evaluated. In the case of K1 and K2 these are necessary criteria, in the case of K3 and K4 sufficient conditions. For K3 and K4 the operator should consider between expenditure and savings of the telemetry employment at the location.

5 Available Technology

Telemetry modules for vending machines

- *communicate with other electronic modules to read out reference data or send control signals,*
- *transfer and receive data via wireless communication technologies (such as GSM, UMTS, WLAN etc.),*
- *dispose of (limited) computing power for interpretation/conversion and (limited) storage for the buffering of reference data.*

Data transmission is typically initiated by the server in the operators' headquarter which sets up a connections to the telemetry modules in the vending machines at determined times. However, in most cases the module is also able to set up the connection; asynchronous communication (e.g. SMS) is possible. Nearly every of the currently offered telemetry modules[2] on the market are brand new products without long terms of practical employment. The costs for such a hardware module account between 300 and 800 EUR. In our project we observed that there are still notable differences between the available modules' capacities and the functionalities described in section 3.

The obtained telemetry data should be stored in a database to transfer it afterwards into the ERP-system of the operator. However, so far only one of the inspected systems could offer an ERP (in that case SAP/R3)-interface. Because of this the operator must evaluate and work with self supplied software with typically very limited functionality.

Most important problems, however, are missing standardization and downward compatibility. Modules only work with a few vending machines or support only the newest interface standards (which are only used by a very small number of vending machines up to now). Hence a use of telemetry is not possible as yet for the majority of the machines already in usage. An additional disadvantage is the limited capacity for local connection via mobile communication technologies like WLAN or DECT. This prevents a shared – thus, cost-efficient – use of WAN-communication and results in every module needing an own cellular modem and contract – a fact that raises the operating costs. Additionally, the determination and interpretation skills of the provided error-data are insufficient, thus, most of the error-handling potentials described in section 3 can not be realized so far. A further disadvantage is that the vending machines are only capable to register a sale, but not a stock. Thence they are not able to send a push message to the filler when minimum stock is reached. The only stock-related information they register is when a slot is empty. At snack or cold beverage machines this condition is recognized by the fact that the consumer selects a product but no product falls to the machines' infrared sensors. However such a message already means a loss in revenue and profit for the operator.[3]

6 Conclusion and Outlook

In this contribution we analyzed the potentials of telemetry for effectiveness and efficiency of the operating process in the vending industry. This development however is still at the beginning.

A main cause of the slow development is the fact that the present available modules can only be run in a small number of very modern vending machines. Operators and telemetry manufactures suffer the same problem, the lack of uniform and widely accepted standards. Precondition for an efficient and broad employment of telemetry is that manufacturers give up their own interfaces in favor of common standards. A European advance in this direction is the recently developed EVA-DTS (European Vending Association – Data Transfer Standard), which is supported by the new modules.

In areas where an employment is already possible, often the real grasp for mobile business processes is still missing [see KPW03; TP03]. Two examples for this:

The apparently innovative product idea to equip the fillers with GSM-integrated PDA in order to transfer filling data directly online into the ERP system is in fact very undesirable. Information from the vending machine is not to be separated from data the fillers are collecting. Both data has to be combined in the vending machine and afterwards transferred to the ERP-system. Only this ensures an optimal reactivity of the telemetry system (push solution).

[2] Regarded modules Tovenco TVG 3000 (Lantec), Vencube (S+M Schaltgeräte-Service), ViTel (Vianet), UMA2020 (BKtel), VendingControl, TeleInfo (Mironic Computersysteme) and DIVA (Hug-Witschi).

[3] A simple solution for this problem would be an extension of the module with the possibility of transferring filling data. This could take place by infrared or Bluetooth interfaces. Thus at the same time the necessity of the synchronisation of the PDA with the ERP-system in the headquarter could be avoided.

The local linking of nearby vending machines to a LAN for the use of one WAN-connection should not be an exception but a regularly used efficient method for the optimization of communication costs. A side effect of this is that in some cases also a linking of vending machines gets possible although a cellular connection is not possible.

A future scenario could look like the following: Vending machines are associated in groups and build a network with local wireless technologies (e.g. WLAN or DECT). One vending machine serves as a master and calls up the data of its slaves. Fillers document the refill of a vending machine by scanning barcodes of the filling products with their PDA-based scanner. The last vending machine of the route is the master; here the fillers transfers all the filling-data of the different vending machines via Bluetooth or IrDA to the masters' telemetry module. Afterwards the master transmits this information to the ERP-system at the operating headquarter. Only this process flow is able to support a needs-based operating because the vending machines is aware of its own actual stocking. With the appearance of a defect or a minimum stock the IT system immediately gets a request and generates a new route planning for a filler or technician and communicates it to him. Routes will automatically arranged and dynamically optimized.

Simple usage of telemetry modules allows for certain improvements within the operating process. But the real potential of the use of mobile technology is to enable completely new, digitized business processes. First approaches were shown in this contribution. A respective solution could allow for decisive improvements on different angles of the "magic triangle" cost–time–quality at the same time. In today's business environment which is getting increasingly difficult for the vending industry, management and control of mobile business processes becomes a critical challenge in competition.

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