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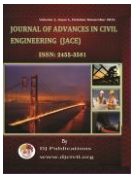

RESEARCH ARTICLE

Complications of Construction in Metro based on Planning and Management

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ABSTRACT

In the present days, majority of the construction projects can be considered as complex and compose of vague efforts. The construction project of each kind has its own properties and issues. At the same time different approaches in specific management and settlement are required. About the cities and their rapid development, construction of underground at urban regions such as construction in metro have been often used for extending daily human life into spaces of underground. Hence, the complex element recognition of a construction in metro can play a remarkable role in its management and planning. To investigate these complexities in construction of subways is the main aim of this study. These challenges may develop high predictability possibility. As projects of metro are also projects of urban underground, both internal and external complexities are studied and their implications on project management are discussed. It is concluded that differences are exceptional in the management and planning of this construction are combined with the internal and external issues and are simultaneously carried out.

Keywords: Project management, Construction project, Underground spaces, Underground transportation, Integration management.

1. INTRODUCTION

Along with changing human life styles and technologies variety of construction projects are growing around the world at a rapid phase. However, for project planning and management, the new project complexities provide various challenges. [1] says that all construction projects can be categorized as complex projects. This is caused by the direct relation between complexity and involving a variety of interrelated parts which should be managed regarding differentiation and interdependency conditions. New technologies and methods are used in different types of construction. The construction project has its own characteristics and complexities which lead to related specific ambiguousness. This address is being successful in a type of project requires managerial solutions. Therefore, the recognition of the effective and challenging elements of each project in advance can play significant role in successful project planning and management. "There is no doubt that construction projects are becoming increasingly complex undertakings. This may be attributable to client's demands and other technological developments [2]. Regarding the rapid development of cities, underground constructions at urban regions such as metro construction have been largely used for extending the human daily life into underground spaces. Metro rail systems are known as convenient underground transportation solutions amongst citizens. However, those require large investments and take considerable time to be designed and constructed for realising all expected social and regional or even national benefits. Such underground constructions are one of the most vulnerable engineering projects [3].

This vulnerability should be identified and considered as it can be a significant threat for public trust. As public citizens are the ultimate consumers of all the funded projects either publicly or privately, every construction project can change the level of trust among the

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society members [4]. Furthermore, a metro system is usually designed to be utilized for crowded area of cities. The process of this construction obviously interrupts civilian daily life. These illustrate the importance of adequate management and planning over whole process of metro project to be delivered on time and on budget with high quality and efficiency. Therefore, the aim of this paper is to explore specific complexities in the construction of an underground metro rail system. Those can be sources of issues for the management and planning of such projects. In this study, the challenges are divided into internal and external complexities as well as the influences of both of them are investigated. The paper and its results are based on the qualitative and quantitative data obtained from the certain real world projects and from the experts of underground construction.

2. INTERNAL COMPLEX

In this study internal complexity can be seen as issues caused in design by the participants and the metro rail project construction process.

2.1. Construction phase changes

A typical construction project design and engineering phase produce substantial details amount and amount of specifications. For details in presenting as precisely as possible, the designers try to consider all relationships between components and conditions in related fields. However, literally coordinating between thousands and hundreds of pages which contains various details of a specification of project is impossible [5].This leads to some mistakes of expecting which will be found in the phase of construction and must be corrected. Details of countless corrections regularly are the requirement of the process. After just the single change, the ambiguities, spaces and each project conflicts are expected to be discovered with conversion process of some kind [5]. In a project of metro rail system, many tunnels and stations must be designed in detail. Moreover, a huge project for designing requires so much larger forces for humans to prepare maps and details whereas conflicts for finding may not be possible. This complexity can soar when a project of different parts are designed by companies of various attitudes. Due to the several expertise required in design of metro, it is required that different companies take part in the phase of design of this project in wide skill. Furthermore, a system of metro rail consumes highly oriented technology construction delivery with its devices for electrical and mechanical processes and equipment being important for the system performance itself. In every moment technology is developed and devices of new standards are updated by inventors, equipments are produced and proposed and companies provide them to users. Mostly newer products have more productivity and performance in task with less consumption of energy and higher quality. This may promote clients, even experts. Some designed equipment and devices can be changed into newer ones and this may require some particular preconditions to be considered and constructed. These replacements in the phase of construction, even in early steps, can be the other changes caused.

On the other hand, some of the designed methods for performance might be implausible. Some impractical designs which are not matched with agreement are to be completed as impossible ones because the project usually provides more challenges [5]. Such issues can be the reason for some changes in the fundamentals which occur during phase of construction as methods for suitable and feasible ones must be detected. All relevant details should be matched and all of them before must be granted. This matter high possibility in the construction of metro and this is because of large and diverse under area of construction in these projects. Any conversion in the project of metro encountering the work method, even in early construction steps phase, can do all the efforts of managerial concern. This may also lead the management of projects into dreamy intricate conditions according to the tension rising between participants.

A construction project can be taken as an example of vulnerable attempt which can be affected by various components. It is very indurate or almost impossible to predict all the events of effectiveness which may have happened unexpectedly in advance. The often discovered unexpected events and surprises, such as the subsurface rock existence obstacles in underground or soil conditions of unusual, unforeseen field conditions, or the unavailability or anticipated delivery delay of materials and equipment [6]. This leads to changes for related either in scopes of work,

schedules of work or details of works. These items and their strength are not providing challenges in considerable amount for a small project. However, in a large project such as project of metro each of them can create an acute complex scenario because of a high level of interdependency in the project. This is also caused by conditions of both uncertainty of underground and restrictions of urban areas. In the projects of underground, where unexpected events possibility is more than other projects, problems for manageability are the issue [7].

Above each mentioned changes in works of construction there is a need in decision making, design of modifying as well as destroying, rebuilding and reworking at the site. These changes may lead to contractors and experts bewilder of the project as the process will be time consuming. This wasting time decreases the participants profit which leads to an effective management of impacts. Projects that have change, even small amounts, are much more likely to have cost in worse and performance of schedule than reserved [8]. In project of metro, about the fact that all sub-projects are one unique project parts, any change in just any sub-project of one part can easily affect almost all other sub-projects, directly or indirectly, and this can be the start statistics of a change chain. A company's great number provides their plans and dive into construction such that their profits follow the plan and gain. Eliminating or changing a detail in just one site, which is a very general event, can be the alteration chain start point and make planning and management of projects of metro more intricate.

2.2. Practical knowledge

In all industries the role of practical knowledge is indisputable. Less omission and better result is caused by repeating previous task. The experience impact possessed by personnel in project key toward outcomes for project has been widely known [9]. In the industry of construction, as various projects have different characteristics and practical knowledge of taking part in a kind of project of construction they can play a useful role in case of participating in such projects in future. Experience of gaining by engineers and managers from different types of project and its novel technology may not be helpful in another project type with various conditions and circumstances [7].This is caused by involving in practically creating a realistic view of a project and being familiar with its particular challenges. The experts have predicted and expected the events for barriers and unexpected cases and took part in such projects before. The clear example is a company which builds buildings for residential and apartments in a city. After completing some first projects, this company can be more successful. This is because of the experience of increasing the level in predicting the events of this category of project advance.

The project managers experience level is one of the useful properties in the construction of success projects [10]. Pre recognizing the conflicts expected and locations of omissions to minimize them in design phase take part in the remarkable advantage in the same schemes designing. This helps designers to prevent repeating the mistakes for previous projects. An additional thing is matching projects with requirements and conditions in social. In every community there is specific culture, social behaviour and requirements. For public projects these must be considered on account of serving services efficiently. Systems of public transportation such as buses and metro lines in the societies majority are regularly designed in the urbanites movements to facilitate it. The improving public transport strategies productivity regularly offers more attraction for customers and the operating modes [11].

Moreover, the conditions for local environment and behaviours are substantial for projects of underground location. Suitable reactions against unforeseen events must be immediately decided with respect to experience of practical knowledge over local environment. In addition, bureaucracies in countries of differences are not the same which can affect directly and indirectly on the progression of project. The project of metro is regularly designed to be a public transportation system part and this justifies spending lots of money in this project to be constructed. Designing a subway in an attractive and efficient way requires to be matched with the priorities and requests for civilians. Being familiar with the local underground situations can be useful in the process of construction of restrictions project to encounter both the constructions for underground and urban region.

Therefore, the attractions and the local

managers' experts in need and companies whom had taken part in the project for metro may be beneficial in the past. In this part, the challenge is lack of these practiced managers kinds and participants as limited metro rail line numbers are regularly ordered and built in every country. In every country limited number of required subway may cause experienced experts from locals. Hence, in this project almost all of the involved managers and companies may be facing the first experience of metro project participating. This leads to less knowledge over the particular challenges of this project type which may provide complex situations in both phases for design and construction as well as the project management.

2.3. Financial problem

In every construction project finance plays a vital role. Hence project financial part can be a problem in management of construction. Project financial valuation and project financial management are the two related parts divided in this section. At the construction phase of the project, financial management of the project financial valuation will be a basis. Attaining its management success requires the valuation to be realistic passably. This estimated accuracy level will be raised by increasing the cost information quality [11]. For bigger projects, this valuation will be tougher. Those contain equipments of enormous variety or tasks, as well as having construction longer duration. About the attributes for diversity in various projects, each project financial estimation needs to be estimated by those who are familiar with the project references in details.

A subway line constructing not only contains technologies, equipment, expertise and fields of wide variety, but also regularly takes a decade from design to closing. This increases the final expenses and unpredictability level about the prices far away future fluctuations. Moreover, the high chance of encountering unexpected events in a project for construction such as project for metro can provide more intricate procedures for the project financial estimation.

2.4. Management for integration

Management for Integration is a crucial requirement for building and assembling infrastructure projects of construction [12]. As fragmenting large infrastructure projects is unavoidable in those projects of construction integration is one of the vital issues. Information for exchanging between subsystems of interdependent as well as knowledge is one of the requirements in integration. This also has decision-making of joint efforts [13].However the integration level depends on multiplicity and included tasks diversity, methods of work, styles in management, and expertise.

Project of metro is one kind of project which is designed mostly to be started from one end to another end of a city by passing a city which is crowded in long line to be more efficient and attractive as transportation system part. This long project of dividing and fragmenting into many sites by location is a construction phase needful behaviour. This is caused by increasing simultaneous process of construction in whole project line to attain less duration for project. Moreover, diverse fields are required for projecting it into expertise of five main stations for building and centre for control, tunnelling, installing of rail, signalling and tasks of electrical as well as mechanicals. Massive resources are required and must be allocated for well and wide thereby producing fast performance.

By a single company, all these resources regularly cannot be granted. Hence, contractors of many suppliers in various expertize and other contributors from diverse fields require being involved in the implementation of project. However, these companies have regularly their schedules at own particular methods of work and policies and they often separate sites work. These sites must be attached to each other to supply a subway line of unique form. This key feature of integration is of importance between all the participants particularly in constructions of metro rail. Table A1 illustrates the main participants and subcontractors of approximate number in three projects of dissimilar metro.

As can be seen by a company's large number and their representatives they must be duly subway projects integrated for having an eligibility metro method. This means that any participant for any matter may affect the process of the whole project.

Hence correct integration among such involved companies in large number is one of the difficult areas of managing and such giant construction planning like projects of metro. Over this harmonization can provide tensions between participants in which considering poor management or paying less attention may result in a project being unprofitable. This can lead to success inability in such expensive project for metro and, because of this problem for recognizing late construction period stages, the project's budget majority will be wasted.

Inquiring into all the changes and effects or other sites problem, schedules of participants and harmonizing between all of them is an attempt in continuous intrication in the whole duration of project from completion of design and contains scrutinizing those effects between fields. So, poor management can cause rework of many steps, wasting money, planning lag and harmonised project loosing chance.

3. COMPLEXITY FOR EXTERNALS

In this paper external intricate of construction project in a metro includes the difficult which is especially caused by the conditions and metro project situations. Project location and its boundaries of site instantiate the big difference between metro rail system and other constructions works. Subways, as a transportation system part, may generally be crowded in urban regions designed to be a transportation system for efficient and attractive things. Hence, city populous region covers the situation of tumble during the phase for construction of project in metro. This highlights the project external conditions according to the citizens and vice versa. Simultaneously the apartments and roads are main reason of construction for underground is underway. This proves the danger high potential over any unexpected event case human lives. Moreover, any stop or work delay during phase for construction of project in metro caused by financial issues, investigation of changes or new decision making can increase the occurring possibility relevant in the neighbouring roads vulnerability and regions of residential plots. Comparison making between constructing an airport even at the city centre with denoted boundaries of site and construction of underground subway under the apartments must be passed

In addition, the conditions on external things are the regularly inconsiderable issues of most suburb projects. However, these conditions reason creates more issues in urban rail project of underground about the particular location's project conditions. These conditions are caused by restrictions in urban and citizenship as well as life styles in civilians. During the progression, sector of construction regularly affords noise and pollutions of dust which requires to be adjusted with life style in the local project. On the other hand restrictions of time and traffic jam, influence the movements in site and time of explosion and destruction. The controls and external conditions threats related to constructing subway of underground in urban area get stuck in the above domains challenging it to be an exceptional intricate project provider.

4. CONCLUSION

Managing a successful project of construction requires familiarity with its challenges and specifications for specific purposes. Construction of underground metro like projects in other domains has its personal situations and complexities. These complexities in this paper have been divided into groups of two main areas. Thus considering that the features in the internal unique of projects for metro rail, such as a participants number, integration required, interrelation between transitions and experience can be of particular complexities source for the management of these efforts planning. Although, a clear difference of projects for metro compared with other projects for construction comes from the complexities for external things are caused by the specific location nature and characteristics where projects of metro construction take place. This feature of exception can manifold and compound the planning and management complexities in these project kind in comparison with other project constructions.

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APPENDIX A

Table A1. Approximate number of Participants in three various metro projects

Project	Path Length	Stations	Participants of Main	Subcontractors
Metro for Shiraz	22.6	19	69	>500
Extension of Espoo Metro (First phase)	15	8	41	>500
Toronto-York Spadina Subway extension	8.5	6	41	>300