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RESEARCH ARTICLE

Big Room concept in project management and control

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Abstract

Especially after the 1980s, computer-aided design programs paved the way for the implementation of unusual forms and building structures in the construction industry. This situation has increased the necessity of process management and the development of existing systems in the field of construction project management has become a necessity. As a result of these developments, the concept of integrated project delivery (IPD), which aims to increase the coordination, cooperation, and communication among the team members of different disciplines, has emerged. In addition to the coordinated work of the design team; project stakeholders such as customers, contractors, and subcontractors are also directly involved in the process. In such large-scale projects, the concept of the Great Chamber, an integrated project delivery system, emerged as a collaboration platform in project management. As a result of the search for process management, the Big Room concept, which aims to increase the coordination, cooperation and communication among the team members of different disciplines, is a physical space organization that uses technology but has central human and human relations. Big Room is a design and coordination office located on the construction sites. In this office, all stakeholders are involved early on and are directly involved in the management and control of a project. Team members work together to improve team performance, interact and accelerate decision-making and reduce project costs for better communication. In this study, it is aimed to introduce, search and determine the advantages of Big Room concept which is used in many big projects in the world by searching literature.

Keywords

Construction industry; Project management; Integrated project delivery (IPD); Collaboration platform; Big Room

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1. Introduction

Nowadays, technology is developing rapidly, and with these developments, the construction sector is in a major transformation process. As the functions of buildings and implementation techniques become more complex, project areas grow, vertical building rates increase and implementation processes become complex. These developments necessitate a systematic construction management process from the design phase to the end of the implementation phase. Reducing costs in complex structures and minimizing the process without compromising on quality have gained importance. In many projects, delays in the construction phase directly or indirectly affect costs, quality decreases are observed in the face of cost increases and projects fail. Errors that are ignored during the

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design phase and the projects delivered without consideration of sufficient detail are also among the reasons for the delays in the implementation phase. For these reasons, the necessity of providing and optimizing all the parameters in the quality, cost and time triangle, has opened the doors of a new research area in the construction sector: Construction Project Management (CPM).

CPM is an area of research that has emerged in the second half of the twentieth century and is constantly developing. To understand CPM, it is useful to know the definition of the concept of 'project. The concept of the project is based on DIN 69901 norms of German Industrial Norms, which are accepted as references in international transactions, and which are similar to those of time, target, welding and so on. It is stated that the works and tasks with constraints such as organization and unique organizational characteristics can be considered as projects [1]. Projects that have a certain complexity by nature have targets for the start and end dates. CPM is a method of establishing a scientific and social systematic, including subheadings such as directing resources, identifying project-critical facts, and process design in order to achieve the project objectives. CPM is expected to be useful in planning, efficiency, job site management, risk management, occupational health and safety, strategic planning and proposal preparation, enterprise resource management, innovation management and dispute resolution [2]. As an organization type, CPM consists of components such as project partners, project management office, sponsors, managers, team leaders and team members [3]. Each component includes professionals from different disciplines, people of different social status and educational level. Also, in a typical construction project, the employer is most of the time involved. Ensuring workflow between all these components and stakeholders also requires certain coordination and rational planning even in simple projects. Because a project cannot achieve a perfect result only with the coordinated work of the design team. In addition to the computer environment such as the satisfaction of the owner, interventions of the permitting organizations, coordination of construction contractors and subcontractors, and feedback from design consultants, a progressive implementation process based on human relations and mutual dialogue should also be designed. These stakeholders have their own goals in the project, often affecting process optimization, often not contributing to the project [5]. For example; failure of a subcontractor to supply the required material at the scheduled time may cause serious disruptions in the process. In order to prevent the construction process which is in a race against time, all stakeholders should make their decisions at the beginning of the project. These requirements have created the concept of IPD [6].

Unlike traditional design process IPD; It is a project delivery method that encourages people, systems, business structures, and applications to coordinate work, and integrates the capabilities and perspectives of all participants in the early stages of the process to optimize efficiency in the design and implementation phases [7,8,9]. Fig. 1 illustrates the difference between the traditional design process and the IPD.

IPD is a CPM system based on the early involvement of all partners in the design process. Involving partners with the right information at the right time reduces physical barriers between project participants. The creativity and discipline of the stakeholders who meet around a strategy increases and an atmosphere of harmony and loyalty occur between them. Although the leaders of these teams are leaders, they are largely self-directed. IPD teams can be small groups that focus on solving specific problems, or larger groups working on brainstorming, coordination or timing [11].

Although the subject of the physical space is neglected in the literature, it affects projects in many ways [12]. With the development of the IPD system over time, the importance of the physical space was recognized and common spaces were needed for the use of stakeholders. The current equivalent of this physical common space requirement is the Big Room concept. The Big Room is a subheading of the IPD approach, first

implemented in the United States, developed in Finland [13].

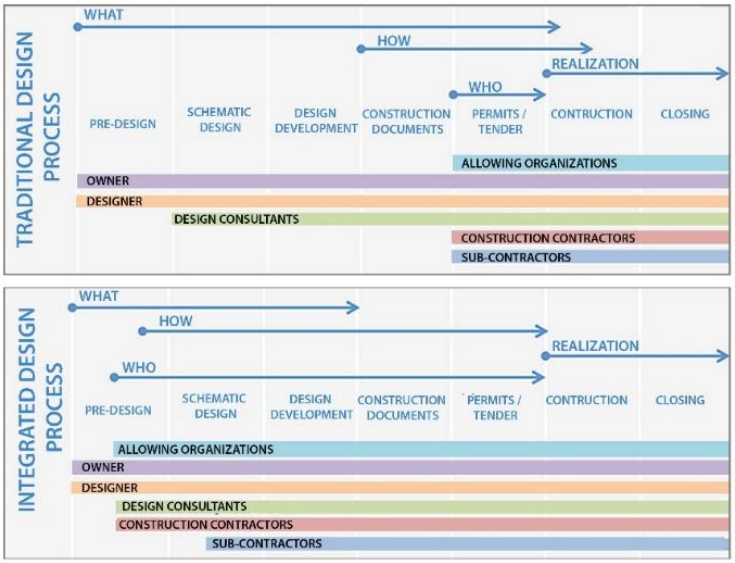

Fig. 1. Traditional design and integrated design process comparison chart [10]

As a result of the research conducted by Ma et al. [14] indicated that 45.5% of IPD projects used a "Big Room," 59.1% used a collaboration platform, 27.3% used both of these infrastructure types, and only 22.7% used neither a 'Big Room' nor a collaboration platform.

Although the use of large-scale projects and research on the subject has increased in recent years, the concept of Big Room is not a definitive concept in the Architecture, Engineering, and Construction (AEC) sector. Therefore, different definitions are available. In general, Big Room is a collaborative workspace design in which a project process involves participation from different disciplines and all project stakeholders are physically in touch from the beginning to the end.

2. Aims and methodology of the research

As a result of literature search, it was determined that there are not many academic studies on IPD and Big Room in Turkey. Although applications similar to the IPD method are found in the field of construction site and design management, there is no construction site organization called Big Room in Turkey. This study aims to raise awareness about the Big Room concept that is used frequently in big projects of developed countries especially for Turkey and other developing countries of the world. For this purpose, the concept of Big Room is introduced. The main aim is not to produce a definitive result, but to compile the hypotheses in the literature. In this context, studies about Big Room in literature have been examined. Particularly empirical research based on empirical study and supporting data collection from information sources through questionnaires and interviews were selected. In the study, the prominent results about the Big Room obtained from the literature and short information about the sample projects were given.

3. Big Room Concept as in Integration Mechanism

The Big Room concept dates back to the G21 project in Toyota, built in the 1990s. It is a solution created by Takeshi Uchiyamada who was assigned as the chief engineer in this technical project called ey Obeya de during the implementation period. In order to make the ideal decisions, he established a team of experienced team leaders, consultants, and workers from different disciplines and created a

working model in a large room where all documents and data were accessible to everyone [15, 16, 17]. Fig. 2 shows a photograph of Obeya, which inspired the Big Room concept.

Fig. 2. The Obeya of the IMV project at Toyota Thailand [18]

Obeya's open information and collaboration platform yield a process in which the concept is developed and used in different fields and projects. Just like Obeya, the Big Room brings together multiple stakeholders in a project in decision-making processes and aims to minimize unnecessary activities that will have a negative impact on the project process [19]. Koskelo [20], in his thesis with empirical inquiries and surveys, revealed that there are three main components to the Big Room concept. The researcher, who defines the Big Room as the Project alliance life cycle, says that in order for this cycle to be successful, the system must be installed in a human-oriented, technological infrastructure and appropriate physical space (Fig. 3).

One of the most important components of the Big Room concept is the establishment of physical space. Implementations of the physical Big Room spaces in the construction vary from single rooms to large open offices [21]. Big Room, which is determined according to the needs of the construction site, can be in the form of a large office where hundreds of people work full time at very large construction sites. However, it is applied as a workshop and meeting place which is used by design and management units continuously in smaller-scale projects and frequently met with other stakeholders. For example, Fig. 4 shows an example of a Big Room at Sutter Health's Eden Medical center project in California, USA.

Fig. 3. The concept of Big Room [20]

Fig. 4. Big Room at Sutter Health's Eden Medical project (Image Courtesy, Sutter Health USA) [19]

The fact that dozens and hundreds of people with different areas of expertise can make a joint decision about a job also leads to some disadvantages, but trials have shown that the advantages of the Big Room are greater than the disadvantages. For example; In the book Integrating Project Delivery, the concept of "Big Room, which is called the center for an IPD, is described in the authors' [11] own words as follows: "You walk into the Big Room. In a corner, a group is gathered around a wall talking constantly as they are adjusting dates and deliverables in a pull schedule. Another group is huddled around computer monitors evaluating different options for mechanical routing. You realize as you look at them that you don't know who they work for. As you move closer, you overhear enough to know that someone is an engineer, another is a facility

manager, and several trades are involved in the decision. A logo on one of their shirts betrays their firm—without that you wouldn't know. In another group, everyone is looking toward a woman. She must be a leader. But as you draw close to that group, you realize that she is asking questions, not giving orders. And she is pulling information from each team member and carefully listening to their response. Moreover, she is asking others to add or comment on the responses. Slowly, she is helping the team evaluate all of the considerations, hear the minority and contrasting views, evaluate them, and draw to a consensus. Looking over at a wall, you see a list of the key project values and you realize that the criteria the team just used to make their decision aligned with the project values. You were right-she is a leader, a team leader. There is a buzz in the room and no librarian to keep everyone quiet. But although you hear excited voices, they are passionate, not angry. If you stopped to ask anyone how it was going, they would explain the problems and the challenges, and then tell you that this is why they got into design and construction" [11].

So people and human relations are the second most important component of a functioning process [22]. In a construction site managed by traditional methods, there is a hierarchical order. In case of any problems, for example, the worker is obliged to inform the subcontractor to which he is attached, the subcontractor to which he is attached, the contractor management office and the managers to the owner. This situation causes problems to prolong the process such as the absence of one of the stakeholders in the working area, the inability to respond to emails instantaneously, or the failure to solve the problem due to communication failure. However, once or twice a week, all stakeholders come together to discuss problems face-to-face and produce joint solutions, reducing the loss of time due to a lack of communication [23].

The third important component is technology. In addition to gathering all participants in the physical space of the Big Room, meetings are also held in a virtual environment. In large-scale projects, the owner wants to work with experts who are the best in the field, but without the Big Room, this is not possible. Because probably the best experts are already working on another project. However, thanks to the combination of Big Room and technology, it is possible for experts to be involved in several projects at the same time. Or on the contrary, there are cases where stakeholders working in small and medium-sized projects are working on other projects in the remaining time. Some of the stakeholders participate in Big Room meetings through video conferences from anywhere in the world [20].

Another contribution of the technology to the Big Room concept is the use of Building Information Modelling (BIM) in projects [24]. The aim of the Big Room concept is to accelerate the construction site process by minimizing potential errors by means of transparent and direct information flow. Also, BIM, which represents all disciplines in a single model, has the same goal [11]. Using these two similar concepts together yields more efficient results for both. For example; There are situations where changes need to be made in the projects designed with all the details in line with the problems encountered during the implementation. This change process, which is managed by the architectural team within the site and called shop drawing, is attempted to be carried out with traditional methods and the possibility of making the right moves at one time decreases. However, unlike graphic-based computerized drawing systems and object-based systems, BIM operates on numerical data and stores design-related information in the database. In other words, a change in an architectural project designed over digital data can be automatically updated on electrical, mechanical and static projects [25, 26, 27, 28]. Like the Big Room, BIM is an important innovation in the design process that will bridge the lack of coordination between different engineering disciplines and architects [29].

4. Project examples managed with Big Room concept

In this section, studies about Big Room in literature are examined. Particularly empirical research based on empirical study and supporting data collection

from information sources through questionnaires and interviews were selected. Brief information about the selected sample projects and the most effective results about the Big Room obtained from the employees in these projects are given below.

4.1. San Carlos Center Project in California

In California, the new San Carlos Center, just south of the Palo Alto Medical Foundation's San Francisco International Airport, is a construction site run by the Big Room. The first phase of this project, 190,000 square meters, was carried out from traditionally established offices 15 miles south of the project. While the project was in progress, the project team moved to the Big Room and had the opportunity to observe the difference. A Big Room of approximately 8000 square meters has been established in order to integrate approximately 40 representatives, construction managers, architects and contractors, landlords and design consultants from the key members of the San Carlos Center team. In order to increase transparency and reduce hierarchical pressures, a minimum partition wall was used and a planning scheme was designed with open office logic. Small stations are designed for use only in situations requiring privacy. A large area has been considered to make presentations, discuss and view BIM-based projects. All parties work together to solve the problems. The reasons for the waste of time such as making phone calls, trying to negotiate in the e-mail environment, chasing people to meet have disappeared. As a result, a collaborative environment is provided that increases productivity and provides a safe environment in the working environment [30].

4.2. Siltasairaala (Bridge Hospital Project) HUS in Helsinki

Construction of the Bridge Hospital, a project of the SRV Company, is underway in an area of 75000 square meters. “True understanding comes from the interaction between people, not machines” the SRV Company, which started the business with the slogan, describes Big Room as a great success. Mikael Lähteenmäki, the project engineer at SRV, mentions that the project is too large-scale for all stakeholders to work together full-time. For this reason, The Big Room, which is designed, has 20 staff working full-time. Meetings are held every Tuesday, Wednesday, and Thursday bringing together project stakeholders. Lähteenmäki says that the flexibility of communication is the best feature of this concept so that someone who needs an idea can touch their colleague's shoulder during the study: “When you can discuss things face-to-face, the solution can usually be reached fairly quickly.” The walls are called’ Last Planner ' and everyone leaves notes to each other with post-it, presentations are made in front of the large projection walls and an interactive working environment is provided [31]. Fig. 5 features a photo of this work area, called the ‘wonder wall’ by the team.

4.3. Sutter Health Eden Medical Center Hospital Project

In this project, the hospital building, which is in the process of renovation, had to be delivered on time with limited resources. An IPD team was created for this job to speed up the process. Even at the beginning of the process, an office was rented in an area close to the project site, as the appropriate hospital could not be found. This office is organized as the Big Room, which provides the appropriate physical environment for the stakeholders. BIM infrastructure was established and technological equipment was provided for video conferences and interactive meetings. The walls are equipped with technical drawings and business planning for the projects. All project risks and opportunities are identified jointly by the project stakeholders here. Commitments have been made. The Big Room was moved to the construction site shortly before construction started.

Fig. 5. Interactive study room in Big Room [31]

This example demonstrates that stakeholders are already involved early on in the process where the project site is not yet ready, without waiting for the work to begin actively, and many potential problems are already solved. Since all price optimizations were done in advance and the projects were prepared before the work started - based on the BIM - there was no disruption in the process. As a result, thanks to the Big Room concept, this project was delivered within the target cost a week before the targeted time [11].

4.4. Canadian Airport Project

Boton and Forgues [32] conducted interviews and surveys with employees at the Canada airport project and indirectly investigated the effectiveness of the Big Room concept on the project. In this project, all members of the project team had to share a common physical space provided by the business management firm near the site. The idea here resembles the concept of the "Great Room ve and is designed to increase the benefits of collaboration between disciplines. The answers to the following questions were sought in the survey studies:

- Does the project working at the site find the cooperation between the stakeholders and other disciplines efficient?
- Does finding a common solution with other stakeholders in a possible challenge make it easier?

Indeed, compared to a traditional project configuration, working in the same physical space during a project seems to have a very positive impact on communication, collaboration, and trust between stakeholders, and on information and data exchange. One interesting particularity of this project lies in the fact that all of the project team members had to share a common physical space provided by the business managing firm near the construction site. The idea here is similar to the "Big Room" concept and is designed to collaboration synergies among disciplines. One of the study's goals is to understand how the respondents perceive the impact and the potential difficulties emerging from working in a common space with other disciplines on the project's efficiency. The unclear contract clause regarding such open space work was perceived as having a significant impact by the respondents. Indeed, compared to a traditional project configuration, working in the same physical space during a project seems to have a very positive impact on communication, collaboration, and trust between stakeholders, and on information and data exchange [32].

The following results were obtained from the surveys [32];

- The whole team enjoyed working together with the Big Room concept,
- There is no hierarchical pressure in the working environment and everyone works in confidence and peace,
- Physical proximity helps the employees to adopt the project,
- The joint workspace accelerates the project delivery process,
- It has emerged that most of the participants will prefer the Big Room concept in future projects.

Here, all the teams are mobilized for this one project," said a BIM coordinator. "The common space is very useful. It brings together the owner and the other disciplines. It serves as an integrator, information is better shared. Small succinct meetings are very effective," added the project manager. This physical proximity contributes to a common synergy, the feeling of working around a goal common to all, simplifies the design phase, increases the effectiveness of decision-making, and contributes to the understanding of a project's specific BIM processes. "At the preliminary stage, there is about one BIM meeting per month. It seems sufficient, given that the workspace is conducive to

speaking directly with the people concerned in case of problems," a BIM manager said. Another BIM manager added "We have a great advantage in being in a common physical space. This provides quick solutions. There is no loss of time or information when interacting with other professionals." Moreover, a very large proportion of the respondents felt very positive about their desire to work in such colocation configurations in future projects [32].

4.5. Medical Center Mission Bay Hospitals Project

In this project, the IPD team carried out their work in the Big Room they established at the construction site. The team consisted of project managers, designers, building information modelers, MEP engineers, general foremen and representatives of the general contractor and facilities operators. Team members have set target dates to finish cost optimization and process. The project teams of all disciplines focused on the best solution by brainstorming in elbow contact. Project manager Ray Tebino stated that 95% of the problems were solved within 30 minutes and all decisions were taken on the same day. Many of the issues that the integrated project team solved within one day would have taken several weeks in a traditionally organized team. One successful Project Modifications and Innovations (PMI) centered on the tray system, which carries cables throughout the hospital. Standard cable trays were expensive, but one common alternative, J-hooks, seemed too unattractive and potentially disorganized to the Mission Bay Hospitals facilities representatives. A low-voltage designer working on the team suggested using common brackets, which would be significantly lower cost both to purchase and to install, yet keep the cables and wiring organized by allowing them to lay more horizontally, rather than thickly bundled as with a J-hook. After requesting some samples from the manufacturer, vetting the system with the facilities staff, and successfully completing the PMI, the team determined that the cable tray substitute would be a perfect solution. The cable tray solution was implemented using Big room or an integrated concurrent engineering (ICE) session. On-site and instant solutions to hundreds of such problems have resulted in the hospital ending 8 days before the scheduled schedule and costing $ 200 million less than the projected cost. Fig. 6 shows the budget reports updated by the Mission Bay Hospitals project team on a weekly basis. Dashboard walls are an important component of the Big Room concept, enabling teams to access real-time information [11].

Also, the Mission Bay Hospitals project team collaborated with a BIM-based project that co-ordinates systems across all disciplines. Of course, the impact of this integrated BIM system on speeding up the process and reducing costs is very positive. Fig. 7 shows the integrated BIM for the patient rooms in the UCSF Mission Bay Hospitals project. It includes walls, metal studs, ceilings, mechanical, electrical, plumbing, fire protection, medical gases, and seismic bracing, and allowed project teams to understand dependencies of their work on others in real-time [11].

Fig. 6. The Mission Bay Hospitals project cost and budget tracking dashboard [11]

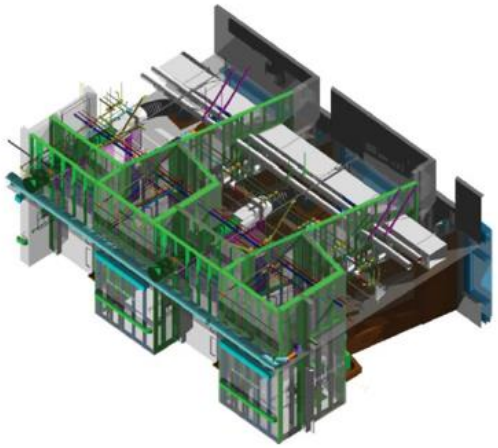

Fig. 7. Integrated BIM at the UCSF Mission Bay Hospital patient rooms. Licensed by The Regents of the University of California on behalf of its UCSF Medical Center; courtesy of DPR Construction [11]

5. Findings and results

As a result of the researches, it is understood that; There are some basic principles that distinguish the Big Room concept from other traditional project management systems. Throughout this study;

- Optimize jobs from the start and the whole, not when it's time to piece by piece
- Early identification of project objectives
- Early detection of possible risks and problems
- Joint work and ownership of all stakeholders
- Mutual respect and trust
- Sharing the award of the achievements by the whole team
- Sharing the responsibility of the problems to the whole team
- Joint work and decision-making for business development
- Early involvement of all participants in the business process
- Transparent management and information sharing
- Open, direct and fast communication
- Increase participation through technology
- Technology is defined as the integration of projects (BIM).

In addition, the advantages of the Big Room concept determined as a result of the reviews are given below [19]:

✓ It does not provide an active cooperation environment.

Due to the nature of the team of qualified staff, no matter how crowded, they have not adopted to the importance of working together. The face-to-face work of the project team strengthens the collaboration environment and increases the motivation of employees in physical contact.

✓ It eliminates the hierarchical order within the project.

In the interactive work environment, since all project stakeholders work for the benefit of the organization, there is no hierarchical order since the Big Room does not have partition walls that draw borders. This has a positive impact on the psychology of employees as well as the financial and temporal gains of the Big Room concept.

✓ Facilitates interaction between team members.

Since factors such as telephone, mail, third parties and hierarchy are isolated from the working environment, possible delays in decision-making are avoided.

✓ It provides high efficiency in a quality-cost-time triangle.

The absence of delays in the decision-making process results in a “high-performance building in line with the planned time and budget. Hosting qualified personnel and working with BIM-based projects are also components that positively affect this performance.

✓ Ensures that team members continuously improve themselves.

Due to the structure of the Big Room concept, sharing of risks and rewards causes team members to support each other. Employees who assimilate the project objectives as a team are open to cooperation in terms of information sharing and psychological support where each other is inadequate.

✓ Technological infrastructure

Where all stakeholders are not working full time on the same project, participation methods such as video conferencing can be used.

6. Conclusion

The construction sector, which has changed with technological developments, has brought with it large scale complex projects. The research conducted to find the most efficient process organization in the application fields, which are conducted in a race against time, brings new methods with each passing day. The Big Room concept, which was developed as a subheading of the integrated project delivery (IPD) method, is one of the most efficient collaboration platforms currently being implemented.

This study examines the application areas of the Big Room concept through examples and explores the literature and explains the Big Room concept. Ultimately, it was seen that the Big Room concept changed according to the size of the project. In very large projects, a single workspace is designed for all team employees, while smaller and medium-sized projects are designed for smaller work areas where part of the team works full-time and only part of the meeting. Another result is that projects are designed to be BIM-based to benefit effectively from the Big Room. In addition to being one of the important components of the Big Room concept, technology is considered to be 'human' and human relations.

In consequence of researches in Turkey, there is no example of project management regarding the Big Room concept. Recently, interest in the integrated project delivery system in Turkey is known to be increased. As a result of the usage of the Big Room concept in the projects in Turkey will contribute to the development of the construction sector.

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