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ANALYZING PROJECT SCOPE DEFINITION COMPLETENESS BY USING PDRI FOR AN INFRASTRUCTURE PROJECT

Shweta Kasnale*[1], V. U. Khanapure[2] & M.A.Khandare[3],
[*1]PG student at RMD Sinhgad School of Engineering, Warje, Pune
[2]Assistant Professor, Sinhgad Institute of Technology and Science, Vadgaon, Pune
[3]Assistant Professor, RMD Sinhgad School of Engineering, Warje, Pune

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ABSTRACT

It has been found that poor scope definition is one of the principal causes of project failure in the construction industry. But the owner and contractor companies however share the delusion that it is not economically viable to spend the time or money, required to sufficiently define the scope of work early in a project's life cycle. Sometimes, project participants are unaware about the necessities of a sufficiently defined scope of work. A tool called Project Definition Rating Index (PDRI) was created to address these problems. The PDRI is an easy-to-use, checklist of 68 scope definition elements, letting the users to measure and manage the level of scope definition as project planning progresses

I. INTRODUCTION

Infrastructure projects in India are notorious for their delays and cost overruns. The recently completed Bandra-Worli sea link shows the picture of project delivery system in India. Planned as a Rs. 300 Cr. project, to be completed by 2004, actually cost Rs. 1,600 Cr., with a delay of five years. Undeniably, very few projects get delivered within schedule and budget.

Projects are started without adequate ground preparation regarding how much land will be required and where it will come from or if the necessary finance is available. Either the tendering process is incomplete, or the terms and conditions are unclear, or there are lengthy proceedings and political interferences, or simply a lack of co-ordination in the management, leaving projects hanging till things are sorted out.

Front-end planning can be defined as the project phase comprising all the activities between project initiation to detailed design. The Construction Industry Institute (CII) has financed numerous research projects concentrated on Pre-project planning. Research results have shown that greater preproject planning efforts lead to improved performance on construction projects in the areas of cost, schedule, and operational characteristics (Chung-Suk Cho and G. Edward Gibson,2001). These studies led to the development of the Project Definition Rating Index (PDRI), a scope definition tool that is widely used by planners in the Industrial, Building and Infrastructure sectors.

One of the major activities of the preproject planning process is the formation of the project scope definitionpackage. During preproject planning phase, project scope is defined and it is made ready for execution. At this very stage risks associated with the project can be identified and the project execution approach is defined.

This Research is being done with an objective of increasing the probability of success of infrastructure project, by using PDRI tool. It is a user-friendly checklist that identifies and describes each critical element that should form a part of Scope Definition Package. It is useful in assisting project managers in understanding the scope of work. Tasks without completion of definition get higher scores implying that the project is bound to face a certain level of risk in the execution process. At this point, solution or remedial action plan must be presented. The application of PDRI at the pre-project planning phase and the development of strategic information allows

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the owners full assurance of elimination of risk. The development of PDRI tool, its benefits and development of PDRI for Infrastructure, in particular, are discussed below.

A. Project Definition Rating Index

The Construction Industry Institute (CII) has developed a tool used in the front-end planning (FEP) process in 1994, known as the Project Definition Rating Index, or PDRI. First PDRI tool was intended for use on industrial projects. After successful research and testing, the PDRI for industrial projects was developed. The need for a similar tool for building projects was then realized. In 1999, the Project Definition Rating Index for building projects was developed by Gibson and Dumont.

The PDRI is a tool designed to measure the extent of scope definition in a project that helps the project delivery team identify strengths and weaknesses early in the overall project cycle. The use of the PDRI tool allows identification of risk areas and focuses attention of the team on timely resolution of issues to avoid delays in project execution.

This tool is composed of a checklist of elements covering scope definition. It is to be evaluated by project representatives before detailed design and construction, based on the level of completeness. After assessing all elements, an index is calculated that gives the relative level of definition for the project. A lower score indicates a more complete scope definition. The PDRI helps stakeholders of a project quickly analyze the scope definition reports and predicts factors that may impact project risk.

The method chosen to develop reasonable and credible weights for the PDRI elements during its validation study, by the early researches, was to rely on the expertise of a broad range of construction industry practitioners gathered together in workshops.

Industrial PDRI was developed in the year 1996 and Building PDRI was developed in the year 1999. The PDRI for industrial projects comprises of 70 scope definition elements (issues that need to be addressed in pre-project planning), grouped into 15 categories and further grouped into three main sections.

The PDRI for Building Projects comprises of 11 categories encompassing 64 scope definition elements.
PDRI is a risk management tool that can help a pre-project planning team assess and measure project scope definition risk elements and then develop mitigation plans. A risk management analysis is most effective when performed prior to finalizing budgets into detailed design and construction. Following are some of the benefits of using PDRI. It is:

- A checklist that a project team can use to determine the necessary steps to follow in defining the project scope;
- A list of standardized project scope definition terminology throughout the construction industry;
- A standard for rating the completeness of the project scope definition to facilitate risk assessment, prediction of escalation, evaluation of the potential for disputes, etc.;
- A means to monitor progress at various stages during the pre-project planning effort and to focus efforts on high-risk areas that need definition;
- A tool that aids in communication between owners and design contractors by highlighting poorly defined areas in a scope definition package;
- A training tool for organizations and individuals throughout the industry; and
- A benchmarking tool for organizations to use in evaluating the completion of project scope definition versus the probability of success on future projects.

PDRI is available for Industrial, Building and Infrastructure projects. PDRI provides an early indication of the probability of project success or failure. PDRI has been proven effective for small and large construction projects. PDRI consists of 64 to 70 elements grouped into 3 categories as follows:

1) Basis of decision/scope (50%)
2) Front-end definition/preliminary design (42%)
3) Execution approach (8%)

The testing of the PDRI for Building Projects used the contributions from 33 sample building projects. The results of the testing process also showed a direct correlation between the PDRI score and projects' success.

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Additionally a PDRI score of 200 was analyzed and it was determined that projects scoring below 200 performed significantly better then projects scoring over 200. This level of definition has become the goal of industry professionals using the PDRI tools. The Table 1. shows the results of an analysis of project performance and its relation to the PDRI score at the 200 level is given.

Table 1. Summary of Cost, Schedule, and Change Order versus Authorization Estimate for Project Definition Rating Index (PDRI) Validation Projects

Performance	**PDRI<200**	**PDRI>200**
Cost	1% above budget	6% over budget
Schedule	2% behind schedule	12% behind schedule
Change orders	7% of total cost	10% of total cost

B. Development of PDRI for Infrastructure Project

Infrastructure PDRI is a combination of both industrial and building PDRI, having a total of 68 elements. It consists of three sections and 13 categories. A complete list of the sections, categories and elements is given in Fig. 1. In PDRI a low score corresponds to a project that has good scope definition or a project having a better chance for success. And a high score corresponds to poor scope definition and lesser chance for success. Lower the score, better is the project. Projects are rated out of 1000 with 70 points as least that can be scored. The PDRI sheet for infrastructure project is the result of the work done by CII, Construction Industry Institute. A good PDRI score can help in forecasting the completion rate, risks involved, thus attracting investors.

II. LITERATURE REVIEW

Chung-Suk Choand G. et al. (2001) evaluated the status of a building project during pre-project planning.The methodology adopted for the same is as discussed further.Key project scope definition elements are identified. The project team evaluate the level of definition of each of the 70 elements and a score is calculated; the lower the score, the more well defined the project. The method chosen to quickly develop reasonable and dependable weights for the PDRI elements was to rely on the expertise of a wide range of construction industry practitioners gathered together in workshops. The PDRI validation procedure, involving over 50 projects, are discussed. A description of the uses of the PDRI and a gist of its benefits to the building construction industry are defined. The primary structure and format of the PDRI and its development are explained. A brief summary of its validation on 33 completed building projects and its use on 20 ongoing projects is given. Problems identified include poor equipment lists, inadequate space planning, undersized utilities, code violations, and so on. These problems are identified at a point in the project when they could be addressed with minimal interruption and cost.The paper concludes by describing the potential uses of the PDRI and summarizing its benefits to building construction practitioners

SECTION I. BASIS OF PROJECT DECISION

A. Project Strategy
- A.1 Need & Purpose Documentation
- A.2 Investment Studies & Alternatives Assessments
- A.3 Key Team Member Coordination
- A.4 Public Involvement

B. Owner/Operator Philosophies
- B.1 Design Philosophy
- B.2 Operating Philosophy
- B.3 Maintenance Philosophy
- B.4 Future Expansion & Alteration Considerations

C. Project Funding and Timing
- C.1 Funding & Programming
- C.2 Preliminary Project Schedule
- C.3 Contingencies

D. Project Requirements
- D.1 Project Objectives Statement
- D.2 Functional Classification & Use
- D.3 Evaluation of Compliance Requirements
- D.4 Existing Environmental Conditions
- D.5 Site Characteristics Available vs. Required
- D.6 Dismantling & Demolition Requirements
- D.7 Determination of Utility Impacts
- D.8 Lead/Discipline Scope of Work

E. Value Analysis
- E.1 Value Engineering Procedures
- E.2 Design Simplification
- E.3 Material Alternatives Considered
- E.4 Constructability Procedures

SECTION II. BASIS OF DESIGN

F. Site Information
- F.1 Geotechnical Characteristics
- F.2 Hydrological Characteristics
- F.3 Surveys & Mapping
- F.4 Permitting Requirements
- F.5 Environmental Documentation
- F.6 Environmental Commitments & Mitigation
- F.7 Property Descriptions
- F.8 Right-of-Way Mapping & Site Issues

G. Location and Geometry
- G.1 Schematic Layouts
- G.2 Horizontal & Vertical Alignment
- G.3 Cross-Sectional Elements
- G.4 Control of Access

H. Associated Structures and Equipment
- H.1 Support Structures
- H.2 Hydraulic Structures
- H.3 Miscellaneous Elements
- H.4 Equipment List
- H.5 Equipment Utility Requirements

I. Project Design Parameters
- I.1 Capacity
- I.2 Safety & Hazards
- I.3 Civil/Structural
- I.4 Mechanical/Equipment
- I.5 Electrical/Controls
- I.6 Operations/Maintenance

SECTION III. EXECUTION APPROACH

J. Land Acquisition Strategy
- J.1 Local Public Agencies Contracts & Agreements
- J.2 Long-Lead Parcel & Utility Adjustment Identification & Acquisition
- J.3 Utility Agreement & Joint-Use Contracts
- J.4 Land Appraisal Requirements
- J.5 Advance Land Acquisition Requirements

K. Procurement Strategy
- K.1 Project Delivery Method & Contracting Strategies
- K.2 Long-Lead/Critical Equipment & Materials Identification
- K.3 Procurement Procedures & Plans
- K.4 Procurement Responsibility Matrix

L. Project Control
- L.1 Right-of-Way & Utilities Cost Estimates
- L.2 Design & Construction Cost Estimates
- L.3 Project Cost Control
- L.4 Project Schedule Control
- L.5 Project Quality Assurance & Control

M. Project Execution Plan
- M.1 Safety Procedures
- M.2 Owner Approval Requirements
- M.3 Documentation/Deliverables
- M.4 Computing & CADD/Model Requirements
- M.5 Design/Construction Plan & Approach
- M.6 Intercompany & Interagency Coordination & agreements
- M.7 Work Zone and Transportation Plan
- M.8 Project Completion Requirements

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Peter R. Dumont et al. (1997) et. al.measured and managed the level of scope definition as project planning progressed. Following are the highlights of their research. As per their findings, it is extensively accepted that poor scope definition is one of the leading causes of project failure in the U.S. construction industry. Project participants are ignorant about the requirements for a sufficiently defined scope of work. The downsizing and decentralization of many owner engineering organizations has forever changed the way that industrial construction projects will be pursued in the future. With these organizational changes has come internal business disintegration, loss of experience and institutional memory, and the need to use and rely on outside consultants to perform many project functions within businesses. It is often difficult to ensure that effective scope management will take place under such circumstances. Many a times communication breakdowns between primary stakeholders along with poorly defined objectives result in projects that fall short of their cost, schedule, and operational goals.

The objective of their project was to predict factors that may impact project risk and integrate PDRI within project scope management.

The methodology adopted to achieve this objective is as discussed further.The PDRI is tested on 40 capital projects in order to validate its accuracy and usefulness is discussed. Results from 40 pilot projects are demonstrated showing that a specific PDRI point threshold provides some measure of confidence in project outcome. PDRI weights are based upon the expertise of 54 experienced estimators and project managers. The document is tested on actual projects to verify its feasibility as a tool. A PDRI score is computed for each project based upon the level of definition at project authorization prior to detailed design and construction. In this project, the effects of PDRI in the project scope management process is explored. The importance of scope definition and its direct impact on project success, explicitly focusing on how recent industry trends are changing the traditional project environment is highlighted. The PDRI alone will not ensure successful projects but, if combined with sound business planning, team alignment, and good project execution, it can greatly improve the probability of meeting or exceeding project objectives.The paper concludes by describing how PDRI provides a structured approach to the project scope management process, thus facilitating better scope definition. The PDRI, when implemented effectively, can greatly improve the probability of project success by reducing the potential for failure due to poorly defined scopes. The writers also recommend that companies should consider incorporating the PDRI as a standard tool to assist in their scope development and management processes.

Chu Tih-Ju et al. (2014) developed IGBP-PDRI model to enhance the performance of project execution, in making buildings energy efficient and reduce carbon emissions.The objectiveof their study was to forecast possible risks in the development of the project. The methodologyadopted to achieve the objective is as discussed further the model of evaluation is divided into 4 sections, 11 categories, and 60 elements. In this study, the green building and intelligent building emblem evaluation indicators and related regulations effective in Taiwan are incorporated into the scope of IGBP-PDRI evaluation. The Project Definition Rating Index (PDRI) evaluation model developed by the Construction Industry Institute (CII) of USA has been adopted as the methodology in this study. As per their findings, in the course of project execution, quality requirement is satisfied through monitoring and control. This helped to ensure the operation efficiency of the project, to the extent that the automated system of the building supported by green construction can meet the goal of sustainable development. The authors conclude by proving that this model could be used as a reference for subsequent development of pre-project planning in intelligent green building projects, which is pioneering work in Taiwan. This research could thus be used as a platform for the joint action of all stakeholders at the preliminary planning stage. This model can help to forecast, prevent, and reduce possible risks deriving from the execution of projects. This model thus performs very well, particularly at the pre-project planning stage.

G. Edward Gibson et. al. (2012) discussed usage of the PDRI in planning charrettes, including real project examples. The planning charrette process is outlined, including key participants, required resources and outcomes. The benefits of planning charrettes are discussed, including key findings. Finally, recommendations are given to project professionals concerning the use of the charrette approach for planning.

Edward Gibson et. al. (2012) discussed the development process of the PDRI, including the methodology used and how industry input from 69 professionals has been incorporated in weighting each of the 64 elements. Key project scope definition elements are identified. Also included are a description of the potential uses of the PDRI and a summary of the benefits it will provide to the U.S. building construction industry.

Rebekha Burke, Kristen Parrish, et al. (2016) presents the first step in the research effort, determining the definition of a small infrastructure project. The authors hosted focus groups and disseminated a targeted online survey to determine what constitutes a small infrastructure project. The authors found that practitioners separate small projects from large based on the complexity of the project; thus, this paper presents the primary factors and their associated breakpoints (i.e., total installed cost and engineering hours) and contributing factors (i.e., construction duration, core team numbers, and availability) that determine complexity on infrastructure projects.

Evan Bingham, G. Edward. Gibson (2016) have developed a novel risk management tool, called the project definition rating index (PDRI) for infrastructure projects, which can be used to identify and address the issues systematically and in a structured manner. Input from 64 industry professionals representing over 30 organizations was used in the development of the tool. In addition to a usable definition for infrastructure in the context of the built environment, a finite and specific list of issues related to scope definition of infrastructure projects was developed with this industry input. Data from 26 completed or in-process projects are given. Results show that the PDRI assessment score is indicative of the current level of scope definition for sample projects and corresponds to project performance. Findings support the hypothesis that projects with improved early understanding of scope definition elements showed improved project outcomes; infrastructure projects with low PDRI scores (well defined) outperformed projects with high PDRI scores. This research contributes to the body of knowledge by specifically identifying those FEP elements that are critical to infrastructure projects.

III. THEORETICAL FRAMEWORK

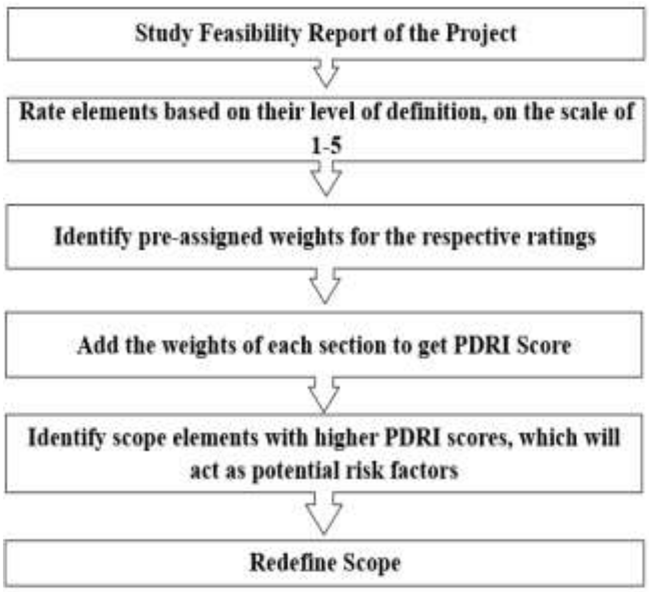

Figure 1. Project Definition Rating Index (PDRI) Sections, Categories and Elements

The above flow-diagram elaborates the theoretical framework of the research. To predict the success of any Project, its documents that encompass the details of the scope definition are to be studied. One such document is its Feasibility Report. The elements given in the PDRI score-sheet are to be rated by referring to the documents. The resulting score of the project is the indication of the success or failure of the project. The results give away elements that may pose risk in the future causing delay. Since this has been identified in the front-end planning stage, necessary mitigation action can be taken to avoid the Project Management failure.

IV. RESEARCH METHODOLOGY

When the project is in its initiation phase of conceptualization and feasibility study, the reports covering the scope of the project are to be referred, to check their completeness using the PDRI score-sheet. This can be done for two to three times, depending on the length of the project, before the start of the execution. The resulting PDRI score is expected to reduce, each time, down the line.

The rating is to be done by all the professionals involved in the planning department. In this research, industry experts have been consulted for rating the elements, by referring to the feasibility study reports.

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Respective weights of all the elements, which are pre-assigned by the CII researches, are then identified. The addition of the weights of all the elements of the three sections is found out, which gives the PDRI Score.

The process of rating gives us the list of elements having a rating of four and five. These can rightly be called poorly defined scope definition elements which need to be focused on. If not, they can later act as potential risk factors, affecting the timely completion of project. It may also cause over run in the budget, resulting in the Project Management failure.

V. CASE STUDIES

A. Case Study I

Name of the Project: Sydney Opera House
Location: Sydney, Australia

This Case Study has been studied in order to understand the effect of insufficient Scope Definition prior to the execution of the project. Sydney Opera House is one of the most known example of Project Management Failure. What was planned to be completed in a budget of $7 million, took $100 million and a decade more to get completed. The possible reasons of this overrun in cost and schedule are as discussed further.

The project was led by an Architect, John Utzon. His on-paper design was thought be an architectural marvel; but the practical ways of executing the same were still not know. Since it was first of its kind project, everyone involved in the project lacked experience in that field and the project started to seem unrealistic. Moreover, the shell-like roof structure was ahead of time and the designs were incomplete. The Project had no Project Manager and implementation methods kept on changing. Some portions of the structure were even built then later demolished, re-designed and built again. Due to considerable changes in the fundamental Plan, the project ran out of funds. And since the government disagreed to financethe impractical idea of Utzon, he resigned. He took his designs with him, and so the new Architect had to start the work from scratch, which further led to delay.

Estimates for the entire cost of construction had risen from AUS $7.2 M in 1957 to $9.8 M in 1958 to $18 M in 1961 to $ 24.5 M in 1962 to $34.8 M in 1964 and to $48.4 M in 1965. By 1968, cost estimates had risen to AUS $85 M.

It can be said that the lack of proper planning prior to the execution of the plan was partially responsible for the manner in which the estimates changed.

Conclusion

From this project, and the mistakes made therein,

1. We learn the importance of planning well before implementing a project. Complete designs would have saved this project a great amount of money and time.
2. We learn that the initial cost estimates and structural sketches which had been given without structural expertise, could have been avoided to some extent, which led to many iterations of the design.
3. The project has shown the importance of implementing a good project management strategy, especially when implementing a large-scale unprecedented plan. Utzon was known to be a brilliant architect but very poor manager. Seeking a project manager would have been of great benefit to this process.

B. Case Study II

Name of the Project: Market Yard
Location: Chandwad, Tal. Chandwad, District – Nashik

This Case Study had been done to validate the PDRI tool in Indian Scenario. This is a construction project of a Market yard in Chandwad Town of Nashik District. This project got completed in a period of three months, which was planned to be completed in 18 months. Also, the budget required to complete the project was found to be Five CroreFifteen Lakh, which was estimated to be Five Crore Thirty Lakh. Table 2 and Table 3 show the details of the planned and the actual budget estimates. PDRI tool is applied to this project to see if the results match. The rating of the elements given in the PDRI score-sheet for Building Project is done in consultation with the Project Manager. The rating of the elements is done by two ways. One is by referring to the documents available. But it is not necessary that every important aspect may find its mention in the feasibility reports. This is where the project manager has to think going back to the time when the project was getting planned. By

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studying the completeness of the definition, elements in the relevant PDRI template are rated out of five, one being given to the elements that are completely defined, and five being given to the elements that find almost no mention in the scope definition reports. Once the rating is done, the individual score of each element, which the CII researchers have calculated after a research of fifiteen years is identified for each element. On adding the scores of each section, the PDRI Score of the project is computed.The PDRI Score is found to be 174, which is less than the 200 limit, as given by the CII Research. Thus, we can say that, implementing the PDRI tool, in the Front End Planning can greatly assist in the timely and within budget completion of construction projects.

Table 2. Summary of Proposed Infrastructure

Summary of proposed Infrastructure Facility		
No	**Particular**	**Amount**
A	**Basic Infrastructure**	
1	Water Tank	457291.95
2	Sale Hall	3213023.59
3	Internal Roads	8743589.97
4	Open Auction Yard	20997978.80
5	Street Lighting	1546622.00
	Total A	**34958506.31**
B	**Productive Infrastructure**	
1	Godown (1000 MT)	10068079.70
2	Grain Gradiation Unit	3642687.59
3	Shetkari Niwas	1955385.89
	Total B	**15666153.18**
	Total A+B	**50624659.49**
C	Contengencies - 3 %	1518739.78
	Grand Total	**52143399.28**

Table 3. Final Estimate

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Name of APMC		Agriculture Market produce comittee Chandawad		
Contractor		M/s Lahamge contractors		
Project Duration		18 Months		
Date of commencement		1.1.2015		
RA Bill No = 3				
INTERIM PAYMENT CERTIFICATE				
	Financial Abstract			
No	Description	Cumulative up to date	Till Previous	Current/ This bill
A	**Basic Infrastructure**			
A	Water Tank	241403.40	236759.80	4643.60
B	Sale Hall	4310015.50	4099595.68	210419.82
C	Internal Roads	7981605.50	2716401.91	5265203.59
D	Open Auction Yard	21391996.96	20013439.93	1378557.02
E	Street Lighting	1687043.50	1448116.00	238927.50
	Total A	**35612064.86**	**28514313.33**	**7097751.53**
B	**Productive Infrastructure**			
A	Godown (2000 MT)	9910079.06	3979755.79	5930323.27
B	Grain Gradation Unit	3633909.41	593498.60	3040410.81
C	Shetkari Niwas	2048025.13	1219365.17	828659.96
	Total B	**15592013.60**	**5792619.56**	**9799394.05**
C	**Other Variation**			
A	Price Adjustment	0.00	0.00	0.00.
b	Variation order new or extra item	0.00	0.00	0.00
	Total C	**0.00**	**0.00**	**0.00**
D	Sub Total A+B+C	51204078.47	34306932.89	16897145.58

C. Case Study III

Name of the Project: Construction of Ring Road
Location: Pune

Pune Ring Road is a proposed circular road for Pune city. The proposal was put forth on 12 June 2007 by the then Chief Minister of the state. The Pimpri-Chinchwad Municipal Corporation, Pune Municipal Corporation and the Pune Metropolitan Region Development Authority were responsible to make necessary provisions for this plan. The total length of road was proposed to be 128 kilometers. The total cost of the Project was proposed to be 799 Crore. The purpose of the ring road is to divert the passing-by traffic from outside, towards other cities, without allowing it enter Pune. It is also proposed to provide connectivity to important areas of the city.But due to irregularities in the Detailed Project Report(DPR), the construction of Ring Road Project is yet to commence.

This case study is done to predict the successful completion of Project within estimated cost and schedule, by application of PDRI tool. The rating is done in consultation with the industry experts by referring to the Feasibility Study Report. Table 4 shows the rating of the elements A and B. Table 5 shows the scoring pattern of the elements A and B. Finally, the PDRI Score is computed. The PDRI Score for this project is found to be around 626.

Table 4. Rating of PDRI Score-sheet elements

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SECTION I - BASIS OF PROJECT DECISION							
CATEGORY Element	Definition Level						Score
	0	1	2	3	4	5	
A. PROJECT STRATEGY							
A.1 Need & Purpose Documentation			2				
A.2 Investment Studies & Alternatives				3			
A.3 Key Team Member Coordination					4		
A.4 Public Involvement				3			
	CATEGORY A TOTAL						
B. OWNER/OPERATOR PHILOSOPHIES							
B.1 Design Philosophy			2				
B.2 Operating Philosophy					4		
B.3 Maintenance Philosophy					4		
B.4 Future Expansion & Alteration				3			
	CATEGORY B TOTAL						

Table 5. Weighted PDRI Score-sheet

SECTION I - BASIS OF PROJECT DECISION							
CATEGORY Element	Definition Level						Score
	0	1	2	3	4	5	
A. PROJECT STRATEGY (Maximum = 112)							
A.1 Need & Purpose Documentation	0	2	13	24	35	44	13
A.2 Investment Studies & Alternatives	0	1	8	15	22	28	15
A.3 Key Team Member Coordination	0	1	6	11	16	19	16
A.4 Public Involvement	0	1	6	11	16	21	11
CATEGORY A TOTAL							55
B. OWNER/OPERATOR PHILOSOPHIES (Maximum = 67)							
B.1 Design Philosophy	0	2	7	12	17	22	7
B.2 Operating Philosophy	0	1	5	9	13	16	13
B.3 Maintenance Philosophy	0	1	4	7	10	12	10
B.4 Future Expansion & Alteration Considerations	0	1	5	9	13	17	9

VI. DATA ANALYSIS

A. PDRI Element Rating

The PDRI tools use a score sheet to rate the level of definition on a list of element concerning scope of project. The resulting score gives the level of scope definition completeness for the project. Elements that are considered completely or well defined are given the definition level one. Elements that are poorly or incompletely defined are given the definition level of five. Definition levels of two, three and four are given for levels of definition in between. Each element has a weight assigned to the five levels of definition. Higher weights or scores are given to the elements which are determined to be the most likely to introduce risk. A higher total score represents a poorly defined project and allows teams to work on achieving higher levels of definition within the project. Whereas, a low score represents a project that is well defined.

Table 6 and Table 8 show the list of some of the highest scoring elements in the second and third Case Study. These elements can be referred to as the risk factors which need to be mitigated at the front-end planning stage.

B. Assessment of PDRI Score

Each element carries a weighted value which has been predetermined from considerable research by CII, over a span of 15 years. The weighted scores indicate which elements can have the most impact on the project and need to be addressed with greater attention in order to minimize risk. PDRI score of 200 or less has been correlated by CII research with projects that perform better on cost, schedule and change orders. Once the

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scoring is completed and weighted, it becomes obvious which elements need to be focused on, where risk is the greater and where further action needs to be taken before moving on to the next phase or readying the project for detailed design and construction.

Table 7 and Table 9 show the details of score of each section of the second and the third Case Study. These scores are a collective numerical representation of the relative influence of the individual elements on the success of the Project. Finally the scores of all the three sections are added to get the PDRI score of the Project. A score around 200 implies that the project will be success. According to the CII research, greater the score, less successful will be the possibility of the project being successfully completed.

Table 6. Highest Weighted PDRI Elements (Case Study 2)

Element designator	Element	Weight
D6	Utility Sources with Supply Conditions	7
D7	Site Life Safety Considerations	4
E11	Room Data Sheets	7
G2	Equipment Location Drawings	5
G3	Equipment Utility Requirements	6

Table 7. PDRI Section Weights

Section	Weight
I. Basis of Design	36
II. Basis of Project Decision	103
III. Execution Approach	35
Total	174

Table 8. Highest Weighted PDRI Elements (Case Study 3)

Element designator	Element	Weight
A3	Key Team Member Coordination	16
A2	Investment Studies & Alternatives	15
C3	Contingencies	20
D2	Functional Classification & Use	16
D7	Determination of Utility Impacts	16

Table 9. PDRI Section Weights

Section	Weight
I. Basis of Design	243
II. Basis of Project Decision	168
III. Execution Approach	215
Total	626

VII. DISCUSSION OF RESULTS

Three case studies have been studied. First case study is that of Sydney Opera House. It is a classic example of Project Management Failure. Budgeted at an initial cost of $7 million, the Opera House ended up costing more than $100 million and took more than a decade to construct due to continual redesigns, underestimates and cost overruns. The study shows how incomplete scope definition can lead to the overruns in Cost and Schedule causing a Project Management Failure.

Second case study is of a completed Building project. The scope definition of this project was assessed in consultation with the Project Manager. The rating was done through discussions and by referring to the Feasibility Study Report. A comparison was done between the expected results and the actual results. The PDRI

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score of the project was computed to be 170, which implies that the project is expected to finish within the planned schedule and budget. And the actual reports of Schedule and Cost were found to be in coherence with the planned and the expected results (as per the PDRI Score). What was planned to be completed in eighteen months and a budget of Rupees Five Crore, thirty lakh, got completed in a period of three months with a budget of Rupees Five Crore fifteen lakh.

Thus validating the effectiveness of PDRI score in predicting the successful completion of Construction Project. The third case study is of a proposed road project. The feasibility report of the same was referred to check the scope definition completeness. The rating was given in consultation with the industry experts. The Project performed really poor, as far as it's PDRI Score is concerned. The results give a list of elements with a rating of more than three. These are the elements which may act as potential risk factors, according to the theory of PDRI. Such elements have been identified and recommendations have been given.

VIII. CONCLUSION

The success of a project is never assured, but its risk of failure or under-performance can often be reduced with proper planning and implementation of proven procedures as the PDRI has demonstrated.
PDRI tool is designed to control and minimize project risk at the early stages where value can be positively influenced the most with minimal cost.
PDRI is an excellent method of providing the necessary scope definition to help assure better project performance.

IX. LIMITATIONS

- There is a possibility that the elements given by the PDRI may not be relevant to the current site situations. Likewise, there could be some factors that form a necessary part of the feasibility study but find no mention in the elements included in the PDRI score-sheet.
- The personnel involved in the PDRI assessment may put a false rating to show a better definition of scope, lest of embarrassment.
- There may also be issues about disclosing the financial details in feasibility report, which will affect the ratings on the PDRI score- sheet, thus increasing the overall score which will end in a negative verdict.

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