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Modern information management throughout a construction project life cycle – selected issues concerning digitization in construction and a case study

Nowoczesne zarządzanie informacją w cyklu życia obiektu budowlanego – wybrane zagadnienia cyfryzacji w budownictwie oraz studium przypadku

Abstract

The use of innovative technologies and digitisation tools may significantly improve the preparation and execution of a construction project. The article discusses the results of the latest research concerning digitisation in construction and an innovative model of communication between participants of a construction project in reference to the Building Information Modelling method, the concept of Integrated Project Delivery and Facility Management principles. Conclusions from the analysis of results of implementation of innovative, digital tools and information management techniques will be presented using case studies of three construction projects - the construction of the New Karolinska Solna University Hospital in the Stockholm region, an office building in Wrocław and the expansion of the national road No. 8 to meet the parameters of an express road at the Wyszków–Poręba hub.

Keywords: information management, digitisation, BIM, construction project life cycle, Facility Management

Streszczenie

Wykorzystanie nowoczesnych technik i narzędzi cyfryzacji może w istotny sposób usprawniać przygotowanie i realizację przedsięwzięcia budowlanego. W artykule omówiono wyniki najnowszych badań związanych z cyfryzacją w budownictwie i nowoczesnym modelem komunikacji pomiędzy uczestnikami przedsięwzięcia budowlanego, w nawiązaniu do metody Building Information Modelling (BIM), koncepcji Integrated Project Delivery oraz według założeń Facility Management. Przedstawiono wyniki analizy wdrożenia nowoczesnych, cyfrowych narzędzi i technik zarządzania informacją na przykładzie trzech przedsięwzięć budowlanych – budowy szpitala uniwersyteckiego w Sztokholmie New Karolinska Solna, biurowca we Wrocławiu oraz rozbudowy drogi krajowej nr 8 do parametrów drogi ekspresowej Wyszków–węzeł Poręba.

Słowa kluczowe: zarządzanie informacją, cyfryzacja, BIM, cykl życia obiektu budowlanego, Facility Management

1. Introduction

Information technology (IT) is of crucial importance for business development and efficiency. The latest trends in management are associated with the use of semantic technologies, the ontology of management and cyber-physical systems [1]. Digitization is increasingly used in the economy through the involvement of technology and digital tools in business development, the creation of jobs and the generation of gross domestic product. However, the construction industry in Europe is characterized by a low level of digitization. This is because this industry is represented by few medium-sized companies on the market. There are large and very large companies in this industry that regularly work with small subcontractors using IT tools. However, the sector consists primarily of small subcontractors that perform small jobs, such as renovation and retrofit, and often operate semi-legally. Most of these organizations use traditional solutions rather than sophisticated information and communication technologies (ICT) in business management. The industry is also stretched between large companies and small renovation and construction teams in Poland. This translates into low results of construction in the ranking of the digitization of the European and Polish economies [2].

The aim of this article is to present the latest research on the digitization of the construction sector and IT supporting information and communication management throughout the construction project life cycle. Furthermore, the article discusses the analysis of the implementation of modern digital tools and techniques for managing information through the example of three construction projects.

The research methods include a literature review involving publications from 2010 to 2016, selected on the basis of keywords related to digitization in the construction industry, using online databases of scientific papers (Science Direct, Google Scholar, BASE). The empirical part is based on the case study method. Both the literature review and the practical application of IT are presented with reference to the Building Information Modelling (BIM) method in a context of the concept of Integrated Project Delivery and information management in the operation phase of a building according to the principles of Facility Management.

2. Specific features of information management in the construction industry

Information management involves the acquisition, classification, collection, processing, presentation, dissemination and implementation of information. Construction and installation companies manage a wide range of data flow, including [3]:

- information required to develop an bid, cost estimation (price lists, price catalogues), the base estimation of the subject matter of the contract and its revaluation during the project implementation;
- the knowledge base developed during the project implementation;
- analytical elements and project optimization;
- project implementation;
- building maintenance.

According to Parsanezhad, effective management of so much data requires constant acquisition, analysis and flow of information in a multidisciplinary environment throughout the building life cycle. The association BuildingSMART defines this approach as a holistic business process involving the generation and use of data in order to design, construct and then use a building. To ensure the efficiency of the information flow, it is essential to identify three main phases in the building life cycle and to treat the use phase with the same significance as the first two phases, i.e. design and construction [4].

There is an important relationship between the organization's information system and its strategy and organizational structure. Understanding information systems is essential to understanding technological changes in enterprises. A huge and varied collection of information at a construction company can be organized into systems associated with one another [2]:

- supporting decisions including simulation systems;
- risk management;
- taking part in information exchange between systems of various manufacturers at the level of source data;
- managing knowledge at an organization Information databases on technology usefulness;
- analysis of competition based on offers and offer prices as well as the current involvement into projects;
- supporting analysis of contracts;
- supporting project management and project portfolio management;
- supporting quality management system and environmental protection system;
- supporting document flow;
- production settlement;
- supporting logistics and supply management;
- supporting technical documentation management;
- preparing cost estimates along with unit prices of equipment, materials and costs of labour for a given company;
- monitoring vehicles and machines with the use of GPS;
- databases relating to enforcement standards and average prices of materials, labour and equipment;
- supporting management with a completed/handed-over facility, device, e.g. building, motorway or expensive construction equipment;
- information about the history of expenditure incurred, the profit generated, work time and return on investment.

Hadaya and Pellerin believe that an important feature of the construction project life cycle, affecting the conditions of information management, is a large number of participants in the project, who are in different locations, use a variety of information techniques and tools and work with data at different levels of specificity and with information at different levels of abstraction [5]. Viljama and Peltomaa indicate that varying technologies and different levels of technological competence among subcontractors and other project participants lead to difficulties with effective integration of data and their use in construction projects.

Necessary information may be dispersed and included in different systems characterized by varying degrees of technological advancement [6]. According to Bankvall *et al.* it is essential to disseminate IT tools and techniques under these specific conditions in order to improve information flow and management throughout the construction project life cycle. Information standards should support the digitization process [7]. Lönngren *et al.* identify the standardization of information as potentially the most important factor in stimulating the productivity of the construction industry [8].

The benefits from the implementation of ICT solutions in the architecture, engineering and construction (AEC) sector can be enormous, especially considering the effects of management activities. Digital techniques and tools implemented in the construction industry include:

- the virtual network (Internet);
- wireless communication;
- virtual reality (VR), mixed reality (MR) and augmented reality (AR);
- the BIM method in a broad sense;
- data exchange and management.

The use of digital information in the construction industry is a developing trend, which strongly affects the ability to anticipate and solve engineering problems throughout the construction project life cycle. The increasing availability of advanced techniques generates new types of digital sets of information, electronic documents and models of buildings, as well as spatially oriented information that is archived using the global positioning system. Information is most often processed on a construction site using traditional methods, which are relatively slow, associated with a high risk of human error and thus inefficient. Furthermore, project participants do not know all important parameters of the processes covered by the construction project. This implies management challenges, especially in the area of construction control [8]. The supply chain phase in the building life cycle is an important area of research on information management in this life cycle.

2.1. Information in supply chain management in the construction industry

A construction supply chain is characterized by [9]:

- convergence at the site of construction materials;
- one-off projects facilitated by repeatable processes of project organizations;
- a make-to-order supply chain – delivery on request.

From the point of view of a construction company, a supply chain should raise the value delivered to customers and establish new performance standards which require optimization in many areas. Even if adapted to the needs, the flow of information about the scope of supply may not be sufficient and so information management skills become important. The dynamics of internationalization and globalization processes, as well as increased competition in the construction market make traditional models of information management insufficient to carry out construction projects in an efficient and successful manner [10].

In supply chain management, it is necessary to integrate a number of areas that are the source of diverse information. These include design, material requirements planning, product delivery and subcontractor management. Digital techniques help integrate different sets of information, acting as a key facilitator. The main advantage is the ability to share strategic, tactical and operational information. One of the results is the reduction of costs associated with the precise planning of logistic processes and the possibility of their accurate monitoring [11]. Information management in modern supply chains should be organized in such a way as to implement the principle of 3V (visibility, velocity, versatility). Visibility focuses on resources, inventories in particular (inventory visibility), and indicates that they can be monitored throughout the supply chain. Velocity is the ability to meet the needs and perform a contract in a short time. Versatility means the ability to work with suppliers and customers under different conditions of delivery (coordination versatility). These elements constitute the three pillars of adaptive supply chains. IT tools and techniques greatly facilitate implementation of the 3V principle in construction supply chains [10].

2.2. IT technology and BIM

In the modern building life cycle, information management can be organized through the use of BIM technology and an interactive communication platform. A BIM model is a database that helps project managers use information through unlimited access to the digital documentation of projects, gathered in an IT communication system. Underwood and Isikdag claim that BIM, defined not only as building information modelling but also as a method for information management, acts like a shared information backbone through the life cycle of the project [12]. The BIM approach involves information management based on the exchange of information using the model and for example IFC format, even if most of the processes are based upon traditional means of communication, such as the exchange of paper documents in the form of printouts or face-to-face meetings of project participants [13]. In the construction project life cycle, BIM involves the integration of information flowing between the parties throughout the life cycle, in line with the IPD (Integrated Project Delivery). The essence of this method is to produce and process digital information about each phase of the construction project life cycle. BIM involves intensive collaboration between stakeholders, which is a basis for an effective exchange of information and data flow. This cooperation can contribute to a better integration of the previously dispersed construction sector and participants of construction projects, thus improving the economic efficiency [14]. Redmond *et al.* indicate that the letter "I" in the acronym "BIM" concerns synchronization of information across the construction project life cycle, the aim of which is to increase the speed and efficiency of work processes and facilitate management decision-making based on well-organized and adequate solutions [15]. Nicał and Wodyński indicate the following application areas of BIM [16]:

- the real-time resource location – productivity and safety can be optimized through integration of a BIM model with Radio Frequency Identification (RFID) technology or the barcode-based system;

- digital data management system that allows for real-time storing, finding and sharing these data;
- planning renovation or retrofit and developing a feasibility study for these works;
- activities related to the operation and maintenance of the building;
- energy analysis and simulation, control of electronic systems in the building management phase as part of Facility Management;
- health and safety management during construction and operation.

There is a growing interest among researchers and practitioners in the use of IT technology and BIM throughout the building life cycle, which means that construction managers will need to be added to the group of participants using the platform for data exchange and communication. The scope of information required for effective property management is extensive, and the main problems related to this issue are associated with access to information and the completeness and timeliness of data. Information contained in traditional two-dimensional as-built documentation is much dispersed. Its use for analysis, decisions and actions related to building operation can be time consuming and costly. Facility Management (FM) is a new concept in Poland aimed at lowering the cost of building operation, improving the quality of resources, investing in real estates to fit the current needs of both owners and users, as well as at identifying and using hidden reserves. The International Facility Management Association defines FM as the practical coordination of physical jobs with people and an organization that integrates the principles of business administration, architecture and the maintenance of technical objects. The scope of information required in FM activities depends on the specifics of the property management system, but it generally includes necessary data on space management, technical maintenance and work to ensure the comfort of users. The integration of hardware and software responsible for the proper operation of technical installations in a building may significantly reduce operating costs, improve the working conditions of people residing in the building, increase their sense of security and shorten the payback period of the investment. The integration of energy management, security, fire protection and other necessary installations may be particularly effective. Management software should allow insight into accurate data, thus enabling a quick reaction to events.

According to Nicał and Wodyński, the major challenges and barriers associated with the practical implementation of such a holistic approach are as follows [16]:

- unclear roles and responsibilities regarding the BIM model;
- vaguely defined roles and competences of the project participants;
- data requirements – level of development (LOD) needed;
- the role of FMs is underestimated in the construction project life cycle and the lack of FM input during the early stages of the project delivery process;
- interoperability concern – information exchange and transfer;
- the lack of BIM knowledge/experience among FM practitioners;
- change-resistant attitude, lack of cases proving the positive business value.

3. Case studies

3.1. New Karolinska Solna Hospital

The world-class university hospital New Karolinska Solna (NKS) belongs to the Karolinska Insittutet, one of Sweden's leading medical universities (Fig. 1). The hospital is located in Sweden, in the city of Solna in the Stockholm region. The construction of NKS is a PPP project realised by a public partner: Stockholm County Council (Stockholms läns landsting) and private partners: Skanska Sweden, Skanska Infrastructure Development, Skanska UK, and the British investment fund Innisfree. The partnership agreement between Stockholm County Council and Swedish Hospital Partners, a partnership established by Skanska and Innisfree provides for funding, construction as well as maintenance and management of the new hospital by 2040. After completing the tasks of design, construction and funding of the endeavour, the project company will be obliged to provide the service of hospital availability which means, maintaining the technical state of the hospital's buildings at the contractual level for a specified time. The maintenance and use of the building include a series of other services such as: cleaning, maintenance of the building or logistics necessary for the proper functioning of the contractual hospital infrastructure. Initial approval of the project by the investor took place in December 2008, then on 31 March 2009 an invitation to tender was published, while the submissions to the tender ended on 30 September 2009. The letter of intent was signed with the private partner in December 2009. The design work began in 2010, after the final agreement was concluded. The estimated project value was SEK 14.5 billion. According to the schedule, the investment is being implemented in stages and the first patients were served already in 2016, in buildings constructed during stage 1. The end of all construction work along with the transfer for use of all the buildings is planned for 2018.

The main goals the contractor had to complete included:

- creating a building of high architectural standards, both internal and external as well as in the close vicinity of the building,
- applying construction solutions which will support effective and optimal processes of resource utilisation,
- realisation of the rules of sustainable construction combined with smart building concept principles.

NKS is going to be one of the first hospitals in the world that follows the strict environmental guidelines of the international LEED Gold certification, which requires the environment-friendly material and technology solutions in the course of the construction of the building. One of the applied examples are the green roofs which serve as thermo-insulation and have a positive effect on the energy balance and internal climate of the building.

Creating the environment for sustainable transport related to the building's use is yet another solution. 10% of the parking spots are going to be fitted with charging stations for electric cars. The building's energy supply is planned to make use of geothermal energy, which will cover 65% of the energy needed for heating and cooling purposes. The environmental

Fig. 1. Visualisation of NKS Hospital building. Source: Skanska materials

guidelines were taken into account from the earliest stages of the project and decision-making processes in the following areas: energy-efficiency, minimisation of the environmental impact of the project, environmental certification by an independent entity, balanced materials and waste management, provision for high quality microclimate inside the buildings.

Parameters approved at the conceptual stage of the project should be considered along with the initial principles which illustrate the scale of the project. These include:

- 1800 people being present on the construction site during the most intensive construction period,
- the buildings will feature approx. 8000 rooms including patient rooms, 36 operating theatres, 8 radiation units, 168 doctor's surgeries as well as laboratories and lecture halls,
- the buildings will have 12 floors with a total area of 320 000 m^2, including a 2-level underground parking.

The concept of the NKS building life cycle assumed that the end users of the hospital complex such as doctors and medical staff will be included in the design process as soon as possible, in order to take their needs related to patient care such as privacy and safety of the patients, into account. One of the earliest principles was to provide one, dedicated room for each patient, where he will stay for the whole treatment time, in order to reduce the need to transport him within the hospital, between the wards.

Management of such a large and complex project is a challenge. One of the main principles aimed to facilitate it was to use the BIM method throughout the life cycle of the process as well as supportive techniques – Virtual Design & Construction. BIM tools were used to calculate life cycle risks over 28-year operation and maintenance PPP contract, including the regular upkeep of components and the periodical replacement of larger equipment. The models were also used in energy simulations for the building, which will support the project in achieving its ambitious energy targets. An as-built BIM model was prepared, including comprehensive structure with regard to placement, function and product. The model comprises generic objects with relevant information only, linked to information, directly (in the model) or indirectly (through links or related databases). From the very beginning, it was assumed that the model would be updated throughout the use of the building, being a valuable source of information for the building's administration. After the contract is finished it will be handed over to the public partner.

The project included innovative solutions at the design stage, which were intended to facilitate the information flow between the users during subsequent stages of the life cycle of the project and provide the means for proper communication with end users of the hospital. The contractors decided to use Autodesk Revit combined with a newly developed and industry specific application. The team of designers together with their Autodesk Partner Cad-Q have developed cloud-based database solutions to handle room descriptions, fixtures and change management. This technology links the databases with the design tool Revit in order to process the information in a database environment instead of in the design mode. Everyone involved was working according to one and the same model of the project [17]. The designers together with the doctors and medical staff were discussing the placing the certain elements in certain rooms. This discussion was supported by usage of a virtual room, where common meetings were held. The BIM model was converted into Virtual Reality, so the doctors and nurses could feel the space that they could work in in the future. This solution caused the reduction of post construction failures thank to the engagement of the final product user at the design stage.

At the realisation stage, BIM was used to analyse the work stages in detail, support the project logistics, support the communication on the project and all analytical aspects. For the needs of the project the 4D schedule was created together with information about the cost analysis, and information about material delivery. The parametric model of the hospital was connected with the temporary schedule, which helped to see the daily situation of the project: which work will be completed, were H&S hazards will be located, how to plan the materials delivery, how many people should work on a certain day and in which part of the project. BIM integration scope during construction included:

- equipment data collection,
- document collection,
- issue tracking,
- commissioning scripts.

At the building's utilisation management stage, the BIM model was designed to support the hospital utilisation processes, helping the building's administrator in running installation check-ups and understanding their functioning. For example, information that the model provides on floor space facilitates planning of cleaning and other hospital upkeep. If a lamp breaks, the model will show not only what type of lamp it is, but also whether a ladder will be necessary to replace it. It is also possible to draw conclusion on the priority of measures, as it is more important that everything functions optimally in an operating theatre than in a break room.

Fig. 2. NKS Mobile Application Screen. Source: Skanska

Another example of an interesting FM-related solution is a system called JiT cabinets, designed to supply the hospital with medical materials and accessories. The system was designed together with the future users of the building and the supplier of FM software and hardware for new NKS buildings. The JiT cabinets for equipment and materials are located in niches at several places on every floor close to the main corridors. The cabinets are the final link in an automated chain that leads to the user, such as staff in an operating theatre. The contents are readily visible and easily accessible. Material supply to the cabinets takes place mainly using robots that control trucks loaded with textiles or sterile goods to and from the units. Virtually all transport takes place using these robot trucks, automated guided vehicles (AGV), which have their own lifts and will carry out around 1600 transports per day. Since the operation planning system can talk with the sterile unit's IT systems, everything will be in place when it is needed. The chain includes sterilisation, material supply and the so-called value-added process that consists of the AGVs and the JiT stores.

The information management system designed for the NKS Hospital includes solutions made to inform the external stakeholders, including the local community. A showroom available to anyone interested in the project was designed and built. With the help of film, images and an interactive model everyone will learn more about the NKS project and the future healthcare system. To strengthen the communication concerning the project information a special application was created (Fig. 2), which everybody could load on their mobile.

The NKS project's app allows navigation round the hospital area and inside the main building. Thanks to this application everyone can see what it will look like when it is fully open.

3.2. Green 2 Day office building

The construction of the Green 2 Day office building in Wrocław is yet another example of digital technologies being adopted for the purposes of construction process. The building will be located in the centre of the city, its office space will be 17 000 m^2. The building was designed in accordance with LEED Gold standards. The solutions used in its design include energy use reduction by 25% and water use reduction by 45% compared to local standards. The construction stage is planned for 25 months.

A cloud-based BIM 360 Docs app is used for project management in this case. This tool allows the contractor to store and manage project files online from any location, and to exchange comments and suggestions between various participants of the process, using technical documentation, which facilitates horizontal coordination. Documents are kept in order in an online repository; the members of the contractor's team can access all the up-to-date files the contractual documentation comprises. Thanks to additional apps, the tool monitors the weather and the conditions during the process of mounting specific elements. The data is then archived. This enables the software to store the data which may be relevant for the maintenance process of the building for future users. In the contemplated example, the BIM 360 Docs app is used on mobile devices and in smart kiosks, which are used for H&S (health and safety) briefings and short operational meetings, facilitating the communication on the contractor's team. In executing the analysed investment, also the BIM 360 Field application was used, whose application allowed components to be monitored during the entire process of development. Components from many groups (prefabricates, components of mechanical systems, switch gears, slings) are coded in the system using unique numbers. Some components also use links in the form of QR codes that allow to be read from the label placed on a component by means of a tool built into the BIM 360 Field and to immediately go to the website of a given component. Prefabricated components such as posts and beams receive labels with codes at the manufacturing plant while during acceptance of the delivery, the supervisor has access to entire workshop documentation of the component after reading the code. Mechanical system components (control units, fans, fire dampers), besides access to catalogue cards, drawings, selection cards and lists, feature additional properties that help in simplifying the process of planning start-ups. These properties are entered by contractors responsible for a given area. Thanks to the above, start-up meetings relate to planning and resolving problems and there is no need to spend time on information gathering.

The use of these tools has an impact primarily on savings of time which would normally be used for hosting technical meetings, gathering information and coordinating communication on the construction site. The construction manager, during inspection and prior to daily meetings, takes photos using a portable device (tablet), and then during the meeting, he prepares notes. Particular subcontractors are saved in the database and the system. The names of their employees and tasks planned for the upcoming day are recorded. In the project discussed, the use of BIM 360 Team, including the BIM360 Docs application, is pilot-like in character. For initial identification of results, a survey was completed among 20 participants of the investment process, representing the supervising inspector, the investor and the general contractor.

The respondents' answers show that the average weekly time savings achieved thanks to the use of digital tools covered by the BIM360 system is 5.5 hours. Other advantages listed by the respondents included improved arrangement of documentation flow in the process and a significant improvement of information flow relating to occupational health and safety [18].

3.3. The expansion of the national road 8 between Warsaw and Białystok

The subject of this project is the expansion of the national road 8, in order to adjust it to the express road parameters in the following section: Wyszków–'Poręba' interchange (with the interchange) from km 516+482.66 to km 529+470.00, 12.987 km altogether. The investment comprises roadworks, including the construction of the S8 express road, road interchanges (3 interchanges) along with the construction and expansion of transverse roads, expansion of existent roads within the area of the investment, reconstruction of existent traffic routes crossing with the planned investment, construction of crossings, vehicle inspection stations, pavements, exits, bus stops, access roads, surface and subterranean drainage systems, road passages (including animal passages) as well as land reclamation of the area where the existing roads are dismantled. The investment also includes bridge-building work, engineering construction such as viaducts on the transverse roads and sectoral work covering additional equipment [19]. The project is being implemented in accordance with a traditional contractual "build" model. In this model, the contractor receives technical documentation and design from the investor. In this case, the investor gave the contractor the documents in a traditional form since he did not have the construction project in a parametric version. The contractor decided to use project digitisation technology in order to use the parametrised project to build BIM models which will then be used to plan and schedule project work, and for the work with controlled construction equipment. Therefore, in order to apply the principles of the BIM method, the 2D documentation had to be transferred to the digital project and supplemented with spatial information. The models were built using modern tools such as unmanned aerial vehicles, laser technology and satellite measurement tools. These tools provided spatial information in the form of 3D images and helped verify the state of groundwork. Digital tools were also used to facilitate the communication during works. Smart kiosk stations were used to provide access to the up-to-date information about the project in the form of a digital model linked with satellite pictures. The kiosks were used by every party and person engaged in the construction process. Smart kiosks were also used to perform H&S training sessions (Health and Safety) using 3D models. Another example of the use of digital technologies by the contractor of the expansion of road S8 are the apps used to improve the onsite reporting system, which rely on the GPS service and allow live exchange of the information. Drones and laser scanning are also used to verify the state of work in the contemplated project (Fig. 3).

In this investment, the effects of using digital technologies were analysed in comparison with the results obtained with traditional methods used in the previous projects completed by the contractor. Hiring a subcontracting geodetic company to conduct the inventory of 13 kilometres of the road with cross-sections every 25 m, would require 7 days of measurements

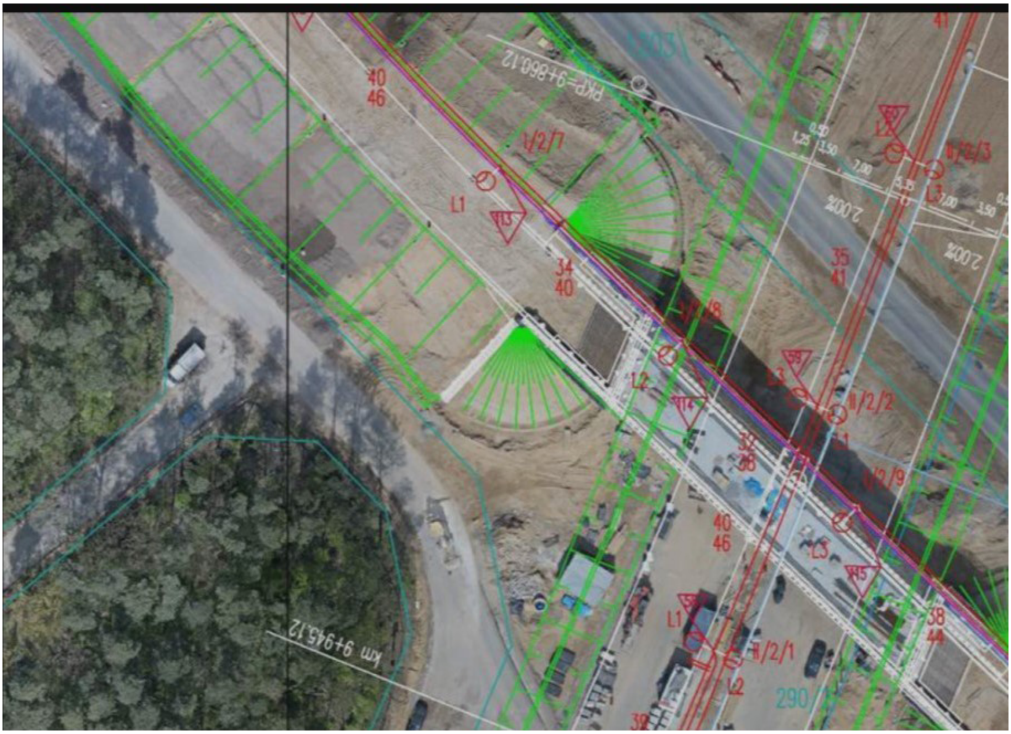

Fig. 3. Digital verification of the state of work. Source: Skanska

and 2 more days for data processing. The data acquired using traditional methods is relatively light (approx. 100 MB) which limits the detail level of the performed inventory. Inventory of the same piece of roadwork using digital technology, which produces ortophotogrametric images, requires 1 day for the flights and 3 days of data processing. The obtained spatial data set is large (12 GB) and provides a very detailed image of the work progress.

4. Conclusions

The article discusses the possibilities of information and communication management in construction projects, using modern technologies and digitization tools. Results of an analysis of three construction investments in the context of the digitization scope of the building project life cycle indicate that there are benefits resulting primarily from saving time and reducing the workload of the processes carried out at the stages of both preparation and execution of construction work. The accuracy of gathered and processed data and the possibility of inter-industry real-time coordination are other effects of the use of IT tools in the presented case studies. The construction of the NKS hospital is an example of an investment implemented from the very beginning with the participation of the users of the facility being designed and built, through the use of digitization and combining BIM with the Facility Management concept. The FM concept is related to the necessity of managing an elaborate collection of data, including information generated at the stage of design and construction of a building. The BIM model, suitably updated and interpreted, may constitute a significant source of support for the administrators of the property, influencing the comfort, quality and safety of utilization of the building. However, developing a model of cooperation as well as digital communication and information exchange between all the participants in the life cycle of a construction project, taking into account the users and administrators of the buildings, requires further in-depth research.

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