

DIRECT PROCUREMENT IN LOCAL GOVERNMENTS AND BUILDING INFORMATION MODELING (BIM) INTEGRATION MODEL PROPOSAL FOR LOCAL GOVERNMENTS

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Abstract

In the present study, the steps of direct procurement processes and related construction works are described, information is given about the effects of BIM on general process management, and the process and cost-based analysis capabilities of BIM are explained. The integration of these processes is performed using a demo program, visuals of the integration are shared, and comparative results are presented regarding what could be achieved if the integration in question were to be applied with traditional methods. Based on comparative analyses, it is concluded that the targeted and desired results are obtained.

Introduction

Local governments are an organic component of the capitalist state apparatus organized on a sub-national scale, with the authority to represent the power and regulatory functions of the state at the local level (Eroğlu et al., 2018). In particular, the embodiment of the state's constructive powers in local governments necessitates the management of a completely different type of financial power. The local response to this power brings with it a capitalist perspective for capital centers. Municipalities can purchase all kinds of goods and services ranging from those that address social needs to infrastructure investments and zoning applications. In this regard, the most rapid approach is to resolve local needs through a procurement method called direct procurement by negotiating the technical conditions and prices with bidders invited by the administration as specified by law (Yıldırım et al., 2018). In order to develop functional and controllable mechanisms for direct procurement, it is necessary to integrate the procurement process with a system such as that offered by building information modeling (BIM). Applying BIM entails representing the physical and functional characteristics of a building with a three-dimensional information model throughout the building's life cycle (Öktem et al., 2017). Within the scope of this study, in addition to outlining the traditional method of direct procurement, BIM integration is undertaken with an internet-based program to ensure more accurate cost analysis and appropriate bids, and to make document and process management procedures more professional and controllable with the help of a conceptual model.

Simulation

Municipalities are obliged to provide many services, especially in cases where central authorities cannot resolve certain problems or process certain transactions faster, and they must ensure that necessary services are provided to the public on site and quickly (Gökalp, 2018). In this context, as stated in Article 3 of Municipal Law No. 5393 of Turkey, municipalities are defined as "a public legal entity with administrative and financial autonomy, established to meet the local common needs of the residents of the municipality and whose decision-making body is elected by the voters." As regulated in Articles 14 and 15 of the same law, municipalities have duties and responsibilities such as maintaining the urban infrastructure, including zoning, water, sewerage, transportation, public transportation, and waste collection. The method that municipalities use to perform urgent work is the direct procurement method, which allows them to purchase goods and services quickly (Ödenkoş, 1999).

Direct procurement processes

Municipalities use the direct procurement method by negotiating the technical conditions and price of the work to be done via tenders, which they invite in the case of special needs as specified in the relevant articles of the law. In the cases specified in Article 22 of Public Procurement Law No. 4737, direct procurement procedures can be employed without tender notice and assurance (Public Procurement Law No.4734, 2002). In such cases, procurement is applied to meet local needs with market research conducted by the person or people assigned by the tender authority, without the obligation of establishing a tender committee and seeking the qualification rules listed in Article 10. This process has become frequently preferred by administrations since it is a method that does not require a notification period or qualification rules and it can be put into practice immediately (Yıldırım et al., 2018).

Building information modeling and similar processes in municipalities

BIM can facilitate the development of comprehensive information and analysis to be applied in order to improve decision-making well in advance during construction processes and reduce the losses or damages that may be suffered during the operational life of the buildings in question after construction (Çetiner, 2010). Especially for local governments, where the operation

processes of buildings and other structures, or their integration into public life and their continuity, are of critical importance, BIM is especially valuable. Forces and changes that the structure will face during its lifetime can be considered in BIM in advance, and information such as decisions regarding the structural design, performance predictions, cost estimations and management, and construction maintenance will be obtained through the model before the structure is completed together with result-oriented information (Pinar, 2022). Upon confirming all relevant technological data, the licensing and settlement procedures of the municipality are carried out with drawings obtained by design offices working autonomously in BIM-based design programs. In other words, these designers receive their licenses and permits from the municipality in accordance with the relevant articles of the Law on Public Improvement and Regulations. Even though local governments are extremely familiar with these programs, it is much easier to integrate the programs in the context of the procurement of goods and services and construction works with a conceptual model created within the framework of an appropriate BIM plan (Pinar, 2022). In fact, this process in municipalities, where the procurement of goods and services or construction work

will be carried out via the Electronic Public Procurement Platform (*Elektronik Kamu Alımları Platformu*: EKAP) using an internet database, is similar to the traditional method of BIM applications. From this point of view, it is clear that BIM can be used more comfortably and professionally by municipalities upon integrating the relevant software with a few modifications.

BIM and EKAP with a proposed conceptual model for direct procurement processes

The process known as direct procurement is followed in accordance with Article 22 of Public Procurement Law No. 4734 in order to facilitate the procurement of goods and services and construction work more quickly. Essentially, this system maintains its continuity by being integrated into the EKAP. When the conceptual model studied for BIM integration with this system is examined, in terms of its use by public institutions, first of all, interoperable integrity must be assured within the BIM system for all parts of the system to work together. Interoperability is “the exchange of information between two or more systems or components and the use of the exchanged information” (Grilo et al., 2010). In order to achieve the interoperability of different institutions or different units within the same institution, a network can be established as shown in Figure 1 (Yazıcı et al., 2019).

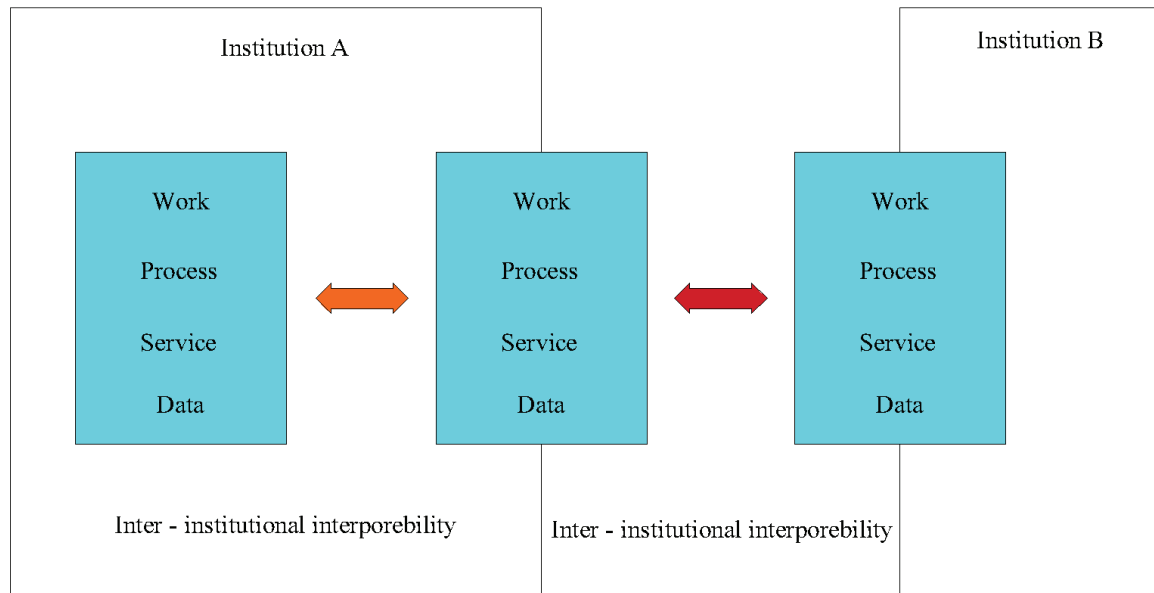


Figure 1: Inter – institutional interoporebility

As shown in Figure 1, especially within the conceptual model, different units within the same institution may try to undertake process management together for various works, processes, services, or data by ensuring interdisciplinary coordination. In order to prevent any problems that may arise, file exchanges for all relevant tools, BIM applications, and the EKAP should be carried out smoothly within the framework of the conceptual model. In other words, not only mathematical modeling

but also details such as proposal creations, calls, orders, and invoicing need to be addressed (Kumar et al., 2010). With the consideration of such details, the information to be transferred to EKAP within the process created within the framework of the BIM implementation plan will be integrated simultaneously and any possible losses following time losses or cost-based problems that may occur will be prevented. Again, since the units and people who take part in this plan will be determined

within the framework of the conceptual model being created, different disciplines will be combined within the same implementation plan by issuing appropriate authorizations and creating job descriptions (Domer, 2017). In order to ensure effective BIM implementation and process management, the established conceptual model should also be supported by regulations and certain standards. In addition, in order for this application to achieve effective results, the external factors that will affect processes in the public sector should be identified clearly in order to ensure a successful implementation plan (Özorhon et al., 2017).

Creation of the conceptual model

When creating a conceptual model, first of all, the current features of the EKAP should be preserved. In other words, even in the early stages of a project, tender processes such as the receiving of bids should be implemented within the legal framework and all the data that will be given as input to the system electronically for the project should be entered into the system. In addition, aside from parametric three-dimensional models, calls for bids, orders, invoicing, and other digital information to be used within the EKAP should be added to the modeling information derived from the BIM application (Çıracıoğlu et al., 2020). This is because the process may become more complex and unmanageable when contractors, material and product suppliers, service providers, and subcontracting services are involved in the tender process after the earliest stages of the project. Due to the nature of direct procurement processes and the fact that the aim of direct procurement processes is to achieve results quickly, the model to be created for integration with the EKAP should include appropriate visualization in the first stage.

Therefore, it is necessary to provide suitable data for the EKAP officers who will be involved in the process in the next stage. The design of the building or the nature of the goods or services to be acquired must be clearly and distinctly outlined. In this way, the desired information on processes, quantities, analyses, and descriptions will emerge in a more reliable way. In addition, the budget control phase of the work will proceed simultaneously with a third party throughout this whole process, as more reliable data will be obtained as a result of high-quality visual studies and analysis. The proposed conceptual model should be described in a way that is clear to all stakeholders within the framework of the BIM implementation plan. As a result of the tasks defined within the BIM framework, the responsibilities of the people from different units participating in these processes will also be clearly revealed. In addition, responsible parties should be notified immediately about the beginning and completion of tasks. In this way, possible problems or errors can be addressed instantly with quick feedback or the time needed to resolve them

will be shortened. The conceptual model created in this sense is described below step by step.

In order to implement the processes described so far and the entire plan expressed as a conceptual model in a software language, a procurement process was programmed as shown in Figure 2, Figure 3 and Figure 4. In order to achieve integration in the direct procurement process as described above, different units must be brought together. Therefore, starting from the moment of requesting entry, the directorates of the relevant municipality that will be involved in the request are allowed to intervene in terms of terminating the process or advancing in the steps in the stages during which they are expected to contribute. Within the framework of this implementation plan, the phases in which a relevant directorate is involved according to the job descriptions given by BIM are clearly defined. From the issuing of a work order to its conclusion, a web-based program was applied here in the first phase in order to support the application of two different programs to provide the necessary warnings for simultaneous updates, with the inclusion of EKAP officials in the software processes at the appropriate times within the BIM framework

The process is begun by opening the request screen for a requested procurement of goods, service procurement, or construction work. In other words, as the first stage of the process, information related to the budget order as one of the main objectives of this integration, such as what the act in question is, the amount of funds being requested, and the budget from which those funds will be provided, is provided by the unit that will do the work in question. As shown in Figure 5, this information is obtained from the first relevant unit by the people assigned within the BIM framework. The process then proceeds to the next stage, which is the provision of information that involves data on quantities, such as special information or special specifications, if any, and the quantity of the product requested, as shown in Figure 6. Lastly, if there are drawings, visuals, or other technical and administrative documents for the work in question, they are uploaded to the system as additional information and the work order is initiated. The additional documents to be uploaded may require large amounts of storage space and web-based programs or cloud computing networks may be used, and any updates to be made to these documents will trigger instant notifications via e-mail to any units that will take part in the next stage. Thus, as described above, interdisciplinary coordination will be ensured.

After the first stage, the preliminary information required by the relevant unit has been entered. In other words, after the design team has out necessary steps together

The Process of Buying

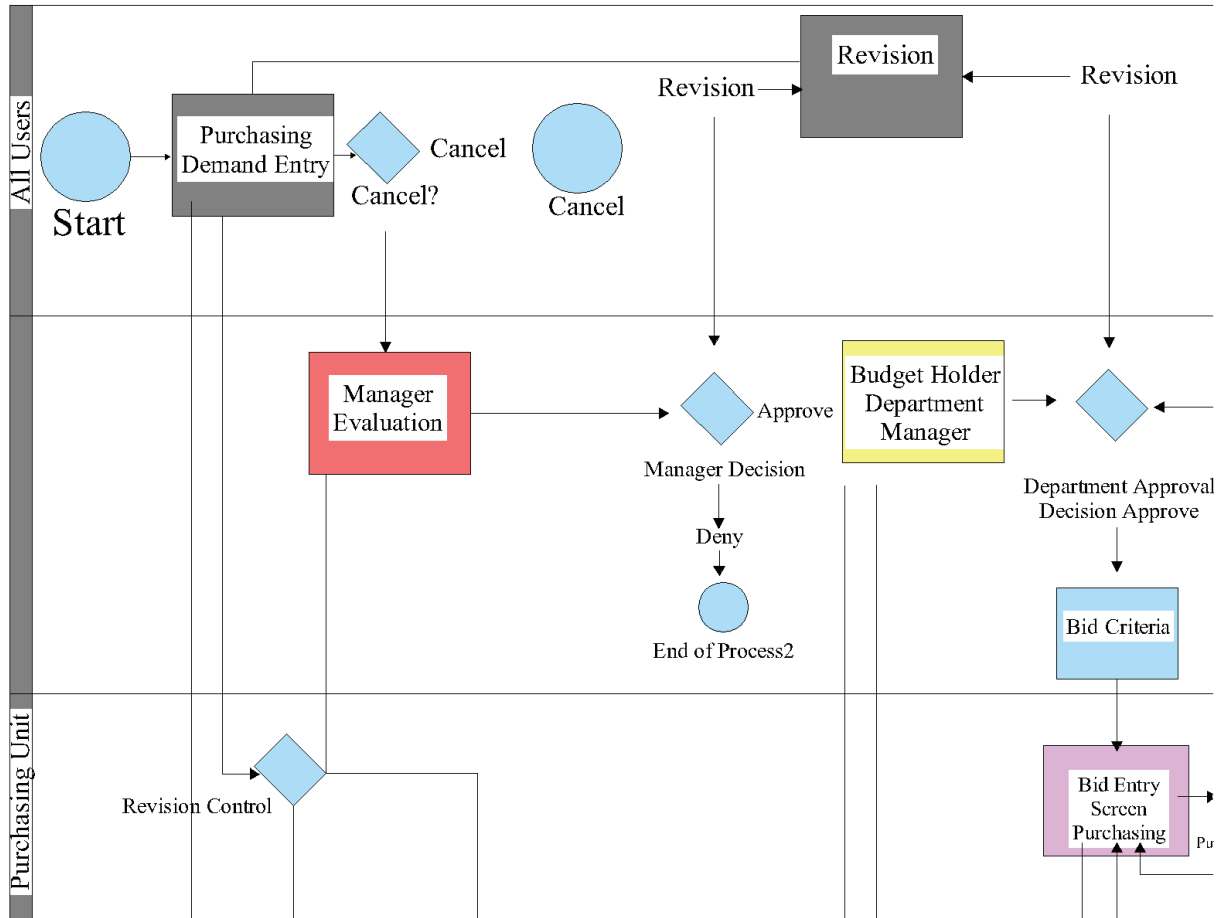


Figure 2: Purchasing process, part1

with the provision of the necessary drawings, quantities, analysis results, and other descriptions, all information is directed to the screen of the manager of the unit that will approve the design. This information appears on that manager's screen in the form of a summary table as shown in Figure 7. The manager can either send this information back to the design team, highlighting points that should be revised after any necessary controls are applied, or the manager can move the process forward by approving the design if there are no issues to be commented on. The administrative chief of the design team can follow all these processes from the beginning to the end, through the entire duration of the work, with access to information on the number of the people working on the design and the time devoted by them. If any deadlocks occur, the administrative chief of the design team can see who or what caused the situation on this information screen and can prevent the further delay of the processes by intervening in problems immediately.

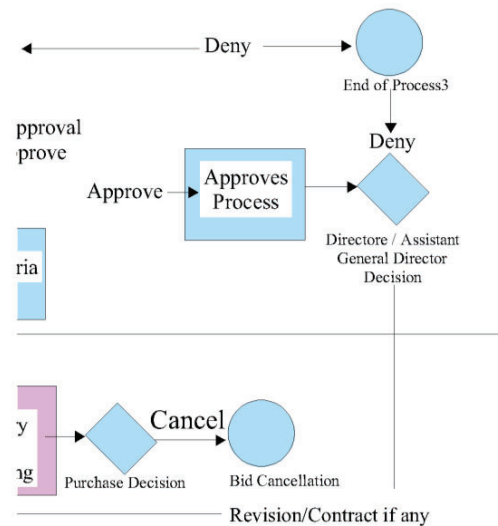


Figure 3: Purchasing process, part2

In addition, the senior administrative chief who is responsible for the whole unit is in a position to intervene at such moments whenever necessary. Thus, as

expected from successful integration, units and individuals make progress as a whole, not separately.

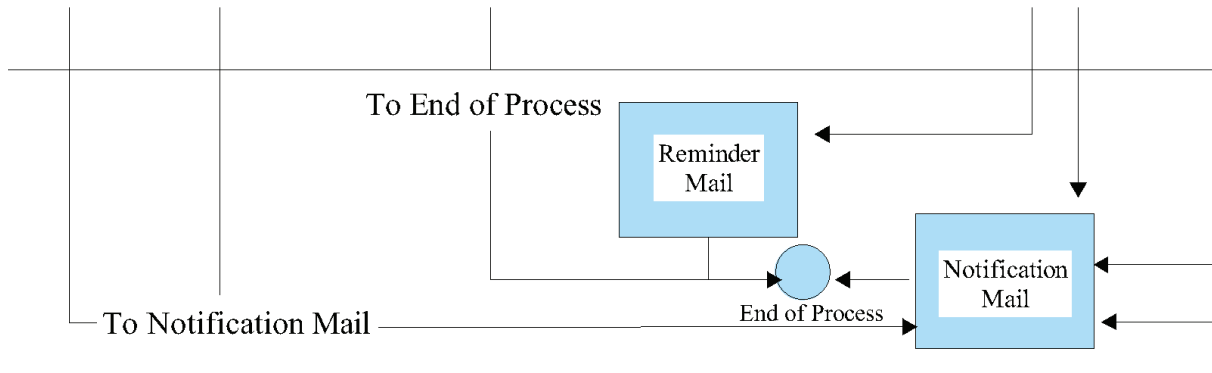


Figure 4: Purchasing process, part3

Following the approval of processes by the sub-chief of the unit to which the budget will be issued and which is obliged to carry out the work, the requests in question are summarized on the screen of the senior manager who is in charge of the units that will be responsible for the design and the construction units. Here, with budget preparation and design carried out by two different units sharing a common field, the framework for the process can be submitted quickly for the review and approval of the manager in question. As seen in Figure 8, the manager will be able to include any comments or revisions deemed necessary during this control phase in additional files, and notifications will be issued simultaneously to the units controlling this process. In this way, time analysis can be performed more accurately throughout the whole process by the relevant manager. Following this process, the EKAP and the unit responsible for market research will be involved in the work. In other words, market analyses and bids collected during the aforementioned process, if any, will be collected from companies that are registered in this system or have the necessary qualifications and capacity to be registered. In this way, more qualified companies can be reached in relation to any desired project and any offers obtained can be examined with retrospective

research or reporting. A more helpful infrastructure will be created with this information, which will also form the basis of public institutions in an institutional sense. Furthermore, on the bid entry screen, brief information about the requested work, files submitted by the bidding companies (if available), drawings and comments about the work in question if it is construction work, and information such as the validity period of the bid can be found. As the EKAP team receives this information, it can be monitored simultaneously on the screens of the design team and the construction team, so if there is any discrepancy between the comments of the contractor submitting the bid and the requests of the institution, an intervention can be performed immediately and the bid or bids submitted can be eliminated with the reasons for elimination being stated. Thus, any differences or discrepancies between the work requested by the organization and the incoming bids will be addressed immediately, preventing unnecessary losses of time or disputes. With the data entered by the EKAP team being seen simultaneously by the design team, construction team, and budget department of the relevant municipality, interdisciplinary coordination will be ensured as the work progresses rapidly toward the desired results.

"Document Type	<input type="text" value=""/>	"Account Determination Date	<input type="text" value=""/>
"Request Date	<input type="text" value="0.00"/>	"Exchange Rate	<input type="text" value="0.00"/>
"Calculation Amount	0.00 TRY		
"Budget Type	<input type="text" value=""/>	"Main Title	<input type="text" value=""/>
"Bottom Breakdown	<input type="text" value="0.00"/>	"Cost Center	<input type="text" value="0.00"/>
"Budget Code	<input type="text" value=""/>		

Figure 5: Request screen, part1

Product Information			
"Special Conditions			
"Product Description		"Group of Goods	
"Demanded Delivery Date		"Place of Production	
"Delivery Address		"Storage Place	
"Quantity	0.00	"Unit of Measure	
"Purchasing Group			
"Purchasing Organization			

Figure 6: Request screen, part2

Purchase Request Information

Request Information	Product Table	Staff Initiating The Request
Request Information		
"Budget Code	0000	
"Document Type	Timber Purchase	"Account Assignment Type Order F
"Amount of Claim	30,000.00 TRY	"Exchange Rate 1,00
"Calculated Claim Amount	30,000.00 TRY	
"Budget Type	Department Budget	"Sub Title Department Materials
"Bottom Breakdown	Department Materials	"Cost Center 32-Bit Computer
"Purchasing Organization	Domestic purchasing Org.	
Activity History		
"Click for Detailed Information		

Figure 7: Evaluation screen for manager

Delays caused by any one department will be immediately revealed within this integrated framework and managers will be able to intervene in the process immediately. Moreover, the accounting unit will be able to view the collected bids and payment plans and examine them within the context of the general progress of payment procedures and processes of the relevant institution. If necessary, this unit will be able to make annotations on the payment plans requested by the relevant companies. In addition, with the intervention of this unit, the attitude to be adopted within the framework of the general budget will be revealed in the early stages before the work starts and this will enable contractors to make their own plans regarding payments over the course of the work. Furthermore, contractors that the institution thinks will not comply with the payment plan will be eliminated in the early stages of the work. Thus, gains will continue to be achieved throughout the process at high levels with the simultaneous involvement of different actors. The final official approval of the process, which has by now received the joint approval of all units with successful reviews made at each stage by

the highest-ranking supervisor responsible for the implementation of the plan via this process, is sent to the appropriate approval authority within the framework of the BIM implementation plan. The highest-ranking approval authority will find the entire process submitted in summary and the construction or procurement of the desired work will quickly begin after all the documents, correspondence, proforma invoices, bids, and other materials required according to the type of work in question are obtained by the relevant approval authority. Thus, the applicability of the conceptual model proposed for integration according to the direct procurement business procedures will be implemented in a practical way in this process. With control mechanisms operating in the desired way, the collaboration of different actors in a harmonious and coordinated manner will be ensured and the ability of different directorates within the same institution to work together will be increased. The desired results can be achieved with a more controllable process and without damaging the relationships between chiefs and civil servants within the institution.

Budget Owner Department Manager Screen

Request Information	Product Table	Staff Initiating The Request
Request Information		
"Budget Code	0000	
"Document Type	Timber Purchase	"Account Assignment Type Order F
"Amount of Claim	30,000.00 TRY	"Exchange Rate 1,00
"Calculated Claim Amount	30,000.00 TRY	
"Budget Type	Department Budget	"Sub Title Department Materials
"Bottom Breakdown	Department Materials	"Cost Center 32-Bit Computer
"Purchasing Organization	Domestic purchasing Org.	
Activity History		
"Click for Detailed Information		
Additional Documents		
<input type="button" value="Upload Document"/>		
*You can download additional documents, you want to upload from here		
Decision		
Decision	<input type="radio"/> Approval <input type="radio"/> Revision <input type="radio"/> Rejection	
Explanation	<div></div>	

Figure 8: Budget Control

Conclusions

Service providers in local governments, and especially the units performing operational tasks, are often required to act quickly and respond quickly to certain demands. This is because some needs may develop instantaneously while others may be repetitive and mandatory. In addition to large-scale construction and service works, the managerial processes to be developed in the rapid fulfillment of instantaneous requests in projects and transactions with smaller budgets that do not exceed certain limits can produce efficient results. In this framework, efficient results can be obtained with such governance techniques to be developed for expenditures up to a certain limit, known as direct procurement. In municipalities subject to the Turkish Court of Accounts, these transactions, which should be carried out via the EKAP system that is actively used in many state institutions of Turkey with the development of technology, will cause unnecessary losses of time and money if not managed correctly. Despite the desire to fulfill the instructions issued by the head of the institution quickly, paperwork requirements and the

necessity of different units working toward the same goal may cause productivity losses. With the widespread use of BIM, models developed in relation to construction work and the exploration and analysis undertaken in connection with these models will facilitate more accurate pricing and approximate cost analysis with the involvement of teams working via the EKAP with this proposed integration model. The proposed integration model allows different units to work together coherently by assuming different roles in the same implementation plan. Furthermore, thanks to this model, more accurate proposals can be prepared with the thoughts and comments of the design team, and the process will progress faster and more accurately with the addition of their comments on unit price analysis during the pricing stages, if any. The presence of the finance unit in the implementation plan within this model and appropriate budget control in the early stages of the project will ensure that problems with off-budget work items are not encountered. While all these processes are developing and continuing through the stages of responsibility as defined by the BIM framework, they will be reviewed simultaneously by the administrative chiefs of the

organization and possible problems can be reported to the relevant chiefs immediately with this model. Thus, process management, document management, and cost management as planned at the very beginning of the work will be achieved automatically. With this model, which will make practical contributions to the working of municipalities, a faster and more controllable process will emerge and the instructions given will obtain results more efficiently. In addition, thanks to the application of this model together with models proposed in the literature, solutions to interoperability problems will be reached, and when the process is supported by the necessary software, the recommended implementation plans can be established in different institutions and academic studies. Therefore, it will be ensured that contributions can be made at the desired level and positive reflections for state budgets will be observed quickly.

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