

Smart Vending

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Abstract

The present study summarizes the evolution in vending business with the adoption and popularity of smart vending concept. Using the methods of descriptive, situational and content analysis are represented the features and benefits of smart vending machines as a form of out of store retailing. It's spreading is the result of combining the processes of digital transformation, the transition to the circular economy model and the impact of the COVID-19 pandemic on business and society. The smart vending machine ensures a great consumer experience and commitment, but on the other hand it provides the vending operator with advanced features for precise at the site and even online management of the device, the sophisticated control of the inventories and the analysis of the clients, the possibilities of modern forms and technologies of payments and communication are diversified, the promotional strategy and the information provision of the consumers is improved.

Keywords: vending business, smart vending machine, intelligent machine, vending operators, COVID-19, Internet-of-things

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Introduction

The challenges and the development of the transition to a digital and green economy put the vending business under conditions of accelerated technological change and systematic adaptation to the increasing requirements of the new normal. At present, smart technologies link the physical and digital dimensions of a product solution, enabling them to be able to perform their purpose better or through more functions and tasks. Smart Products are cyber-physical products/systems which additionally use and integrate internet-based services in order to perform a required functionality (Abramovici, 2015). Therefore, smart products have the ability to communicate in different dimensions of their operation with other smart devices, systems and users, through the use of a variety of communication channels, but mainly through the Internet. This turns smart devices into connected devices, but unlike them, smart devices, have some kind of intelligent behavior that enables them to react to real-world situations and even predict the needs of their users (McGehee, 2019). This means that smart vending machines are products that are simultaneously connected through different communication channels to other systems. But also devices that can collect and process for different purposes information from the environment in which they are located and from the users they serve, as well as interact with other smart machines or products applying the concept of Internet-of-things. This turns them into technological solutions that are context-aware, pro-activity and self-organized (Greftegreff, 2017). In this way, smart vending machines expand the applied aspects of their operation and to the greatest extent provide the economic process with appropriate and timely information. It allows making optimal business decisions to make the device itself, its positioning, product offering, price level, etc. more fully tailored to the requirements and needs of specific users.

The main aim of this paper is to summarize the state and improvement of various aspects of the vending sector in the present, which are caused by combining the processes of digital transformation, the transition to the circular economy model and the impact of the COVID-19 pandemic on business and society, that impose with great urgency the transformation of vending machines into smart business solutions.

1. Methodology and experimental methods

The paper uses data collected and summarized from the annual observations of the European

Vending & Coffee Service Association and other secondary information on global vending trade. The estimates of the total annual revenues from the activity of the vending operators for the period 2006-2019 are presented. The data used from secondary sources are interpreted and graphically visualized. In the course of the research general and specific methods were applied, such as the method of situational and content analysis and the descriptive method.

2. Thesis statement and literature review

Vending has always been a good opportunity to develop micro-entrepreneurship and self-employment, which stimulates the interest of a wide range of economic participants, forms a relatively competitive market and a steadily improving technology that is constantly evolving. The vending machines provide the possibility for conditionally continuous and autonomous operation, without a day off and at any time of the day. Smart vending machines not only improve process automation, but make it significantly more adaptable to consumer preferences. The use of pre-processing algorithms or even the possibility of applying Artificial Intelligence (AI) allows through systems of sensors and precise automation to create products tailored to a greater extent to the needs and preferences of customers. Moreover, Artificial Intelligence refers to systems that display intelligent behaviour by analysing their environment and taking actions – with some degree of autonomy – to achieve specific goals (High-Level Expert Group on AI, 2019). This is fully covered by the understanding that „intelligence is concerned mainly with rational action. Ideally, an intelligent agent takes the best possible action in a situation“ (Russell & Norvig, 1995, p. 27). In synergistic combination with the adoption of machine learning smart vending unit can provide some advantages which include “maintenance cost reduction, machine fault reduction, spare-part life increases and inventory reduction, operator safety enhancement, increased production, an increase in overall profit” (Istrefi & Zdravevsk, 2020, p. 13). This allows improving the overall operation of smart vending machines, and thus the customer service of self-service machines, which simultaneously improves the achieved economic and social effects, and hence is a prerequisite for improving the efficiency of their operation.

The transformation of the vending machine into a smart device is a logical and rational evolutionary process, driven by the automation of service in this form of commercial exchange. The digitalization of the vending industry is a logical step in its development, where smart vending machines provide a more complete and comprehensive service to end customers. Thus, “the vending industry is undergoing a sea-change, using intelligent systems technologies to deploy innovations ... to go far beyond simply dispensing food and drink” (Intel Corporation, 2014, p. 2).

Within the meaning of Art. 56, para. 2 of the Spatial Planning Act, vending machines are movable objects that can be placed on land properties (Zakon za ustroystvo na teritoriyata, 2021). For this purpose, they shall be positioned in certain places after issuing of a permit to the interested natural or legal person, in accordance with a procedure set out in an ordinance of the municipal council (Natsionalno sdruzhenie na obshtinite v Republika Balgariya, 2021). If the place where the vending machine will be placed is on a municipal property, the approval of a placement scheme is required, which is agreed with the general architect of the administrative unit. In this mode of operation, the vending machine either pays the so-called "sidewalk right" or rent for the use of municipal land. When placing the device within a private property (land or building), the relationship between the parties is most often settled through a lease agreement, but again through a permit regime of the local authority (Reshenie № 471/2018 g. na Administrativen sad - gr. Pleven, 2018). The introduction of such a liberal approach to the initiative of the entrepreneur and a restrictive commitment to obtain a controlled permit for the installation of vending machines is a prerequisite for non-market forces to influence the activities of vending operators. Their business should be subject to safety control and compliance with the rules for doing business, especially if it is related to the supply of food and beverages, but not with regard to the use of such administrative levers to limit the entrepreneurial initiative and innovative business behavior of the economic

agents of the vending industry. This is mostly due to its seamless mobility and wide possibilities for repositioning, upgrading through additional installation of devices in the selected location or withdrawal in case of unsatisfactory economic performance of a vending unit. However, at this stage there is no regime for licensing of vending machines, except for the requirement to use a certified fiscal device for sales reporting to revenue authorities and mandatory registration with the Bulgarian Food Safety Agency for certain categories of vending machines, which makes the devices available on the market to be of extremely large variety, age and functionalities. This determines that this business has relatively low barriers to entry of new participants and relatively easy start-up, including through leased devices.

The current regulatory changes that affect the vending business can be identified in several areas:

- The ban on the use of certain disposable/single-use plastic products, some of which are widely used in vending machines for hot drinks, such as beverage cups and their lids and caps (European Parliament, 2019). An EU Directive stipulates that Member States must implement the necessary laws, regulations and administrative provisions to restrict the use of certain plastic products no later than July 3, 2021, which is delayed in Bulgaria due to political situation from the summer of 2021. This is part of the measures to achieve the strategic goal of transforming the EU into the first climate neutral continent by 2050, which can be achieved by reducing emissions by at least 55% by 2030, compared to 1990 levels (European Commission, 2021). The specific restrictive measures will directly affect the vending business, using plastic packaging and disposable products, which will have to look for new product innovations in order to continue its normal functioning. The latter may cause the price of the final product to rise. Apart from that, there are also increasing commitments for participation of vending operators and their suppliers and partners in the chain for recovery of packaging waste and their recycling. In this regard, through the concept of reversible vending, this business becomes a preferred element of the circular economy, through the automated collection of certain used products and packaging, and their inclusion in the cycle of resource utilization.

- Restrictive and other administrative measures imposed during the COVID-19 pandemic. In March 2020, administrative decisions of local authorities were issued throughout the country to suspend or partially restrict the operation of vending machines located outdoors and/or indoors, in order to limit the spread of COVID-19 infection, which is based on of misinterpretation of an order of the Bulgarian Food Safety Agency Order № RD 11-695 of 13.03.2020 (Balgarska agentsiya za bezopasnost na hranite, 2020), it has a control function in the registration / approval of sites - food vending machines – “as conditions and procedures for food production and trade” (Zakon za hranite ot 1999 g., 2020). For example, similar is the decision of the Varna Regional Crisis Headquarters to suspend the operation of vending machines located in the open spaces (Zasedanie vav vrazka s merki za ogranchavane na virus COVID-19 na teritoriyata na Oblast Varna, 2020), this prohibition on the operation of vending machines in open public places is specified in orders of the Mayor of the Municipality of Varna № 1129 from 19.03.2020, № 1214 from 27.03.2021, № 1340 from 07.04.2020, which at a later stage were declared null and void with a decision in administrative case № 780 of 2020 of the Administrative Court - Varna of 06.08.2020 (Reshenie po proizvodstvo po reda na chl.179 i sledvashti ot APK obrazuvano po zhalba na „Dzhema vending serviz“ EOOD, protiv Zapoved № 1129/19.03.2020 g. na Kmeta na Obshtina Varna, 2020). The main consideration behind this decision is related to the crowding of people near the service unit and the inability to provide disinfection on the surface of the device after each use. Discrimination against outdoor vending machines compared to those indoors is illogical, since at a later stage in the development of the pandemic, it was concluded that “the risks are low in fully open spaces” (Shukman, 2021) or in the open environment transmission of the viral infection is more difficult. In contrast to the measures for control of the epidemic situation, which regulate certain restrictions and regimes for the work of traders and in particular of the vending business, certain economic mechanisms are

established with action within precisely defined periods and characteristics of the development of COVID-19 pandemic. In this way, incentive and/or compensatory measures are implemented at the local level. An example of this is the decision of the Varna council to exempt from the so-called "sidewalk right" fee for all commercial sites and establishments of the Municipality of Varna, which introduces this instrument for the period from April 1 to June 30, 2021 (Obshtinski savet - Varna, 2021).

▪ Vending machines must be provided with a remote connection on the integrated fiscal device for reporting sales to the National Revenue Agency. The legislation stipulates that the vending machine be marked with information about the owner, the materially responsible person and when selling goods or services through a self-service vending machine with electric power supply to register and report any sale through a fiscal device integrated in the self-service vending machine (Naredba № N-18 ot 13 dekemvri 2006 g. Za registrirane i otchitane chrez fiskalni ustroystva na prodazhbite v targovskite obekti, iziskvaniyata kam softuerite za upravlenieto im i iziskvaniya kam litsata, koito izvarshvat prodazhbi chrez elektronen magazin, 2021). The requirement for electronic reporting is the sale of the vending machine through a fiscal device is aimed to highlight the real turnovers in the sector and their correct tax treatment. The specificity of the devices certified for tax purposes is their operation, which must be carried out by means of built-in fiscal components, which are adapted to the peculiarities of the vending business, therefore it is not required to print a receipt and hand it over to the customer. An alternative mechanism is implemented which requires visualization of precisely defined tax information on a suitable electronic display built into the device and visible to the customer. There are a variety of smart vending machines that have an integrated fiscal printer that issues a written document (receipt) for the services performed by the vending system and the payment made by the customer (for example, when paying utility bills, services, etc.). In addition, the connection to the information system of the national revenue agency and the actual reporting of each sale significantly interrupts the possibility of incorrectness, both between the employees in the company and the business unit to the state.

The smart vending business can benefit from the development of multi-synergy and increasing attractiveness, when due to the location of various machines that offer substitute and/or complementary products in proximity, the power of attracting customers in the relevant service area and its attractiveness increases. Moreover, in a market situation in which we have direct competition between products and their substitutes, the consumer receives an additional incentive due to the ability of the customer to integrate into the decision of his choice additional factors such as preferred brand, image consumption, etc. Additionally, when the economic results of a device are insufficient and it has unsatisfactory sales performance, it can easily be replaced with another device – in terms of capacity, product characteristics, etc. This allows the vending operator to make a change in location, which is relatively seamless and conditionally without high costs for changing the place of contact with customers. This advantage of vending minimizes the risks associated with the strategic decision to identify the right location for the business and the wider opportunities for repositioning. The latter is a serious problem for stationary (brick and mortar) trade and the key decisions for success is the approach of choosing the location of the outlet and the size of the site. At the same time, building a recognizable brand allows the devices to acquire distinctive features, which are a factor in attracting loyal customers to the brand, regardless of where the devices are located. Moreover, stimulating the interest of loyal customers in the vending business is as important as attracting new ones. This is due to the specifics of vending trade, where physical constraints do not allow offering very wide and deep product ranges/assortments. These relative weaknesses of vending are determined by the physical limitations and capacity of the devices, but can be conditionally overcome by placing related to their offerings vending devices in proximity or in the same location.

The smart vending machine can have one or more built-in sensors that improve individual operations and processes and allow achieving higher automation and complexity of service. They

can be sensors for:

- **Motion** - Sensors of this type allow registering the approach of a potential customer and the device to activate certain visual advertising effects and preparation of the device for sale when it was in standby mode. In addition, here we can have a presence of a built-in camera, which allows recognizing faces and through appropriate algorithms to offer more complete commercial offers, tailored to specific and automatically identified characteristics of the served persons or targeted consumer segments. This expands the possibilities for collecting additional data from customers, which can be applied in their more specific segmentation, study of certain patterns and trends. At the same time, these sensors can also detect the lack of movement of potential customers and then the device can go into standby mode and this is associated with the reduction of electricity consumption, which is a significant cost of modern vending machines. In such a situation, appropriate information should be provided for the clients about the video recording been carried out, as well as there should be a regulation to respect of the legal rights of the citizens and their protection such as constitutional rights, personal data, etc.

- **Light** - With the help of the light sensors it is possible to determine at what moment the respective device will switch to night mode of operation with the lightning of buttons or intensity of the gleam on the surface of the device. Of course, these electronic components can also be used for the purpose of increasing the security of the device placed in a public open environment, where the light presenting reduces malicious attempts directed against the device. Additionally, motion and light sensors can be linked to various seasonality factors in product demand, both within the seasons of the year, but also for the hours of the day, the days of the week, and so on. It is even possible that depending on the location outside a given season certain vending machines may not work, provided that in the remaining time periods, they register significant economic results that maintain and justify the economic benefit and the rationality of the investment made and the location selected;

- **Physical parameters of the environment** - They allow to measure the temperature of the environment and certain circuits and systems in the device, humidity and other parameters, and at certain physical values can be activated or unlocked certain supporting systems of the vending machine (preheating, cooling and precise temperature control in the devices offering cold drinks, etc.);

- **Location** - Through these sensors, it can be easier to identify the location of a mobile device and its possible movement (in case of theft or other events, such as, for example, those rented for various organized events, or in ticket vending machines in public transport, etc.), for its more accurate placement on orientation/geolocation maps or in case of mobility of the vending technology. The latter makes it easier to advertise the location of the device through electronic navigation systems;

- **Checking payment instruments** (banknotes, coins, etc.) for counterfeits and fraud attempts. At the same time, opportunities for non-cash payments can be provided through the use of various contact or contactless payment instruments and technologies (card payments, virtual wallets supported by NFC, RFID, Bluetooth, QR code, etc.);

- **Touch screens** - This is a screen content management technology that allows the user to perform certain actions and set the execution of certain commands that are executed by the device to which they are integrated. In addition, the touch screen has all the advertising capabilities of a traditional display and can be used to attract attention and direct user interest. Reducing the cost of this technology (LCD, LED, OLED, PDP, etc.) allows vending machines to be equipped with larger touch screens and/or a classic display with an increasing panel resolution and improved color reproduction. This allows using all the possibilities of modern audio-visual concepts, commercials and other forms of appropriate presentation of media content. This enables active application of call-to-action options and touch buttons.

Smart vending machines can, through real-time remote information exchange, carry out a number of activities that require the intervention of an attendant in traditional devices. Thus, for

example, they can execute incoming commands to switch from one operating state to another standby or even shutdown mode, thereby saving resources when the device is located in places with a flow of customers at specific time intervals (public buildings with working hours, controlled access, etc.). Sending at certain intervals or in real time data on stocks of consumables and products, informing when certain critical levels of stocks are reached, informing about the need for refilling or intervention of a service person of a certain type (supplier, service technician, collection service of cash accepted by customers, etc., as well as automated generation of transport schedules for their visit), etc. Of course, the timeliness of such critical information presupposes that the trade process is not interrupted due to lack of product resources for sale, which has occurred before the period or schedule of regular charging. Moreover, the timely control of product stocks and their turnover make it possible to eliminate the weaknesses for the occurrence of expired products and to conduct a more successful trade policy with expired products, those that are obsolete and not object of consumer demand and interest (mainly for food and beverages with a shorter shelf life). The better organization of service in smart vending machines, allows avoiding long non-working intervals, which cause missed sales and may divert customer flow or create dissatisfaction. Smart vending machines maintain higher levels of security in order not to accumulate large amounts of money in the device, which would cause malicious activity, for which a video surveillance (CCTV) system and a system for protection of the machine from illegal external interference and encroachments. All this can be summarized in the concept that intelligent vending machines “engage users in a more rich user experience, reduce operating costs, improve the vending operations' efficiency by remote management and insightful analytics based on the collected data” (Istrefi & Zdravevsk, 2020, p. 13).

3. Current vending business state and discussion

Globally, COVID-19 restrictions continue to cast a dark shadow over the industry (Irvine, 2021). The economic effects on the global vending business formed on the basis of the monitoring of the European Vending & Coffee Service Association for 22 European vending markets are estimated as “significant reduction in sales, vends and turnover in 2020, and at a much higher scale than during the economic and financial crisis in 2008” (White, 2020). In Bulgaria, this out-of-store form of commerce was most seriously affected by the restrictions of the so-called the *first lockdown* of 2020, during which there were direct total bans or partial restrictions on vending operators. Such restrictions have immeasurable economic consequences for both vending machine operators and their customers. All this affects the amount of revenue accumulated by the state from the interruption of sales and the entire supply chain of the vending product. Additional effects in the later stages of the pandemic development have the transition of many people to work from home, where vending machines located in office buildings and close to areas with many companies, lose a significant part of their traditional and loyal customers. By means of the so-called *home office* and teleworkers with a limited presence, is proving to have the most serious impact on the work of those vending machines that serve staff in workplace rest areas, which is a major challenge for the survival of this business segment.

Within Europe, the most successful year for the vending industry for the 14-year period under review was 2019, with revenues in the sector reaching volume of € 17.2 billion (Figure 1). The picture clearly shows the market contraction caused by the global economic crisis after 2008, with a minimum estimate of € 13.9 billion registered in 2010, after which we have a relatively long and anemic recovery. This negative processes were successfully broken only in 2015, which started a rising wave, but the pandemic processes related to the spread of COVID-19 and the imposed restrictions on business in 2020 and 2021 are a prerequisite for a serious contraction of vending trade, which will continue to deepen during the period of attempts to control the epidemic situation and the subsequent economic and social restart in the conditions of the *new normal*. The diversity of measures and their timeliness to manage the health crisis will be a leading factor in the adverse

economic effects on the vending business locally, regionally, nationally and globally.

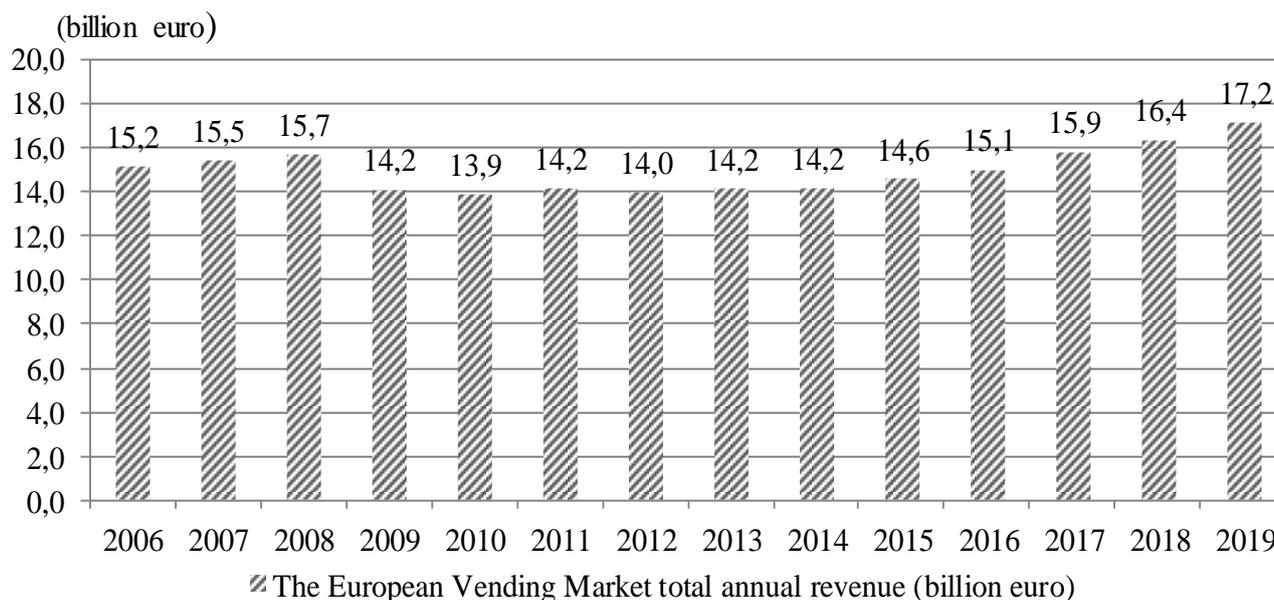


Figure 1. European Vending Market total annual revenue in billion euro, 2006-2019

Source: EVA, the European Vending & Coffee Service Association

Despite the adverse effects of the crisis caused by the COVID-19 virus infection, based on the market analysis of HNY Research, the global Smart Vending Machines market will continue to grow upwards with an expected growth estimate with a CAGR of 10.47% from 2020 to 2027 (Absolute Reports Pvt. Ltd., 2021), the alternative forecast of 360 Market Updates gives an estimate of the growth of global smart vending machines market CAGR of 9.2% during 2021-2026 (360 Market Updates, 2020), which in more up-to-date version of the market research, as a result of the deepening of the COVID-19 pandemic, lowers the assessment of the expected market development to CAGR of 2.9% during the forecast horizon 2021-2027 (360 Market Updates, 2021). The continuous change of the market environment under the influence of the global spread of the health crisis caused by COVID-19 and its unpredictability is a powerful generator of uncertainty for the economic system and a challenge for the development of any business and its survival in such a highly volatile short-term business environment.

In the future, the main areas of improvement in the vending business can be identified in the following areas:

- Increasing of the forms for payment of the products acquired by the vending machines. This will allow, along with the continued use of all traditional monetary instruments used in a country's payment system, to move to more widespread use of contactless forms of payment used by various smart personal devices or increase the so-called mobile payments. The latter is achievable through the use of NFC (Near-Field Communication), Bluetooth and other wireless technologies;

- Wider application of wired and wireless remote control and telemetry. The transmission of data about the state of certain parameters of the device, registered by its sensors and shared through the technologies of information and communication exchange. Remote control reduces a significant part of the costs of servicing the vending machines at the point of their location. This allows some of the settings and control over the operation of the device to be performed remotely. As the information collected by the sensors can be used for other purposes, for example, to assess variations in the physical environment and their impact on sales and the possible transmission of

this information to other users for more in-depth analysis;

- Significant change in the packaging used in the vending industry. Replacement of plastic packaging with those produced by new environmentally friendly technologies and mass replacement of traditional packaging with those made of paper and other materials of natural origin, mainly vegetable, with a high level of biodegradability and recyclability;

- Change in the assortment structure and an increase in the share of organic and biobased products, foods and beverages with positive effects on human health, the use of raw materials and products of guaranteed and certified origin, for example, certified by Fair trade, Rainforest Alliance, Forest Stewardship Council (FSC) and others;

- Increasing requirements for hygiene, disinfection and safety of the device and its products. This can be achieved by applying special coatings and using innovative materials for the contact surfaces. Other possibilities are the placement of disinfectants near the devices, application of UV lamps and other means and technologies for protection of public health when working with the vending machine.

- Increasing opportunities for connectivity of the vending device not only through wired, but also widely used wireless network technologies (WiFi; 3, 4 and 5 G, etc.), which allow real-time data transfer. Two-way communication ensures not only the accumulation of data on the operation of the device, but also the setting of commands, sending advertising content to digital screens and a wide range of tasks to be performed by remote access to the machine. Moreover, the presence of a constant connection with the devices allows to improve the relationship with customers and to answer their questions, objections and complaints. Thus, for example, in case of inquiries or seeking additional information from the customer, he can send his message to a competent service person in real time via the device, including through the chatbot technology. Additionally, the development of mobile applications of the vending operator or its partners allows the interaction between the participants in the trade to move to a higher personalized level and interactive experience at the point of contact or at any given moment both on online and offline mode. At the same time, the identification of the customer at the point of sale allows the application of adaptive pricing and even the possibility to apply individual pricing of the exchange for each individual customer recognized by the system;

- Increasing the existing product alternatives and technical solutions, through which through appropriate modifications, plug-ins and additions the existing conventional vending machines can acquire certain characteristics and functionalities that upgrade them to the capabilities of smart vending devices.

The main factors that will continue to determine the successful development of vending automation are related to the increasing concentration of urban population, lifestyle variability and its relative acceleration, the development of vending technology in search of new solutions to offer convenience in meeting specific needs, etc. Smart vending will continue to offer better conditions of exchange, which is determined by the price of the engaged labor factor, which in automated service remains an insignificant element in the formation of the price of commercial services in this form of out-of-store exchange. Simultaneously with the growth of the smart vending market, the activities of the suppliers of products for vending machines, service hardware and software services, opportunities for alternative financing of this type of business, etc. will increase. Smart vending in its broadest sense can be assessed as a lower risk business, since providing the economic process with more quantified information about its individual dimensions allows the allocation of economic resources to be based on solutions whose information security reduces the levels of uncertainty.

Conclusion

Digitalization drives innovative changes in all areas of human life, it is also the engine for a serious transformation of the vending industry. The expansion of the technologies of the connected

devices, the sensory integration in the devices, the machine learning, the artificial intelligence, etc. are a wave of change in the vending business in the present. Such a move allows the traditional product offering of the vending machine to be expanded by adding features, customization options and additional services, which increases the satisfaction of current customers, their commitment to the brand and creates opportunities to attract new customers. Smart vending builds on the traditional vending concept, which improves the operational management of the device, improves inventory management and customer analysis, diversifies payment and communication opportunities, and improves the promotional strategy and information security of customers, vending operator and government authorities and all other participants in this form of trade.

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