Digital transformation in management of container-on-flatcar transportation: evaluation of business effects

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Abstract. The article discusses the main areas, in which digital technologies were implemented in container-on-flatcar transportation. The article also analyzes the results of digital technologies implementation in container-on-flatcar transportation market over the recent three years. One should take into the account that the main issues of the research in this field expand over the following tasks, including improved communication between transport services consumers and direct participants of the transportation process, search for a compromise to improve quality of services provided by transportation companies and reasonable cost-reduction at the same. These are the issues the search for the relevant digital business solutions should be aimed at. The authors name three main areas allowing to get the maximum business effects: these are quality of customer service improvement, company's operational processes transformation and company's business models improvement. In accordance with the selected areas, business effects of digital technologies implementation by railway companies are evaluated. Sales systems, warehouse activities, customs systems and terminal activities in container-on-flatcar transportation business, where digital technologies are implemented, have been identified as the main activities showing the most business effects. The authors come to the conclusion that container transportation is a comprehensive and indivisible process, and company's digital model shall be made based on this fact.

1. Introduction

Currently, container transportation sector undergoes active transition to the model of digital economy. The term of “digital economy” was suggested by N. Negroponte in 1995 [1]. The scientific approach [2-4] is based on the logic of complicated investigation of business effects’ evaluation due to digital transformation in management as a whole and regarding the transportation in the era of shared economy [5-7] (according to professor O. Kalinina) being an integral part of Internet economy, New economy or Web-economy regarding the economy which is considerably based on digital technologies [8-10]. The number of well-known international online projects and startups from 2017 to 2018 has almost tripled, but at the same time, there is no uniform understanding on what product the market needs. Before we start assessing the results of introducing digital technologies in container transportation sector, it is necessary to identify problems to be addressed as a result of transition to
digital economy taking into account the scenarios of market transformation in this case. One possible area is to assess the expected business effects a company can get through the introduction of digital technologies. Today, the demand for container transportation is growing. Business growth rate in 2018 was 4.5% in inland traffic and 21.7% in international traffic [11]. At the same time, improved communication between transport services consumers and direct participants of the transportation process, search for a compromise to improve quality of services provided by transportation companies and reasonable cost-reduction at the same, are still the main issues. These are the issues the search for the correspondent IT-solutions should be aimed at.

The aim of the article is to identify and evaluate the main business effects, based on the analysis of digital technologies introduction in container-on-flatcar transportation over the recent three years and identification of bottlenecks in container transportation process, in which digitalization tools can lead to maximum cost-effectiveness of the business.

2. Materials and methods

Digital technologies implementation in Russia and all around the world is one of the main factors of global economic growth. McKinsey Global Institute estimates the potential effect in value growth created through digital technologies, in the amount of $US 1.6 - 2.2 trillion by 2025 [12]. The potential economic effect from the Russian economy's digitalization can make the country's GDP to go up by 4.1-8.9 trillion rubles (in 2015 prices) by 2025, which will amount to 19 to 34% of the total expected GDP growth [12]. Modern economic literature provides various definitions of the term “digitalization”. For the purposes of this article, the term “digitalization” stands for “the process of transferring functions and activities (business processes) into a digital environment, previously performed by people and organizations, to improve business - results based on digital data.” [12]. Digitalization of a company requires significant costs associated not only with the purchase of the necessary equipment, but personnel training as well. The statistical data is used to develop the approach enabling the systematical view on business effects implementation [13-16]. So, it is important to identify the main business effects that will be obtained as a result of implementation of modern digital technologies. Business effects should be deemed as the value or result that can actually be achieved as a result of implementation and operation of new equipment and technologies into basic and secondary business - processes of the company. Therefore, business effects can appear when solving various types of business tasks in the course of doing business. The main areas of digital technologies application and business effects in container-on-flatcar transportation are shown in Table 1.

| Area of application            | Basic tools          | Business effect                                                                 |
|-------------------------------|----------------------|---------------------------------------------------------------------------------|
| Marketing                     | Mobile applications | Reduction of the number of cash desks. It will reduce operating costs;           |
|                               | Big data             | Reducing the number of staff and increasing productivity.                      |
| Production & Maintenance      | Internet of Things   | Reduced repairs;                                                                |
|                               | Big data             | Reduction of energy consumption;                                               |
|                               |                      | Improving transport safety.                                                    |
| Logistics                     | Internet of Things   | Less cargo delays during transportation;                                       |
|                               | Blockchain           | Improved transparency of operations;                                           |
|                               | Big data             | Minimizing human participation in various processes                            |
| Implementation of payment     | Mobile applications  | Improved customer service                                                       |
| transactions                  |                      |                                                                                 |

Table 1. Areas of digital technologies application and business effects implementation.
The analysis of digital technologies implementation in container-on-flatcar transportation identified three main areas allow to obtain the most business effects in the business:

1. Customer service quality improvement, as the consumer is one of the important key links in the market chain. It is the understanding of a client, the analysis of using various electronic gadgets and smart contracts that help improve interaction with customers;

2. Company's operational processes transformation: digitalization and automation, virtualization and other technologies contributing to management optimization;

3. Transformation of business models used by the company: creation of a new digital business and digital globalization.

The basis of digital transformation in container-on-flatcar transportation business is IT block “Digital Railways” of the long-term development program by JSC “Russian Railways” until 2025 (approved by the Order of the Government of the Russian Federation on March 19, 2019).

"Digital Railway“ program includes five tools used in digital economy:
- Internet of Things - automated online planning and management systems;
- Big data — Electronic Document Management System (EDMS): documents storage and processing, digital signature;
- blockchain — data distribution across the entire chain;
- mobile applications [17].

The authors distinguish three main areas, allowing to get maximum business effects: these are quality of customer service improvement, company's operational processes transformation and company's business models improvement.

3. Results

To improve the quality of customer service, most companies have started implementing digital technologies into their sales system. For example, almost 100% of inland traffic sales by PJSC “TransContainer” were made online via the Internet in 2017, while the share of online orders in the international sales network covered 29 countries and amounted to almost 50% [18].

3.1. Quality of customer service improvement

To provide e-commerce, the company develops online services like iSales and RAS (Remote Access Set). Today, 9 out of 10 customers of the company make orders via e-commerce tools. More than 70% of revenue and 82% of the total volume of the company's transportation goes via e-commerce channels [19]. Main business effects due to such activity are shown in Table 2.

| Business effect                              |
|---------------------------------------------|
| Less time for documents processing and searching |
| Improved labor efficiency                   |
| Elimination of paperwork                    |
| Lower costs                                 |
| The emergence of new customers              |
| Gaining experience in online sales          |
| Established sales system                    |

For further development of transit container traffic, many companies use the electronic cargo platform “Freight transportation” developed by JSC “Russian Railways” within the framework of the program “Digital Railway”. This is a service where shippers can order transportation in the rolling stock of different owners from any point via the Internet and pay it right away. In 2018, 1724 organizations and 8 rolling stock operators used this platform; services for 2.5 billion rubles were provided via the latter [20].

Electronic trading platform “Freight transportation” serves for automation of processes of interaction with customers as well as for development of electronic digital sales channels. In 2018, the following business effects were obtained thanks to this platform:
- increased loading volumes and, as a result, revenue;
- increased number of the mobile application's users;
- transition to electronic documents;
- less time to service customs operations.

3.2. Company's operational processes transformation

Company's operational processes transformation in container business strongly depend on the company itself as well as on the company “Russian Railways”, the owner of the railway infrastructure and the national carrier. Therefore, in this area, main business effects will depend on how efficient all container transportation companies will use various digital tools. One example is the electronic document flow system. It was developed by JSC "Russian Railways", and is installed by its customers (ETRAN System). By 2016, 1,300 organizations used electronic document flow system, though, by 2020, 2,500 organizations will be using it. Quitting paper technology reduces transportation time fivefold. In 2019, the pilot project "INTERTRAN", developed by JSC "Russian Railways" and FESCO, was launched. The first container train using this technology was sent from Vladivostok to Moscow, for which registration time at the sea port was reduced from 5 days to 21 hours. The technology includes paperless processing of up to 30 operations. Calculations show that this technology allows saving 1,014.7 thousand rubles per year only for one train station. Table 3 shows business effects due to the introduction of electronic documents flow.

Table 3. Business effects due to the introduction of electronic documents flow.

| Business effect                                      |
|-----------------------------------------------------|
| Less time for documents processing and searching;   |
| Increased labor productivity;                       |
| Elimination of paperwork;                           |
| Lower costs;                                        |
| Cutting time for customs operations;                |
| Cutting car demurrage time;                         |
| Established sales system.                           |

The other area of digital transformation is its use to control the status and route of containers. For this purpose, a system of intelligent electronic sealing (IES) called "BigLock" based on GLONASS technologies was developed, allowing to control location and route compliance by the vehicle online, as well as to track unauthorized access to the cargo, its temperature, strikes and slopes [21]. The system has already proved to be effective on the Oktyabrskaya, Gorkovskaya, South-Eastern, South Ural, Far East railways, as well as on the main Trans-Siberian railway. The annual economic effect from IES amounts 7.5 billion rubles, including about 3 billion rubles for JSC “Russian Railways” and about 4.5 billion rubles for cargo owners.

The biggest economic effect of this system is achieved when used in interstate and mixed loading through container-on-flatcar transportation business. For example, a comparative calculation of IES efficiency along the Silk Road route from Zhengzhou (China) station to Malaszewicz (Poland) station are as follows [22]:
- shorter cargo delivery time in expedited container trains by 5 days, or by 34%;
- increased delivery speed by 304.1 km./day, or by 35%;
- lower costs for cargo protection in transit;
- lower cargo insurance costs by 5 -7%;
- faster turnover of cash capital.

Table 4 shows main business effects that can be obtained through this service.

Table 4. Main business effects that can be obtained through GSuite service.

| Business effect                  | GSuite                      |
|----------------------------------|-----------------------------|
| Cutting labor costs of IT professionals and its users within the company, including through videoconferencing|
| Cutting costs for technical support of user workplaces |
Cutting time to transfer documents between departments
Cutting time for meetings
Less number of purchased antivirus licenses, which further increases the safety of users on the Internet
User directory service (ActiveDirectory) integration with the services for users' automatic transition

Evaluation of digital technologies implementation to optimize internal operating processes of the company showed that business effects can be reached in this segment as well. It can be done using the cloud service GSuite instead of the Microsoft Office package, for example. This tool is designed for teamwork with documents, interaction between colleagues through videoconferencing, and files storage, which contributes to high speed of information processing and transfer to the next department, thereby cutting time spent by the company's staff for the stated operations. Calculations show a possible cost reduction per year by 700-800 thousand rubles due to GSuite cloud service implementation.

3.3. Transformation of business models used by the company
Fast container trains development requires modern rail infrastructure. JSC "Russian Railways" is designing the Unified Corporate Automated Infrastructure Management System (UCA IMS) to organize on-line monitoring of rail infrastructure's status. For this purpose, only in 2018 4 diagnostic units were supplied (29 more units are expected to be supplied until 2021) as well as 20 units equipped with tracking and video monitoring systems, 123 dismountable means of defectoscopy with the option to transmit results online and 388 electronic templates [23, 24]. Table 5 shows business effects from UCA IMS implementation.

Table 5. Business effects from UCA IMS implementation.

| Business effect from UCA IMS | Business effect |
|-----------------------------|----------------|
| Improved objectivity of information due to automated interpretation | Long periods between railroad inspections by road inspectors |
| Minimizing the number of dismountable tools for diagnostics | Less number of uncoupling loaded cars along the route |
| Less number of failures of technical means and technological violations | Improved labor efficiency |
| Less infrastructure maintenance costs | Increased trains speed |

The operation of warehouses and terminals at stations and seaports is of great importance in the activity of container transportation companies. The Internet of Things (IoT) is used to improve the efficiency of this activity to automate logistics of storage.

Currently, companies have started implementing a warehouse management system called "Warehouse Management System" (WMS), aimed at efficient placement of containers at each warehouse. The information system analyzes the tasks to be performed, identifies the most optimal action plan and gives orders to warehouse workers to perform. These systems include the following ones: Microsoft, Oracle, SAP. Business effects from their implementation are shown in Table 6.

Table 6. Business effects through the use of the Warehouse Management System.

| Business effect WMS | Business effect |
|---------------------|----------------|
| Increased speed of goods collection; | Efficient goods management with limited shelf life; |
| Efficient goods management with limited shelf life; | Increased efficiency of goods processing at the warehouse; |
| Increased efficiency of goods processing at the warehouse; | Optimized use of warehouses. |

The most active company working in this direction is PJSC “TransContainer”. In 2016 it launched the project “Intelligent Container Terminal” (ICT) at Kleshchikha station in the city of Novosibirsk, and in 2017 it successfully completed implementing the new information system. Intelligent container
Terminal is a special computer software, which uses video-cameras and various recognition systems to automatize processes in the terminal. This software allows organize container platforms automation through collecting and processing information on spotting and viewing the condition of containers, platforms, vehicles and lifting equipment under the customers' orders.

The system is aimed at optimization and automation of technological processes, which makes it possible to increase the efficiency of business processes (Table 7).

**Table 7. Business effects from ICT software (Intelligent Container Terminal) implementation.**

| Business effect | ICT     |
|-----------------|---------|
| Reduced car demurrage for operations with cargo by 2.4 h; | Reduced car turnover by 0.1 day; |
| Reduced car turnover by 0.2 day; | Reduced container downtime by 2 days; |
| Reduced electricity and fuel consumption by 2 percent; | Reduced container turnover by 0.2 day; |
| Reduced costs for maintenance of lifting equipment and repairs of container platform. |

The effects from implementation of automated logistic system to control troubleshooting are shown in Figure 1.

Based on the results of the analysis of the terminal operation, increased processing capacity of the site as well as reduced downtime of the rolling stock were identified as the main business effects.

**4. Discussion**

Thus, implementation of digital technologies into operational processes increases labor productivity and reduces costs for container-on-flatcar transportation. The analysis of digital technologies implementation showed that container-on-flatcar transportation companies are only taking the first steps in the area of transformation of business models as well as new digital business creation. Although there is an example of successful motorcar company in the stated area. It is Uber.

Digital transformation involves a fundamental rethinking process of how a company functions and how it interacts with the environment. The majority of large Russian companies have not yet been ready for systematic development of a digital business model that will allow to gain strategic
advantages from digital technologies. However, given the high pace of global digitalization, fast adaptation of the best practices of digital transformation for national business development is a very important task. To do this, the research papers on digital transformation regarding theoretical and practical aspects [20-25] can be used with analyzed practical examples of successful business transition to “digital management” and special factors identified through which the company can significantly improve its efficiency.

Currently, PJSC “TransContainer” is testing the Unified Transport Information System (ETIS), combining various business models, the goal of which is to organize interaction of all participants in the transportation process. JSC "Russian Railways" has started the development of the "Digital Railway" Comprehensive Scientific and Technical Project, which aims to ensure sustainable competitiveness of the JSC "Russian Railways" by increasing attractiveness of transport and logistics services provided to its customers through the use of digital technologies. The planned business effect of this project is a digital railway in which at least half of the added value is created using digital technologies.

5. Conclusion
The present analysis of results of digital transformation tools implementation in container business showed that a company receives business effects that not only increase labor productivity, reduce operating costs and increase companies' competitiveness in the transport market, but also have a significant impact on optimizing the main business processes and changing existing business models. Sales systems, warehouse activities, customs systems and terminal activities in container-on-flatcar transportation business, where digital technologies are implemented, have been identified as the main activities showing the most business effects.

Today at the stage of implementing digital technologies, the main goal is to combine separate data taking into account that the process of container transportation is a comprehensive task, and based on this understanding, companies will be able to start making their digital models.

To improve efficiency of digital technology implementation, it is necessary to take into account some specific features of a particular industry, the company and its management personnel as well, and at the same time remember that during the digital transformation of its container business, they are the means, and not the ultimate goal. When using digital technologies in individual segments of its business, it is always necessary to consider the impact that this has on the complex transformation of the company's business activities. And these changes depend not only on what tools of the digital economy have been used, but also on the performance of individual employees and the overall organizational culture. It could be proved that the most important aspect of digital business transformation is changing the way of thinking.

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