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Feasibility of Using an Integrated Project Delivery (IPD) in Mass Housing Collaborative Projects

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ABSTRACT

Integrated project delivery (IPD) is a project delivery method that integrates people, systems, business structures and practices into a process. This study first introduced the IPD method and then the required factors and infrastructure to implement this method and its conventional and behavioral principles have been identified. After getting familiar with IPD and its principles, some interviews were conducted with experts in order to identify the barriers and challenges to implement IPD in four cultural, financial, technical and legal areas. In next step, the identified barriers and challenges changed to consistent statements and in form of a questionnaire, they were distributed among the statistical population, and according to the results the barriers and challenges have been prioritized. The results of this study showed that the most important challenge in the application of IPD is related to cultural area which should be taken into account. Besides, teaching IPD, promoting culture of teamwork and improving the quality of relationships and implementing the sample projects by using this method can contribute to know this method and make it inclusive.

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INTRODUCTION

It can be argued that in the present projects, the conventional implementation of design and construction services has been involved in an adversarial process that has led to inefficiency and distrust between the employer, counselor, contractor, and suppliers. Today, buildings are complex machines that in order to be completed, they require skills and expertise of many professionals. In order to answer to this unwanted paradox, in order to facilitate communication, reduce / share risk, increase profits and create positive experiences for project stakeholders, the construction industry has turned to new systems that are more collaborative. IPD is one of these collaborative systems.

The economic growth and development of countries depends on delivering various infrastructural and service projects and increase the efficiency and quality of services delivery which are regarded as their main goals. Limited budgetary resources to finance large projects and also the high demand in investment in these projects have caused that countries make all their efforts in enjoying from active contribution of private sector and creating a proper competitive environment for their activities. One of the problems of developing countries in successful implementation of infrastructure and construction projects which leads to waste of financial and human resources is senior managers of organizations who don't use project management techniques and don't benefit from the impact of their coherent and scientific organizing in projects. Recently, in Iran, housing supply is less than demand, the Mass Housing Building Projects (MHBP) as the best solution for balancing the supply and demand are really important, On the other hand, the mass housing building projects in other industries have increased the importance of these projects. Regarding the importance and the annual turnover of MHBP, the factors that influence on time, cost and quality of these projects are really important. Project implementation method is one of the critical factors in success of the project that significantly affects on project schedule, cost and quality [10]. Project implementation method is defined as the overall process by which a project is designed, constructed or maintained [17].

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Although the integrity is not generally a new concept, only in recent years IPD multilateral contracts have been highly considered. A few academic researches has been done on IPD, but it seems that IPD is superior to many conventional project implementation methods. The recognition and popularity of IPD in the designing and manufacturing companies are increasingly raising [5]. Since using IPD mechanism and vision in the country has not seriously taken into account and those involved in the project and construction industry are not aware of the benefits and advantages of this approach and its mechanism, it seems necessary to introduce and review this method. Partnership is the most important factor in determining the quality of implementation of building projects that shapes a commitment and communication environment among people. Interests and partnership in project implementation include: sharing responsibilities, having mutual benefits, investing and spending resources, dividing risks and responsibilities, and regarding accountability. Therefore, it seems that IPD method in collaborative projects runs more efficiently, because the benefits of private investor are uncertain and the interests of manufacturers and designers are not coordinated and IPD can make them coordinated and causes the project success. The purpose of this study was to do feasibility studies and to answer the following question: Considering the required factors for this method and considering legal structures and available technical and engineering facilities, is it possible to use this method for collaborative mass housing building projects?

A Review of Literature, Theoretical Framework and Research Hypotheses:

Construction industry has faced with many problems, including; lack of cooperation, collaboration, trust and also unprofitable communication which has made hostile relationships among all those involved in the project. This kind of relationship reflects in the area of delay in project delivery, difficulties in resolving disputes, imposing additional costs, win-lose debates and stances [12]. In this case, there is an urgent need for a new approach to eliminate such problems; hence the new management techniques have been developed to solve this problem [14]. Partnering as one of these techniques attempt to make a management process between two or more organizations. This technique aims to create an environment rich with trust and open communication between the agents and employees of the project [13].

Partnering and its main features:

Partnering is an organized management process to achieve ease of teamwork within the scope of the contract, while its basic components are the dual objectives, agreed methods to resolve problems and striving for continuous and increasing improvement [11]. Partnering, with a clear and concrete definition of the overall goals and targets of project is based on mutual trust and goodwill between the parties, and there is a consensus among all authorities about that and it provides and covers interests of anyone specifically and starts it. Benefits of partnering are growing and cumulative. Thus, using long-term partnering is more effective and more profitable than short-term cooperation [15].

Partnering in Construction:

Partnering in Construction as a potentially important way to improve the performance of construction projects has been proposed. This approach has benefits for both contract parties namely; the employer (client) and contractor. In recent years a growing interest has been seen in using partnership in construction and other forms of cooperation, as a way to deal with the fragmentation and lack of integration have been used [16]. In this study, the purpose of partnering in construction is a kind of contract between the employer (owner) and contractor (builder) where the employer can prepare the land and the construction site of the project as well as the relevant licenses, whereas, the contractor is responsible for the design and construction of the project. Financing of the project is the responsibility of the contractor or builder, and after completion of the project, a percentage of the project (in this case the number of built housing units) which is determined by agreement is entrusted to the contractor.

Integrated Project Delivery (IPD):

Failure to achieve the expected partnering and inappropriate sharing of risk and reward between the project agents in the past systems gave birth to partnering approach based on relation-centered contract making in two previous decades and the success of this approach resulted in the emergence of Integrated Project Delivery (IPD).

Offering a new contractual method by the Architectural Institute of America (AIA) and the partnering of Association of General Contractors (AGC) in America and many reputable architectural and construction companies was seriously presented in two journals "Definition of IPD" and "IPD Guide "in 2007. IPD introduced the inconsistency of the people and project success in the conventional methods as the reasons of problem in projects; therefore it is recommended that by signing a multilateral contract, all factors related to the profit and loss of project be involved. IPD is a highly collaborative process expertise which integrates project teams in the early stages of the project. Specialists of various sectors are present from the beginning of the

project in order to ensure that the designing decisions meet the needs of all involved companies. Besides, numerous professional organizations such as AIA and AGC support IPD development [7].

IPD principles:

Integrated Project Delivery is built on collaboration, which in turn is built on trust. Effectively structured, trust-based collaboration encourages parties to focus on project outcomes rather than their individual goals. Without trust-based collaboration, IPD will falter and participants will remain in adverse and antagonistic relationships that plague the construction industry today. Thus, achieving the benefits of IPD requires that all project participants embrace the following principles of Integrated Project Delivery [2].

Mutual respect and trust, mutual benefit and reward, collaborative innovation and decision making, early involvement of key participants, early goal definition, intensified planning, open communication, appropriate technology and organization and leadership [2].

IPD principles can be used in many contractual arrangements. IPD teams have members usually higher than the project original triangle (employer, consultants and contractors). An integrated project requires comprehensive cooperation among members of the project team from initial designing stage to project completion [2]. Many partnering tools and approaches used in IPD have been adopted from an original method (LEAN). LEAN is a production-oriented approach to project management which has been provided by Lean Construction Institution (LCI) [16]. In traditional contracts each project partner has its own responsibilities. IPD seek to remove these borders by focusing on partners to achieve common objectives. But this does not mean that the IPD partners don't have separate scope but each partner has a defined scope. Roles and tasks in IPD team are divided based on assigning the task to the best individual. The project team ensures that the duties, responsibilities or scope of services have been known and clearly defined at the earliest possible time [2].

Building Information Model (BIM):

BIM is an evolving technology which has been introduced to industry, with the ability to modernize the construction industry and to move it from a two-dimension-based process toward a model-based process.

The buildings are constructed virtually and problems are resolved before construction. This new approach "The virtual designing and building" is called VCD [1]. BIM is a three-dimensional digital model which is connected to the project database and it is one of the most powerful tools to support IPD [3].

IPD contracts:

Integrated approaches include contractual communications which are completely different with traditional contractual models. Currently, AIA has prepared standard forms to help people who are interested in IPD [3]. One of the best ways to defuse tensions between the contractor and consultant in order to create a strong team and coalition is through design and construction contracts. Various contracts have been made for IPD. AIA provided two examples: a Single Purpose Entities (SPE) and traditional contracts in which IPD principles have been embedded. AGC has established Consensus DOCS contracts which are tripartite agreement and aims to encourage IPD objectives [4].

IPD contracts known as relational contracts, because consideration is given to the process of IPD, not just the end product. IPD contract which have been widely used are as follow:

• AIA C-195 (Single Purpose Entity-) this contractual model embraces the principles of IPD by creating a limited liability company (LLC) whose sole purpose is to plan, design and construct the project.
• AIA C-191 (SINGLE MULTI PARTY AGREEMENT), In this contractual model, employee, consultant, contractor and other project partners sign a single contract for the project delivery.
• CONSENSUSDOCS300 (TRI-PARTY Agreement) This model attempts to align the interests of parties through a collaborative process in the design and construction of the parties by sharing certain risks and rewards.
• INTEGRATED FORM OF AGREEMENT (IFOA) The main purpose of this contract is to facilitate the integrated practice through collaborative design, construction and commissioning of a project [7].

Mass Housing Building:

Mass Housing building definition is usually based on the number of produced housing units, Article 138 of the third program of development of the country defined mass housing as the residential housing with 3 units and more in rural areas, and 5 residential housing with 5 units and more in cities with population of 250 thousand and 10 residential units and more in other cities (Jaffari, et al. 2009). Considering the literature review and the proposed theoretical framework, the following hypothesis can be put forward to achieve the main objective of the research:

H: Factors, infrastructure and requirements for the application of IPD in delivering collaborative projects for mass housing are available.

Methodology:

The objective of the present research is applied and it is descriptive in nature. The conducted data were gathered from library, documents and field through library studies, documents analysis, observations, interviews and questionnaires. But the most significant instrument for data gathering in this study in order to achieve the results was questionnaire. To identify barriers and infrastructure of IPD, library studies and documents analysis were applied. Therefore, Ghasemi and Becerik-Gerbe, [7] method has been used to achieve the desired purpose. According to conducted research, the present barriers and challenges in implementing the IPD can be classified into the following four area:

Cultural
Financial
Legal
Technical and technological

Interviews:

The aim of interviews in this study was to initially identify barriers and challenges in the implementation of the IPD. The interview questions were developed after an extensive study of literature of this research which was classified in four groups; cultural, financial, legal and technical. The questions were designed in order to gather information about partnering mass housing projects and identify the present barriers to use IPD in these projects. Thus, eight experts and professionals with over three years experience in this area who were involved in collaborative mass housing projects were asked to participate in this interview, however, their job list and record is below. The qualified persons to do the interview were those who has had experiences in collaborative mass housing projects and they have has top careers in organizations such as the business owner, executive director and project manager.

Questionnaire:

The purpose of using questionnaire in this study was to validate and prioritize barriers and challenges ahead in the use of IPD. After initial study of barriers and challenges through interviews, the researcher changed the barriers to the consistent and accountable statements based on questionnaire form. The questionnaire was divided into three parts. The first part was about people general information. In this section, the respondents' demographic information were asked. The second section was about informational background and their familiarity rate with the concepts of IPD, BIM and multilateral contract. This section of the pictured questionnaire asked about the respondents' knowledge and experience in relation integrated project delivery. The third section was about getting comments about barriers and the participants were requested to rank between very low to very high (1 to 5) according to the Likert scale to any barrier in collaborative mass building projects. This part of the questionnaire has 19 questions which have been sorted into 4 parts. In addition to the questions raised in each section, respondents were asked to add barriers that have not mentioned here at the end of the questionnaire.

The statistical population and sample:

The statistical population of this study consisted of the builder and investor companies in mass housing of residential section in Tehran, including 750 natural members of the Association of Mass housing. Since a large population had to be study and in order to save time and cost study, the researcher used the sampling method to evaluate the population, so 52 companies and organizations were used as sample. Then , a theoretical or judgment sampling was conducted to determine the sample.

Reliability and Validity:

Since the first part of the questionnaire which is about organizational and personal information is exactly modeled from an authentic version of the questionnaire, and its validity and reliability can be trusted. But the second and third part of the questionnaire were made by the researcher and barriers in the use of IPD were questioned and the questions raised in this section are exactly about the barriers identified in the researcher proposed structure while the validity of this structure has been approved. Then, in order to assess the reliability and validity of questions, the researcher asked for judgment and evaluation of professors and advisors, and experts in the field of project management. Besides, after the questionnaire was designed, before distributing among the statistical sample, a limited number of questionnaires were distributed among the informed people on the research topic to complete and review the questionnaire. Then, by using corrective feedback from supervisors and experts, and after several revisions, editing, and revising the questionnaire, the validity of questionnaire was confirmed. One way to assess reliability is Cronbach's alpha coefficient. Cronbach's alpha coefficient for this study by using SPSS18 was obtained 0.891, indicating satisfactory reliability of the questionnaire.

Findings:

Identification of the required factors for IPD:

The defined subsidiary purpose of this study was to identify and define the concept of IPD and to know the required infrastructures for the use of the IPD. The first step is to recognize and learn more information about the topic. Due to the nature of this subject and lack of internal resources and researchers in this field and lack of access to foreign researchers, so the library studies and review of literature were conducted. Thus, the available sources about IPD were gathered and studied by researcher. Thus, the concept of IPD and factors required for its use were assessed.

Identification of barriers and challenges in the use of IPD in collaborative Mass Housing projects:

The second defined subsidiary purpose of this study was to identify the barriers and challenges to use IPD. To achieve this goal, interviews were conducted with experts of this the field. The following the results of interviews have been presented.

Interview Results:

According to the views of the interviewees and the main points of the issue, present in literature, the characteristics, barriers and constraints of IPD were identified to some extent. Since the extraction of barriers was partly based on the related manager's speculation and interpretation of the scope of his work, the results should be reviewed by other experts through distributing questionnaires.

Questionnaire results:

After the initial identification of barriers and challenges in the implementation of IPD, the barriers were turned to consistent statements and in order to monitor and review of experts, a questionnaire was distributed among them. All of the questionnaire and calculations were performed by using SPSS18.

Descriptive analysis of the questionnaire:

In this section, the obtained information about the characteristics of respondents and the rate of their familiarity with the basic concepts of research that is the result of the first and second parts were described. About 50 percent of respondents had bachelor degree, about 40 percent had master degrees and 7 percent of respondents had PhD degree. According to the results, 6.7% of respondents had less than 5 years experience, 36.7% between 5 to 10 years, 26.7% between 10 to 15 years and 30% had more than 15 years experience. 20% of respondents were chosen from employers companies, 13.3% from consulting companies and 66.7% from contracting companies.

In the second part of the questionnaire, first some explanation were given about IPD, BIM and multilateral contracts and then the respondents were asked to rate their familiarity with the mentioned concepts. The respondents were familiar with IPD just a little, the familiarity of 50% of the sample at a very low level 37% of the sample at a low level, and only 13% of samples were moderately familiar with IPD. Besides, familiarity with multilateral contracts was too little as well. Familiarity of 33.3% of the sample was too little, 50% was little, 10% was moderate and only 6.7% of them were highly aware of the multilateral contracts. The familiarity of the sample with the concept of BIM was as low as two mentioned concepts. 46.7% of the sample had too little information, 43.3% had little and 3.3% had moderate information, and only 6.6% of people are highly aware of the multilateral contracts. The first major barrier in using IPD was lack of information and little familiarity of authorities with the main concepts of this method in collaborative mass housing projects.

Quantitative analysis of the questionnaire:

After the initial identification of barriers and challenges, they were changed to consistent statements which were presented in a table in the third part of the questionnaire, and they were asked to rate their facing with these barriers in collaborative mass housing building project based on the Likert scale, from very low to very high. Table 1 lists the barriers in question:

Table 1: List of identified barriers and challenges.

Order	Description	Area
S1	Reluctance to use new contractual methods	Cultural
S2	Tend to use the contractual and conventional methods	
S3	Absence or lack of confidence of the project parties to each other	
S4	unwillingness of employers, consultants and contractors to carry out the project in a team with common interests	
S5	Having the right for final decisions on specific issues for employers	

S6	Employer's unwillingness to share consultant in the profits of the project	Financial
S7	No specific plans for encouraging and rewarding	
S8	Lack of transparency in spending done by the contractor	
S9	The need for large capital to do projects by contractor	
S10	Differences in the accounting system of parties	
S11	preliminary rejection of issued law by the parties and recourse to the courts	Legal
S12	High levels of employer authorities	
S13	contractor's unwillingness to participate in the design phase	
S14	Disengagement agreement of the parties to implement the project on time	
S15	Absence of sufficient knowledgeable individuals to solve faced problems and conflicts	
S16	Unfamiliarity with BIM	Technical
S17	No believe in activities of all related teams to the project in one place since the beginning of the design phase	
S18	lack of sufficient knowledge to design and build an industrial method among consultants	
S19	changes in the original design in the building phase	

Prioritizing the identified barriers and challenges:

After analyzing the results of the questionnaire and achieving the mean scores, each of the barriers can be prioritized. After prioritizing barriers, the next step is to present solutions for five better identified barriers. The results of barriers' prioritizing have been presented in Table 2.

Table 2: Prioritized barriers.

Priority		Description	Mean	Std. Deviation	N
1	s3	Absence or lack of confidence of the project parties to each other	4.5333	0.9371	30
2	s5	Having the right for final decisions on specific issues for employers	4.4000	0.89443	30
3	s12	High levels of employer authorities	4.2667	0.73968	30
4	s2	Tend to use the contractual and conventional methods	4.0000	0.78784	30
5	s1	Reluctance to use new contractual methods	3.7000	0.79438	30
6	s16	Unfamiliarity with BIM	3.6667	1.18419	30
7	s7	No specific plans for encouraging and rewarding	3.4333	0.62606	30
8	s11	preliminary rejection of issued law by the parties and recourse to the courts	3.4000	0.96847	30
9	s6	unwillingness of employers, consultants and contractors to carry out the project in a team with common interests	3.3667	0.92786	30
10	s19	changes in the original design in the building phase	3.3333	0.71116	30
11	s14	Disengagement of the project parties to implement the agreement articles in due time	3.3000	0.74971	30
12	s15	Absence of sufficient knowledgeable individuals to solve faced problems and conflicts	3.2000	0.80516	30
13	s8	Lack of transparency in spending done by the contractor	3.1000	0.60743	30
14	s17	No believe in activities of all related teams to the project in one place since the beginning of the design phase	3.0333	0.88992	30
15	s4	Unwillingness of employers, contractors and consultants to undertake the project as a team with common interests	2.9667	0.61495	30
16	s9	The need for large capital to do projects by the contractor	2.7000	0.79438	30
17	s18	The lack of sufficient knowledge to design and build with industrial methods among consultants	2.5000	1.07479	30
18	s10	Differences in the accounting system of parties	1.9667	1.09807	30
19	s13	changes in the original design in the building phase	1.9000	0.88474	30

According to Table 2, the top identified barriers in the application of IPD in collaborative mass housing building projects include:

• The absence or lack of trust of the project parties to each other
• Right to make final decision on specific issues for employers
• High levels of employer's authorities
• Tend to use conventional and old methods and unwillingness to use contractual new methods
• Being unfamiliar with BIM

In addition to the above barriers and challenges, the unfamiliarity of the statistical population with IPD and its principles are among the major challenges in the implementation of an integrated approach which people have been faced with it in large-scale collaborative and partnering mass housing projects.

Conclusion:

The first defined objective of this study was to define and identify the concept of IPD and to know the required infrastructures for the use of the IPD. In this way, the resources associated with IPD were collected and studied by researchers. According to studies conducted by the researcher, it can be noted that the main required factors for the implementation IPD in each project, including the project of partnering mass housing IPD are as follow;

• Early participation of the partners in the project: The simultaneous determination of the main contractor and consultant at the beginning and before start of the designing phase and the contractor and employer cooperation with the consultant in the design phase.
• sharing of risks and losses resulting from the failure of the project
• Sharing the contractor and consultant in profit of the project
• Financial transparency
• Waiver of Claims
• Partnering decision-making
• Establishing goals in partnering form
• Making trust and respect between partners

In order to implement these conditions and factors to application of IPD, some catalysts have been introduced in order to facilitate and accelerate it. The catalysts are:

• The multilateral contract
• The use of BIM
• Using LEAN principles
• The teams in the same place

The second defined objective was to identify the present barriers and challenges to the use IPD. Based on the conducted studies in the field of IPD, the present barriers in the implementation of IPD were classified in four categories and then barriers were identified. These four areas include cultural, financial, legal and technical barriers. Based on the results of the questionnaire, the barriers were prioritized as follows. It is worth noting that in addition to the present barriers, unfamiliarity with IPD and its' related concepts is also one of the major barriers.

In addition to identified barriers, partnering mass housing building projects that are collaborative have some features that are very similar to the IPD and they facilitate IPD implementation. These features can be regarded as opportunities due to their consistency with IPD and by changing their structures; they can be tuned into IPD. These features are as follows;

• Transferring the design and construction to contractor (such as design and construction contracts)
• Regarding the contractor in final result and profit of the project
• Holding meetings for partnering decision-making
• Solving dispute internally
• Making a culture of waiver of claims

Finally, according to conducted studies and researches, it can be acknowledged that the implementation of collaborative and partnering Mass Housing projects is very similar to IPD method and the factors required for the application of IPD are present in it. IPD is the advanced and scientific form of partnering in construction. Despite the barriers that which have been identified and mentioned, the training and recognition of IPD, trust between the project parties, the development of a culture of teamwork, changes in existing contracts, and training and using BIM, the concept of partnering in the construction can turn to IPD.

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