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Evaluating the Existing Barriers in Implementing Constructability

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Abstract

In fact, constructability is facilitating the construction of a project through integrating knowledge and experience to achieve the overall and common objectives of the project in all stages of it, but practically there is still a significant gap between design, construction, and achieving the desired project objectives. Studies show that separating the design and construction processes and lack of presence of the contractor in the design stage, prevent the effective use of experiences and specialty of the contractor to improve and develop design processes. This issue results in increasing project time and cost, poor relationships, and also increasing project waste and duplication. The barriers to implementing this concept can have major differences with each other in different locations all over the world, due to the unity of the executive conditions in various countries. This paper evaluates the existing practical barriers to implementation of constructability in the construction industry. A comprehensive literature review has been performed by the authors through using the Meta-Synthesis method and findings were used to form research assumptions. Three case studies of Mass Housing project (MHP) in Tehran were instigated. Outputs taken from nine interviews with different experts in this industry working in diverse areas, including owners, consultants and contractors are then ranked after theoretical saturation compared using the NVIVO Software and through pattern and descriptive analyses. The concept of constructability is focused on the early presence of contractors in the initial stages of the project. So that, through integrating knowledge and experience, problems due to lack of their presence in the early stages of the project can be reduced. Comparing the existing barriers to implementing constructability in Iran with those of the wider world, presents some effective solutions to facilitate the presence of the construction contractors in the early stages of projects.

Keywords: Constructability; Analytic Comparison; Constructability Barriers; Integration; Mass Projects; Construction Contractors.

1. Introduction

"Studies conducted during 1960 to 1970, indicate that the origin of many complex problems in the construction industry is due to lack of integration of knowledge and experience in the framework of design and construction." [1] Designers, through evaluating constructability studies, have always sought to reduce the existing gap between designers and builders. In practice, always a far distance is observed between the design and construction stages in order to achieve the desired project objectives [2]. Studies show that separating the design and construction processes and lack of presence of the contractor in the design stage, prevent effective use of experiences and expertise of the contractor to improve and develop the design. Consequently, extra time and wasted cost of the project, creating adverse relations, and

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also increase of wastes and duplications are observed [3]. The problem of wasted construction time for project owners, i.e. duplications and cost due to it, leads to passing the project redlines. The origin of these problems is performing project stages separately and lack of integration among them [4]. Having such integration provides a clearer view of the construction stage for designers. This issue is more important in infrastructural projects, as often there are more complexities in these projects in comparison with smaller structures. Even the most professional teams of designing, may neglect them. This issue can affect project success in terms of time and cost [5]. Because of the ability of constructability to influence costs and time progress to achieve the optimal conditions, considering design constructability in the early stages of the project lifecycle is necessary [6]. So, if the contractor wishes to implement the plan correctly before starting the construction phase, he/she should identify the potential problems of the initial plan. Even if there is no problem, this trend is necessary for improved performance. Constructability leads to improving and savings in all dimensions of a project, including time and cost during its process from its beginning to the operation and maintenance stages. These advantages will be provided through creating conditions to facilitate presence of executive contractors in the early phases of the project [7].

The constructability knowledge is to resolve/predict future needs such as identifying poor structure design, which is due to mistakes or non-executive decisions of the plan in the conceptual studies phase [8]. Engineers, during the construction process, often have problem with design engineers because of non-operating possibility and/or non-executive and conflict designs [9].

What identified as barriers to constructability implementation everywhere in the world, necessarily will not be considered as barriers in other parts of the world, too. Factors such as cultural, executive, legal, social, and economic conditions will be affective in the prevailing barriers. Up to now, no focused study has been done in Iran to identify the prevailing barriers to projects for implementing constructability and improving operability in the construction industry and also facilitating proper constructability implementation. This study evaluates these barriers through an exclusive focus on comparative analysis of the available constructability barriers existing in Iran and other parts of the world in order to predict, reduce and even eliminate most of these problems.

This study provides an analytical comparison of the existing barriers to constructability implementation in the Iranian mass housing construction industry to achieve a comprehensive and regular view about these barriers. It also provides the possibility of presenting effective solutions to facilitate presence of contractors in this field. Before that, there is a significant need to explore the necessity of implementing constructability in MHP.

2. Literature Review

2.1. The Necessity of Constructability in MHP

"Constructability refers to optimal use of construction experience and knowledge in planning, design, procurement, and implementation to achieve the overall objectives of the project. This technique -before project implementation and through identifying barriers -will result in reducing and/or preventing mistakes, delays, and also costs overrun." [10] Constructability principles have been used in various projects consciously or unconsciously. It has been studied and evaluated by researchers as an optimal use of construction knowledge and experience in the conceptual planning, detailed engineering and construction phases to achieve the overall objectives of the project. In fact, constructability is improving the process of constructing a project by using a combination of knowledge and practice to realize the overall objectives of the project. This study analytically compares available barriers to real implementation of constructability in mass housing industry [11]. Economic development of countries depends on implementing different kinds of infrastructure and service projects. Increasing efficiency and quality of service delivery are among their main objectives. In fact, infrastructure projects are basic facilities with common features of public investment at all levels of the government, including highways, public transportation systems, wastewater treatment system, water resources, air traffic control, airports, and urban water supply system, etc. [12]. Nowadays, developing infrastructure projects in the global economy is so common, and complexity of these projects at the financial and cross-border levels cannot be denied.

Traditional construction is in fact that individual construction, which in terms of definition and implementation, is against mass production. In the traditional construction, there is a limited access to the financial resources, and there is a lot of wastes in consumption of materials. On the other hand, construction speed is low and technology upgrade is slow. Existence of these limitations and waste of resources were in contrast with the available conditions in our society that demands high productivity and efficiency. Therefore, there is no way but updating management. Consequently, housing policymakers, who have the task of bedding, chose the policy of mass production of housing to meet the increasing needs of this field in the country, in order to maintain national interests and alignment with the global practices [13]. The need to a large number of houses and also the speed of implementation, made it to be used as Mass Housing for the first time after the Second World War. MHP in Iran, due to high housing demand in today's society, is very significant, as it is the best solution to meet such demand [14].

The first step in achieving the objectives of urban MHP is removing the existing managerial barriers and limitations.

Existence of an active and efficient manager is not only useful in the systematic planning and its realization, but also is necessary in different parts of the study, investigating barriers and problems, formulating the document of the plan, executive operations, financial planning and performance, organizing, exploitation, and maintenance. In this regard, an appropriate context is created for mass production and its development [15].

Although in the field of managing mass production, experience is important, exerting these experiences in the early stages of study and plan is more necessary; because not paying attention to constructability is identified as an important problem during the implementation phase of the mentioned projects. "Usually, this problem is due to inappropriate designs without the possibility to implement them, poor decision making when designing, and lack of executive experience of the engineering design team. Executive engineers usually have problems with designer engineers during construction process, due to lack of plan implement-ability, and/or contradictory and non-executive plans".[1] Construction stakeholders usually have problem with designers at the construction stage, due to lack of plan applicability or conflicting and non-executive plans [9]. The barriers to facilitate the constructability process have been identified up to now all over the world. This issue will be discussed in detail in the next section.

2.2. Existing Barriers for Proper Constructability Implementation in Construction Projects

Because of the direct influence of constructability implementation on project cost and time, progress to achieve the optimal conditions, considering planning constructability implementation in the early stages of the project lifecycle is necessary [6]. In 1979, the Construction Industry Research and Information Association (CIRIA) suggested conducting research about finding problems related to buildability/constructability in the United States construction industry. These studies show that the problems of constructability are due to lack of participation of planners and designers in the executive processes of construction, rather than shortcomings and negligence of employees [16]. A list of the barriers to implement constructability was published by O'Connor [17] in 1994 and also in 2008 by the Institute of Professional Engineers New Zealand Incorporated Constructability [18]. However, the most comprehensive research in the field of evaluating the barriers to facilitate constructability up to now, has been done by Jadidoleslami et.al [19, 20] by using the Meta Synthesis method.

In the mentioned research, identifying, evaluating and classifying these barriers have been done in three main groups of managerial, engineering, and environmental studies, through the Meta Synthesis method and using appropriate keywords provided in valid databases. In this study, researchers evaluated and analysed 17 articles related to this field selected through screening based on the conventional principles of meta-synthesis methods. Then, the obtained results led to 63 codes as the barriers to implement constructability in the construction industry. After that, the overlapped codes were determined and their overlap was resolved. Codes with common content were also identified and a common code was assigned to them. Finally, output of this stage was 63 dissimilar codes. In the next stage, these codes were identified and re-evaluated, and similar codes were placed in one subgroup. New codes were also assigned to each of the subgroups. The identified barriers- by using the pattern analysis based on the kind and nature of the barriers- at first were classified into six organizational, strategic, executive, technical, cultural, and legal subgroups. Then, according to the structure and the fundamental concept of these barriers, the six mentioned subgroups were classified into three environmental, engineering, and managerial groups (macro barriers).

For instance, one of the barriers was lack of mutual respect between designers and builders, which has been repeated several times in different resources in the early stage of encoding [17, 21, 22]. Finally, the researcher has considered a code and has classified environmental-cultural barriers in the group. As lack of commitment of owners for applying the principles of constructability [17] and lack of cooperation among stakeholders in implementing constructability [23] had similar concepts, they have been considered as a unit code. Similarly, other barriers were encoded and evaluated and their output was verified by the experts. These barriers were identified against implementing constructability in the construction industry. They were classified and evaluated by researchers in this study, and are shown in the Figure 1 [20].

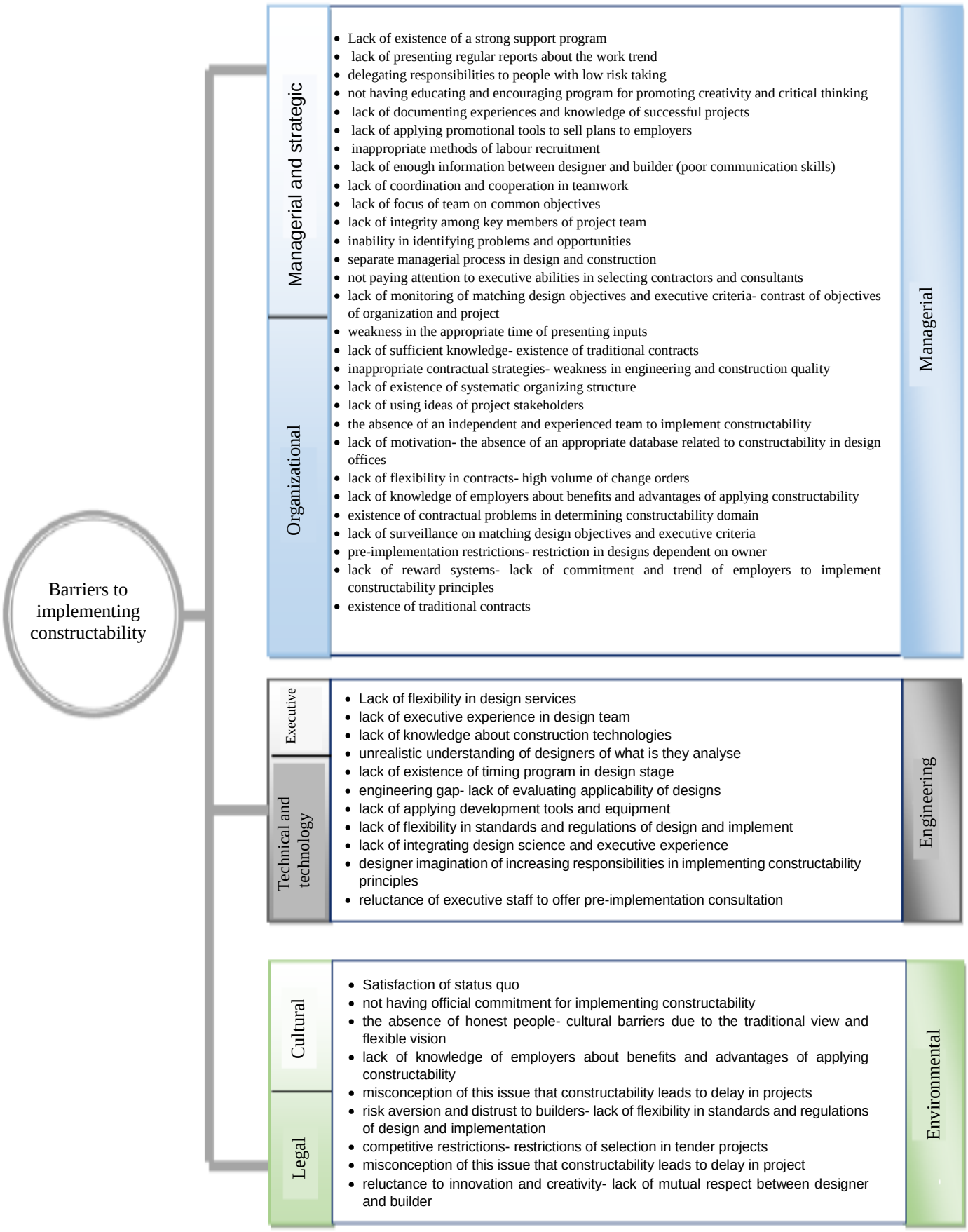

Figure 1. Conceptual framework of the barriers to constructability [20]

What is understood from the above framework, is that to-date, most of the focus of previous studies has been on the managerial barriers. Among this group of the managerial barriers, non-comprehensiveness of traditional contracts and incomplete contracting strategies should be more studied, as they are the origin of many other barriers. Yet, significant

overlapping of the imposed environmental barriers to implement constructability with the managerial barriers indicates that focus on improving management and/or changing managerial performance can create appropriate direction for studies to find solutions to resolve these barriers. In relation to the existing barriers in the engineering group, an overview of this evaluated framework, shows that most of the barriers are due to lack of knowledge and experience in the project teams, particularly the design team. This case provides a suitable background to create a regular mental image to resolve these barriers [24]. In the next section, the research methodology of this study is stated.

3. Research Methodology

In the previous research performed by the authors of this study, the barriers to implement constructability in the construction industry have been evaluated by using the Meta Synthesis method. Finally, an organized and classified structure of these barriers was presented. This method, which is a qualitative, engineering and reforming method, is focused on integrating qualitative results, research findings and available studies. The Meta Synthesis is not an integrated review of qualitative literature of the subject and an analysis of secondary and basic data of the selected studies; it is the analysis of findings of available studies [25]. Therefore, it should be noted that the aim of Meta Synthesis is increased confidence of its cause and effect on description and understanding of a phenomenon [26]. The available interpretive view in Meta Synthesis is one of its obvious features, and this interpretation is not seen in any other research reports, but at the same time, it is somehow inferred from any one of them.

In this study, the mentioned structure is the main basis of the available barriers in the world to compare it with the available barriers in Iran [20]. In this research, finding the barriers to implement constructability in Iran, has been done using the three case studies method. The aim of this study is classifying available barriers to apply the concept of constructability in the Iranian MHP. Without literature reviews performed previously, implementation of the current case study was impossible. Literature review is always a basis for future field studies [27]. In order to increase generalizability of case study method, using several cases for study is highly recommended [28]. Several respondents cause creating a reliable basis for generalizing the theory [29]. In this study, nine interviews have been done with different experts in this industry working in diverse areas, including owners, consultants and contractors. These people in turn have had many experiences in similar and divers projects. One of the features of the statistical study considered in this study is:

Table 1. Interviewees' specifications participated in the study

Statistical features of interviewees	Studied projects in Tehran	Title of interviewees
• At least 10 years of work experience • Undergraduate and higher education in the field of construction	Pardis MHP	Owner1/consultant 1/ contractor 1
• Having work experience in similar MHP • Direct cooperation in the studied project	Tehransar MHP	Owner2/consultant 2/ contractor 2
• Having Grade 1 for a consultant company and a selected contractor related to the statistical society	Parand MHP	Owner3/consultant 3/ contractor 3

Nine interviews with three contractors, three consultants, and three owners of MHP in Pardis, Tehransar, and Parand MHP within the capital city of Tehran metropolitan district were conducted. After theoretical saturation for analytic comparison of the available barriers to implement constructability in the Iranian construction industry and all over the world, descriptive analysis and pattern coding were performed using the NVivo Software. Then, interpretive analysis of comparisons and classifications of interview outputs were performed with what was available from previous literature studies. This software is mainly used for analysing texts in qualitative studies. This software with a diverse set of research methods includes organizational and network analysis, functional studies or based on evidence ones, speech analysis, basic theories, interview analysis, ethnography, review of literature, phenomenology, combined research methods, and consistent framework methodology.

With correct understanding of the barriers identified in the previous studies, obtained by meta-synthesis method, and creating an appropriate mental context, in the next section of this study, the available barriers to implement constructability in Iran have been collected through interviews. Given that a main part of the available problems in the construction industry in Iran is due to lack of experience in the design phase and lack of early presence of the executive agents in this stage, and also in order to achieve the objectives of research, in the next section, the barriers to implement constructability in Iran have been identified through interviews. By analysing these barriers and comparing them with the classified barriers obtained through structured framework meta-synthesis method, they have been shown for their applied and effective evaluation. As illustrated, Figure 2 shows the process of the research Methodology.

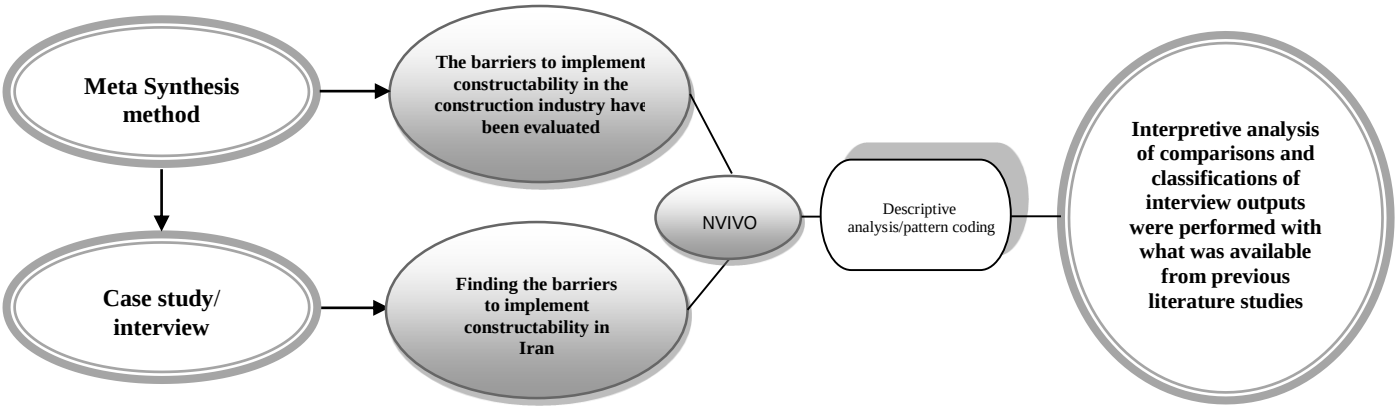

Figure 2. Process of the research Methodology

4. Data analysis

4.1. Barriers to Facilitate Implementing Constructability in Iran

During interviews with consultants, owners and contractors in the field of the mass housing industry in Tehran, the barriers leading to lack of implementation of constructability identified the duplications and unanticipated obvious changes in the project.

One of the major barriers was inappropriate selection of contractors which led to wasting a lot of financial and time resources. In many of the proposed cases, the contractor has not been selected from the certified contractors, and their qualitative and financial criteria have been investigated precisely. In one of the interviews, the representative of owner 2 stated:

"In some of the executive phases, contractors are assigned who not only don't have the competence of doing the contractive affairs, but also they don't have the grade of Mass Housing. They have been selected just through private relations."

In another interview, owner 1 declares that:

"... Because of the process of selecting contractor, i.e. holding tender, key members of the project including the contractor, didn't have the permission for early participation in the design stage. Also, in the statute of contractor, cooperation is not stated in the design stage. It is clear that the contractor won't cooperate with the designer in this stage, without receiving a predefined money. Although owners won't pay more money because of lack of knowledge about advantages of this process."

Since in the present tender system, the contractor is selected based on the least suggested price, sometimes contractors offer a price lower than the reasonable one, intentionally or unintentionally, and win the tender. After the beginning of the executive operations, the contractor is forced to use claims or the simplest way, which lowers the quality, to compensate this shortcoming. In both cases, the projects are faced with increased runtime, possible claims among different agents, reducing functionality of the project and increased fixed prices.

During interviews, even representatives of owner's point to insufficiency of feasibility studies of the project and also not having principled and realistic planning in MHP. The representative of owner 3 states that:

"According to the political and sometimes social necessities, constructing these projects were started without sufficient studies and considering the ability of providing infrastructures and principles of urbanism and even sufficient knowledge of the site. In the middle of executing, because of unanticipated inflation and not having realistic planning, in practice, the projects are stopped."

Consultant 3 pointed to a case in this regard that was also confirmed by consultant 1:

"If at least six months are spent for basic and adequate studies to plan these projects, now in exploitation we wouldn't be back for three years from the predicted time."

Another barrier identified and evaluated in interviews for facilitating projects' applicability, was existence of managerial interferences and lack of integration and weakness in coordination. Two subjects of consultants and also

contractors participated in interviews, considered this problem due to unclear decision making vertices because of the role of government as the project owner. The case pointed to by consultant 2, and also consultant 1 noted:

"Because of the public nature of plan and existence of motiveless and sometimes improper forces in management, responsibilities and authorities of people are not clear; and everybody knows himself/herself entitled to interfere in the project."

According to what is done through interviews with consultants and owners and contractors in the field of Mass Housing industry in Tehran, some barriers were identified by interviewees, which are shown in the Figure 2 as follows.

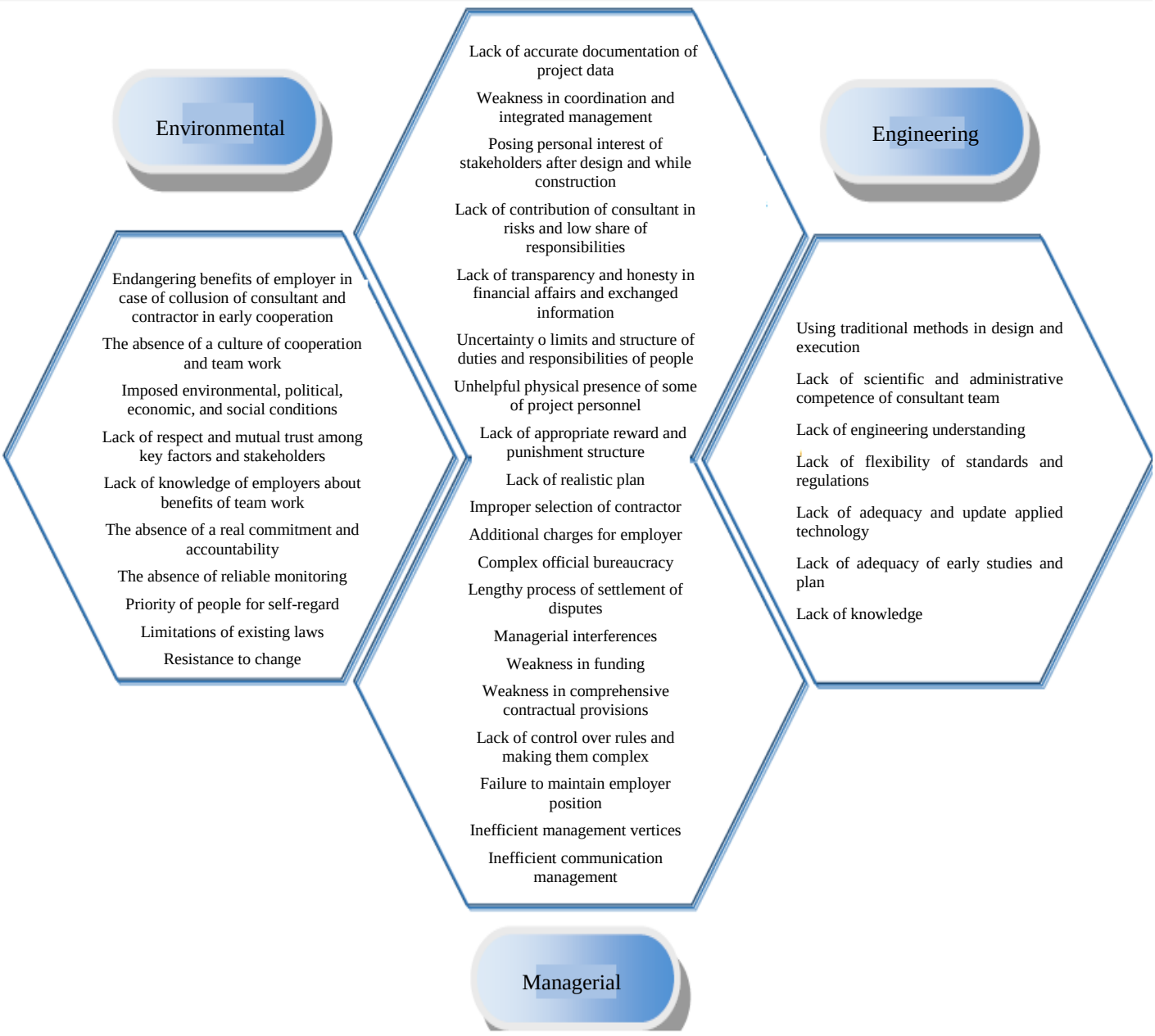

Figure 3. The barriers to proper implementation of constructability in Iran

Factors such as poor decision making, lack of knowledge about details of designing components of a project, poor coordination among agents, inaccurate estimation of time and cost, uncertainty of responsibilities and duties of agents, lack of applying updated technology, lack of realistic planning and insufficiency of feasibility studies, lack of equal sharing of consultant and contractor in project's profit and loss, legal and contractual trend of selecting contractors, lack of awareness of owners about benefits of teamwork and absence of culture in teamwork and weakness in collaborative thinking and decision making system, are among cases proposed and identified during research as barriers to impellent constructability in mass housing projects in Tehran. In the following, we try to describe and analyse and compare what is obtained from meta-synthesis method and interviews about the barriers to implement constructability.

4.2. Analytical Comparison of the Barriers to Implement Constructability in Iran and the Wider World

Using traditional methods in design and implementation of the projects, inappropriate criteria, time and method of selecting contractors in MHP, and limitations of existing laws, have caused substantial waste of time and in financial resources. Comments given by legal persons even with impersonal motivation and along achieving the charitable goals, have also influenced the typical trend of proper selection of the contractor. More importantly, there are many reasons to consider such a procedure as a reasonable one. Respecting principles and regulations of contracting formalities and showing tracking consistent with regular trend, to guarantee exclusive and continue access of the contractors to lucrative contractual contracts are very important. Timely information about the quality of real and administrative conditions of the project, healthy competitive behaviour, and possible suggestions of other contractors and relations of employees in public centres with other contractors, are considered as strengths of contracts.

Leaving formalities or legal and formal rent delegated to managers and systems, can result in an easy takeover of the project, violation of rules and competitive pressure with other contractors by influential contractors [30]. These cases result in not considering appropriate criteria to select a competent contractor.

Under the present governing laws in Iran, according to the Public Audit Act, purchase of goods and services for government is possible through tenders only. This is while, according to tender conditions, the plan is already prepared and in the study and design stages, there is no cooperation between the contractor and designer. In selecting the contractor, because of some of political and social conditions governing the society, their financial and qualitative criteria have not been defined and investigated carefully. Existence of this tender law is a barrier to early presence of the contractor in the design phase. The problem of legal restrictions and posing conditions such as what is governing on tender formalities, is not unique to Iran [21]. Previous studies have pointed to it in the conceptual framework of the barriers to constructability as legal-environmental barriers.

Due to the increased complexities of the projects, early presence of key factors- their presence is necessary for project success- provides more accessibility to the set of expertise and better understanding of applicability of design decisions [31]. Early presence of agents, allows manufacturers to improve quality and financial performance of the project in the implementation stage, by early applying their executive experiences and comments in the design process. Therefore, resolving this barrier-i.e. inappropriate criteria, time, and method of selecting the contractor despite all available challenges- is necessary to facilitate constructability and cannot be ignored.

Among other barriers that are associated with many challenges, is lack of the culture of teamwork, existence of destructive claims due to false working pride, spirit of individualism and lack of engineering maturity among project agents. Culture is a complex set of knowledge, beliefs, art, rules, attics, and habits that people learn from their community. In fact, culture is the product of training and experience. Existence of a binding type of teamwork through mentioning it in the contract, was agreed by the majority of participants in the interviews. In fact, it was shown that how far we are from this culture, that in order to promote this idea, we need to use coercion.

Of course, unawareness of owners about benefits of teamwork and lack of support of owner for paying team participation costs are additional items. Active presence of the owner and contractor in the design stage, causes transfer of a part of design risks to these two factors. This risk distribution is a motivation for more interaction among stakeholders to achieve the superior plan [32]. The need to marketing and basic training is felt to enhance awareness of owners in this regard.

Unawareness of Owners about benefits of applying constructability and lack of commitment and desire of them to implement it [17]. Resistance to financial investment and attempt and early presence of builders in the initial stages of the project [17, 20, 21] lack of coordination and cooperation in team affairs [17, 20-22, 33-36] are also other barriers found in the previous studies, confirm that the absence of a culture of teamwork is considered as an important barrier to implement constructability.

Another sample of barriers to facilitate constructability identified through interviews, includes insufficiency of feasibility studies of the project and also lack of principled and realistic planning in MHP. According to what is obtained through interviews, nowadays in Iran, feasibility studies in most of the projects are just a formal job and most of the consulting engineers don't have expert and experienced forces for economic justification of plans. Most of the plans are provided based on type information and by considering studies of previous plans and are implemented without having economic justification. Meanwhile, a lot of sources are wasted. It is obvious that one cannot rely just on personal observations as a means for evaluating results and project status, to succeed of a project, rather it is inevitable to base planning as a necessity. This barrier has been discussed by other researchers in the previous studies, too; it is not observed solely in Iran. Previously, it was noted under the title of lack of a strong support plan [20, 21, 33, 37] and weakness in appropriate time of presenting inputs and inability to identify problems and opportunities [17].

In the barriers found in the previous studies, issues such as resistance to change and satisfaction with the status quo [17, 33] and the cultural barriers due to the traditional view and flexible attitude [17, 21] have been mentioned.

Managerial interferences and lack of integration and weakness in coordination are among barriers that were emphasized on them during the interviews. Informants considered this problem due to uncertainty of decision making vertices, existence of unmotivated and improper forces in the management team and uncertainty of responsibilities and authorities of people.

Another case of barriers to implement constructability, is lack of communication exchange tool and ambiguity of information. In the identified barriers in the research literature, they were referred to as lack of adequate communication between designer and builder (poor communicative skills) [17, 21, 33]. In fact, establishing an effective relationship caused reduction of stress in the work environment and improvement of process communication, and creating healthy and effective communications eliminates or at least reduces available tensions in the course of performing these tasks. In communication between people, including communication between manager and employees, the more and broader the public area, the less conflicts and misunderstandings will exist. The absence of such a communication was obvious in the studied projects and was mentioned several times. Also, it was referred to the unavailability of credible information that is one of the factors of this absence of commination. During implementing the project, various financial, executive, legal, and technical problems and events and initiatives and creativities, and dilemmas occur. Solutions and measures are considered for each of them. If these cases are documented, an effective help is provided to avoid duplications and empiricism in implementing projects and plans.

Another barrier, which is more basic than other ones, is lack of mutual trust and respect between project factors. This item was also among the barriers proposed in the previous studies as lack of mutual respect between designer and builder [17, 22, 33] and absence of honest people [15, 19]. Owners are against the presence of contractors in the early stages of the project for fear of collusion between the consultant and contractor and creating corruption. On the other hand, they fear that their interests be at risk. While the construction industry needs a lot of trust between participants, because of lack of existence of high certainty; this trust can be formed based on the reputation already exists and/or independent of the project domain in a natural way. This can be the result of a continuous team cooperation, the spirit of trust, open and extensive communication, and comprehensive participation. It makes the construction process successful for all stakeholders of the project. Participants need to know that their motivations are understood by their colleagues.

Factors such as poor decision making, lack of knowledge about details of designing components of a project, poor coordination among agents, inaccurate estimation of time and cost, uncertainty of responsibilities and duties of agents, lack of applying updated technology, lack of realistic planning, and insufficiency of feasibility studies, unequal sharing of the project's profit and loss between the consultant and contractor, legal and contractual trend of selecting the contractor, lack of awareness of owners about benefits of teamwork, and absence of a culture about teamwork, and weakness in participatory thinking and decision making system, are among issues identified during research as barriers to implement constructability in MHP in Tehran. Summary of this analytical comparison is presented in Table 2.

Table 2. Barriers to Analyses the Barriers to the implementation of constructability in Iran

No.	Barriers to facilitate the constructability of the world	barriers to implement constructability in Iran	Source Interview
1	limitations of existing laws [17, 21, 22, 33]	Incorrect time, methods and criteria for the selection of contractors	Owner 1,2 Contractor 3
		Limitations of existing laws	Owner 1,2,3 Contractor 1 Consultant 1
2	Lack of a culture of teamwork [17]	Lack of teamwork	Owner 1,2,3 Contractor 1,3 Consultant 1,2,3
		Despite damaging claims	Owner 1,3 Contractor 1,2,3 Consultant 3
		Working false pride	Owner 2 Contractor 3 Consultant 1
		Spirit of individualism	Owner 1,3 Contractor 3
		Lack of maturity and growth factors engineering project	Contractor 3 Consultant 1,3

3	Resistance to the early builders in the initial stages of the project and financial investment [17, 20-22, 33-36]	Owners ignorance of the benefits of teamwork	Owner 3 Contractor 1,2,3 Consultant 1,2,3
	Lack of coordination and cooperation in a team [17]	Lack of support from the owner to pay for team participation	Contractor 1,2,3 Consultant 1,3
4	The lack of a strong support program [20, 21, 32, 37]	Inadequacy of feasibility studies	Owner 1,3 Contractor 1,3 Consultant 1
	Weakness at the right time to provide input [17]		
	Inability to identify problems and opportunities [17]	Lack of planning and realistic	Owner 2 Contractor 1,3 Consultant 1
5	Resistance to change and the consent of the status quo [17, 33]	Traditional management	Consultant 1,2,3 Contractor 3
	Cultural barriers caused by traditional views and uncompromising attitude [17, 21]	Lack of integrity and lack of coordination	Owner 1,2,3 Contractor 3 Consultant 1
		Interference management	Owner 3 Contractor 1,2,3 Consultant 1,3
6	Lack of adequate communication between the designer and the builder (poor communication skills [17, 21, 33])	Lack of communication exchange tools	Owner 2 Contractor 1,2,3 Consultant 1
		Not clearly defined information.	Contractor 1,2,3 Consultant 1,3
7	Lack of honest people [17, 21] Lack of mutual respect between the designer and the builder [17, 21, 32, 33]	Lack of trust and mutual respect between the Human Resource's project	Owner 1,3 Contractor 1,2,3 Consultant 1,2,3

What is observed in Table 1 indicates that- like barriers obtained by using meta-synthesis method to implement constructability in the world- a large portion of the available barriers in Iran is also related to the managerial barriers. This issue reveals the necessity to pay more attention to identifying and resolving the managerial barriers. Of course, not only in terms of inclusion a large volume of managerial barriers these two comparison are similar, but also in terms of content of barriers, there are a lot of commonalities. Among common barriers, we can refer to lack of funding, weakness in comprehensive contractual provisions, inefficient management vertices, incorrect selection of contractor, and managerial interferences. This issue confirms the necessity of reviewing management executive principles to resolve these barriers.

Many of the environmental barriers identified, were due to poor culture and engineering immaturity. This case is different in each country because of their special conditions. It cannot be denied that in some cases, it requires more preparation and training and attention. According to the position and culture of each country, the type of these barriers and how to identify them, and resolving them are different.

What is significant about the engineering barriers, is their many common aspects with the identified barriers in other points of the world. Engineering barriers due to incomplete studies and lack of knowledge and also lack of team cooperation, are a relative comprehensive issue in all of the construction projects. The need to binding to use updated technologies and teamwork is obvious for resolving the constructability barriers in these projects.

5. Conclusion

Ignoring the effects of a poor design or bad decision, leads to incompatibility in performance of the construction projects such as increasing construction cost and time, and reducing its total quality. While achieving success in projects is impossible without simultaneous revision and reform of the design and construction process and parallel application of knowledge and experience, examining available problems to facilitate the presence of contractors in the early stages of the study and plan, in order to improve constructability, is the foundation in implementing this concept in construction. In this study, by using the interpretive analysis, the constructability barriers extracted from available literature, were compared with the ones available in Iran collected through interviews. Consistencies and inconsistencies of these barriers were evaluated.

A lot of barriers including lack of principled and realistic planning, traditional management, and also management interferences, in addition to lack of integration and weakness in coordination in analytic comparisons, were identified.

They emphasize the managerial performance and also improvement of experimental fields in the design team. Lack of awareness and the traditional views of Owners towards the benefits of constructability are also among the prominent barriers considered by researchers, and was referred to in interviews. Other cases such as traditional contracts, engineering gap, lack of supervision, and lack of incentive plans are among the barriers identified in Iran and all over the world, which have not been considered so much. It seems that they need more discussion and attention to implement this concept. Although there are many similarities between the available barriers to implement constructability, there are many differences between these two in terms of implementation condition and challenges and also how to deal with them. These different barriers have caused this condition, that what is considered as a barrier in Iran, not to be proposed as a barrier in other parts of the world, and vice versa.

Given the undeniable benefits of constructability, identifying these barriers provides a clearer view of the construction stage. Also, through identifying these barriers, the attempt to relieve its effects can be considered. It is suggested that though considering the conditions of the construction industry and based on the identified barriers, we try to find solutions to relieve these problems in the field of implementing constructability, particularly finding a functional framework to implement this concept in the urban construction projects in Iran.

6. Conflicts of Interest

The authors declare no conflict of interest.

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