FUNCTIONS OF COMMON DATA ENVIRONMENT SUPPORTING PROCUREMENT OF SUBCONTRACTORS

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Abstract. The paper is focused on exploration of selected common data environment functions supporting procurement processes of subcontractors. As common data environments are becoming widespread within the construction industry, they must provide all project stakeholders with necessary functions to support their business processes. Generally speaking, common data environment is a digital space, where project stakeholders can share data and information between themselves. However, current common data environments can offer more functions than just a storage and a way of sharing data and information. They can provide their users with workflow and status management for setting up approval processes, mobile applications for monitoring construction site progress, as well as functions for managing BIM projects. That is why it should also be possible to manage procurement processes of subcontractors within existing common data environments. This paper's focus is to analyse selected common data environments and their available functions supporting procurement processes of subcontractors. Information presented in this paper was obtained from online sources, also questionnaires with predefined questions were sent to CDE representatives and videoconferences were conducted with CDE representatives. Main goal of this paper is to analyse, if selected common data environments have available functions for managing procurement processes of subcontractors. Identified functions are evaluated in accordance with current praxis of managing procurement processes of subcontractors for building construction projects, which also involve development of building projects in rural areas. The paper also describes strong and weak points of identified functions.

Keywords:BIM, common data environment, digitalization, procurement.

Introduction

With progressing digitalization and standardization of processes within the construction industry, Building Information Modelling (BIM) [1] is becoming widespread throughout the industry. With increasing number of construction projects designed and built with the use of BIM models a new data storage management system is becoming standard in the construction industry. This data storage management system is known as common data environment (CDE) [2], which allows its users share data and information relevant to the project between themselves. However, not only project stakeholders shall benefit from the use of CDE, but also external partners, who are not yet part of the project, shall benefit from its use. These external partners are, for example, bidders, who participate in a tender for a specific type of work. That is one of many reasons why CDE shall support functions necessary for managing procurement processes of subcontractors. As procurement processes of subcontractors play a vital role, if a general contractor makes a profit out of a project or not, they shall be carried out in a standardized and shared environment to lower possible risks related to these processes. Procurement processes of subcontractors require specific documents and record of correspondence with bidders, as is described in the author's previous article [3]. Hence, the required documents and record of correspondence shall be managed within CDE. The aim of this paper is to conduct a research of existing CDEs and their functions supporting procurement processes of subcontractors.

Materials and methods

Method of this paper is conducting qualitative research of existing CDEs and their functions supporting procurement processes of subcontractors. First of all,an online research had been conducted to identify existing CDEs, which states that they provide functions supporting procurement processes of subcontractors. Then, based on the author's previous research [3] and experience, a questionnaire with predefined questions was worked out and sent to representatives of selected CDEs. This questionnaire consisted of questions reflecting required tender data and information. For example, if it is possible to store necessary tender documentation within CDE and share it with bidders. First question of the questionnaire served to divide those respondents whose CDE does not support functions for procurement of subcontractors and those whose CDE does. For those respondents whose CDE does not support required functions there was only one more question left. For those whose CDE

does support required functions there were 21 questions left, which were grouped into 8 categories. General information about CDEs were obtained from the developer's official web pages or from online videos. The author also conducted videoconferences with those CDE representatives that were willing to share their knowledge.

Researched existing CDEs were the following:

1. Dalux Tender [4]
2. Viewpointfor Projects [5]
3. Trimble Connect [6]
4. Bentley ProjectWise® ProcureWare® [7]

Results and discussion

Questionnaires were sent to Czech representatives of selected CDEs. Three representatives sent back filled out questionnaires and video conferences were also conducted with them (Dalux Tender, Viewpoint for Projects, Trimble Connect). One representative offered a personal meeting, which had to be cancelled due to the spread of COVID-19 (Bentley ProjectWise® ProcureWare®).

At first, a general description of CDE is provided with its licencing scheme. Then description of selected CDE functions supporting procurement processes of subcontractors is provided.

1. Dalux Tender

1.1. General information

Dalux is a Dutch company, which was initially developing an application for defect management with the use of BIM models and 2D design documentation, known as Dalux Field. Then Dalux started to develop its own CDE, which is now known as Dalux Box or Dalux Box Pro. Recently they developed a tender module called Dalux Tender, which supports procurement processes of subcontractors.

1.2. Licencing

Dalux portfolio consists of various modules, which have to be paid separately. Dalux licence is dependent of total project cost and is therefore paid for each project separately. The advantage of this licence scheme is that the number of users and data storage are practically unlimited.

1.3. Functions supporting procurement processes of subcontractors

As it was already mentioned, Dalux has a module called Dalux Tender, which supports procurement processes of subcontractors. Dalux Tender module is basically an extension of Dalux Box.

1. Work packages and tender documentation

It is possible to create work packages in Dalux Tender that represent what is to be tendered. It is also possible to set, if tender of a specific work package is private or public. Each work package can have its selection of tender documentation that will be visible to selected bidders. There are two options how to insert tender documentation into work packages. The first option is to select data from the user's computer. The second option is to link down data that are stored in Dalux Box. Advantage of the secondoption is that data are not duplicated but only linked by URLs. If data in Dalux Box are revised, then data in linked work packages are also automatically revised. This can be disadvantageous, if one bidder opens tender documentation before and another bidder opens it after a revision occurs, because then each bidder will initially work with a different tender documentation. At the end of a tender the bidders can upload their bids directly into the tender module without having to insert any metadata at this stage.

2. Correspondence

Selected bidders will receive an e-mail invitation to register themselves into the tender module in order to access tender documentation. Tender module also allows for questions and answers, which are visible to all registered bidders, but are anonymous to everyone except to tender manager. All

questions and answers have to be sent within the tender module. The disadvantage of Q&A is that they are not kept in a thread but separated from one another.

3. Tender time schedule

It is possible to set the tender commencing date and tender termination date for each work package.

4. Database of bidders

Each work package has its own list of bidders that they have to be inserted manually. List of bidders cannot be imported from an external file, neither can be imported from a different Dalux project. However, import of bidders from external list is in development.

5. Classification system

Classification system can be used for classifying work packages. For other purposes the classification system cannot be used at this moment.

6. Standardized forms

There are currently no available standardized forms for processing procurement of subcontractors.

7. Summary

Dalux Tender module is fully dependent on the bidders working within the platform. Because only that way bidders can access tender documentation, state their questions and receive answers and finally upload their bids.The advantage of Dalux is its intuitive and modern looking user interface. The reason for that is that Dalux is a relatively new platform, which was developed with modern technologies. Dalux Box also has several functions supporting procurement processes of subcontractors, but these functions are not presented in this article.

2. Viewpoint for Projects

2.1. General information

Initially 4Projects was a British company, which was acquired by an American company Viewpoint in February 2013 [8]. After its acquisition 4Projects was rebranded to Viewpoint for Projects [9]. In July 2018 Viewpoint for Projects was acquired by another American company called Trimble [10]. That is why it is nowadaysdeveloped and owned by Trimble. Viewpoint for Projects was initially a document management system (DMS) [11], which in recent years extended its functions to support management of BIM projects. It supports not only document management, but also allows setting up workflows and managing correspondence between project stakeholders and with external bidders.

2.2. Licencing

Licence of Viewpoint for Projects can be bought for a specific project, where its price is dependent of the total project cost. In this type of licence unlimited number of users and data storage are included. Another type of Viewpoint for Projects licence is an enterprise licence scheme. Price of enterprise licence scheme is dependent on the company's annual turnover. In this licence unlimited number of projects, users and data storage are included.

2.3. Functions supporting procurement processes of subcontractors

Viewpoint for Projects does not provide a specific module dedicated to procurement of subcontractors, but it has many functions supporting related processes.

1. Work packages and tender documentation

What is to be tendered can be defined by creation of virtual containers. Data in virtual containers are not physically stored, but are linked down from Viewpoint for Projects DMS. Again, the advantage of this system is that data are not duplicated but linked. Those linked down data represent a tender documentation that will be sent to selected bidders as a basis to work out their bids. There are two types of virtual containers available. The first is a static container, which contains an imprint of data and freezes them in current version at a given moment. This is a big advantage, because all bidders

receive with certainty the same tender documentation, and if a revision occurs, then a tender manager can easily update linked down data and send a notification to selected bidders. The second type is a dynamic container, which contains actual data in real time. That means, if any linked down data to the dynamic container are revised in DMS, then the linked down data in the dynamic container are updated simultaneously.

2. Correspondence

It is possible to create a specific e-mail address for each virtual container and provide it to selected bidders to send all correspondence related to the tender onto this e-mail address. This way all tender correspondence is stored at one place allowing all authorized project stakeholders accessing it. It is also easy to set up workflows and notifications for these virtual containers, so selected project stakeholders can receive an e-mail notification, if any correspondence had been received into a virtual container.

3. Tender time schedule

Viewpoint for Projects does not support creation and management of tender time schedule.

4. Database of bidders

Viewpoint for Projects allows its users to import a list of bidders from an external file. This way the list of bidders can be easily exported from an external database and imported into the platform.

5. Classification system

Classification system can be used only to classify virtual containers, but nothing else.

6. Standardized forms

Standardized forms could be provided by an external application connected with Viewpoint for Projects via its API.

7. Summary

Although Viewpoint for Projects has no specific module dedicated to procurement processes of subcontractors, it has many functions that allow its users manage those processes with ease. The advantage of Viewpoint for Projects is that there is no need for bidders to work within the platform to access tender documentation and manage tender correspondence. That avoids management of hundreds of user accounts, because only awarded bidders will receive permission into the platform. The disadvantage of Viewpoint for Projects is its old fashioned user interface. The reason for that is that Viewpoint for Projects was initially developed as a DMS and is now adapting itself to modern technologies.

3. Trimble Connect

3.1. General information

Trimble Connect was based on GTeam platform developed by an American company called Gehry Technologies [12]. In September 2014 Trimble acquired Gehry Technologies and based their CDE platform called Trimble Connect on GTeam platform [13]. Since then Trimble Connect is developed and owned by Trimble. It is its preferred CDE for BIM projects; that is why it has many functions supporting management of BIM models, as well as other documentation.

3.2. Licencing

Licences are paid for each user separately, but then it does not matter, on how many projects does the user participate. Unlimited data storage is included in the user's licence [14].

3.3. Functions supporting procurement processes of subcontractors

Trimble Connect has no specific module dedicated to procurement processes of subcontractors, but it has several functions, which can be used for procurement of subcontractors.

1. Work packages and tender documentation

To identify what will have to be tendered, it is possible to create folders specific for each work package orit is possible to add metadata to data stored in Trimble Connect and filter them out. Data in created folders will automatically be updated, if new revision is uploaded to Trimble Connect.To share data from Trimble Connect with external bidders, it is possible to create an URL link and send it to selected bidders from an external e-mail client or send a release from Trimble Connect to selected bidders. The disadvantage of sending a release from Trimble Connect is that external bidders will receive an e-mail from Trimble's no-reply e-mail address into their inbox. That is why they will not be able to answer this e-mail, but they will have to open the platform through a link inside the e-mail.

2. Correspondence

Correspondence with external biddersis only possible within the platform. It is not possible to send e-mail inquiries, neither it is possible to receive e-mails into the platform. Therefore, bidders will have to work within the platform to access tender documentation and conduct correspondence.

3. Tender time schedule

It is not possible to manage tender time schedule in Trimble Connect, however, it would be possible to connect an external application with Trimble Connect via its open API.

4. Database of bidders

There is no centralized database of bidders in Trimble Connect, from which its users could select bidders into their tenders. However, it is possible to import the list of bidders from an Excel spreadsheet. At the same time, it is possible to migrate bidders from one project into another. Another solution could be creating a new project from a template project where all required bidders would be already included.

5. Classification system

It is possible to classify folders representing work packages with arbitrary classification system, as it is possible to use classification system as metadata of stored data.

6. Standardized forms

Trimble Connect does not provide any standardized forms.

7. Summary

Generally, Trimble Connect is a powerful platform supporting BIM processes, however, it is not a suitable solution for procurement processes of subcontractors, because its functions supporting these processes are very basic. To satisfy the needs of procurement processes of subcontractors it would be possible to connect a specialized external application with Trimble Connect via its open API.

4. Bentley ProjectWise® ProcureWare®

4.1. General information

ProjectWise® is a CDE developed by an American company called Bentley Systems. ProjectWise® is a powerful DMS with many functions supporting BIM and other processes, which can be enhanced with the user's defined workflows. ProjectWise 365 services are integrated with Microsoft 365, which enables setting up automated digital workflows in ProjectWise [15].

4.2. Licencing

No public information about licence scheme had been found.

4.3. Functions supporting procurement processes of subcontractors

ProjectWise® ProcureWare® enables bidder's pre-qualification, online bidding and award. It is also possible to create standard templates and documents to support standardization of procurement processes throughout a company. Bidder's offers can be scored and evaluated by internal project stakeholders. Bidder's certificates can be uploaded into the system and shared with internal project stakeholders with the possibility to set up alert reminders, when certificates expire. Essential functions of ProjectWise® ProcureWare® supporting procurement processes of subcontractors are: RFx

templates, bidder list management, electronic bid responses, team bid scoring, side-by-side bid comparisons, streamlined award-to-contract, expiration alerts, certificates tracking, records of user log-ins, digital bid document distribution, custom message templates, integrated supplier notification system, approval workflows for bids, suppliers and contracts [16].

Based on public information ProjectWise® ProcureWare® is a very powerful tool with many functions supporting procurement processes of subcontractors. Hence, further research of this platform will be conducted.

Conclusions

The aim of this paper was fulfilled, as qualitative research of existing CDEs was conducted and their functions supporting procurement processes of subcontractors were analysed and described in this article. Conclusions of the conducted research can be summarized as follows.

1. All selected CDEs provide functions supporting procurement processes of subcontractors.
2. Work packages representing what has to be tendered can be created in all selected CDEs.
3. Tender documentation can be stored, managed and shared with bidders in all selected CDEs.
4. Viewpoint for Projects enables correspondence via its platform with bidders that have no access to the platform. Other CDEs require registered bidders to the platform to conduct correspondence.
5. Dalux Tender enables limited tender time scheduling, ProjectWise® ProcureWare® states that it enables tender time scheduling, other CDEs do not support tender time scheduling at all.
6. In all selected CDEs it is possible to manage the list of bidders, however, with only very limited functions. Possibly only ProjectWise® ProcureWare® has a centralized database of bidders.
7. Classification system for managing work packages can be used in all selected CDEs, however, it is not possible to use the classification system for other purposes of procurement of subcontractors.
8. Only ProjectWise® ProcureWare® states that forms can be predefined and thus standardized.However, further research of ProjectWise® ProcureWare® willhave to be conducted.

Acknowledgements

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