APPLICABILITY OF PUBLIC PRIVATE PARTNERSHIP MODEL ON LARJI DAM CONSTRUCTION

A Thesis

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CERTIFICATE

This is to certify that the work which is being presented in the project entitled **"APPLICABILTY OF PUBLIC PRIVATE PARTNERSHIP MODEL IN LARJI DAM CONSTRUCTION"** in partial fulfillment of the requirements for the award of the degree of Master of technology and submitted to Department of Civil Engineering, Jaypee University of Information Technology, Waknaghat is an authentic record of work carried out by Rhishabh Prashar during a period from August 2017 to May 2018 under the supervision of Dr. Saurabh Rawat**,** Assistant Professor, Department of Civil Engineering, Jaypee University of Information Technology, Waknaghat and co-supervision of Prof. Ashok Kumar Gupta, Head, Department of Civil Engineering, Jaypee University of Information Technology Waknaghat.

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Abstract

Public-private partnership (PPP) model, if executed well, can help to conquer inadequate foundation that constrains commercial growth, especially in growing countries. Infrastructure properties are known to stimulate much-required growth in growing countries and lessen income disparities. Although inadequate infrastructure is often a consideration of numerous constraints governments face, for an example, inadequate public funds, poor preparation, weak judgment underpinning project determination, or corruption. Infrastructure assets are also usually prepared. P3 s can help to overcome few of these difficulties by mobilizing private field resources, helping develop project collection and on-time and on budget implementation, and securing adequate subsistence. Although initially, limited to public infrastructure in the construction of roads, railways, power production, or water and garbage processing facilities, P3s have frequently moved into the stipulation known as social infrastructures like institutions, hospitals, and fitness services.

In this research work, we are taking into consideration the Larji project in Himachal Pradesh. It was found the total cost of the dam is 1500 crore .The project comprises of two data sheets one contains the work description and the second work sheet consist nodes and vendors of dam construction. The cost in crore is observed for the questions are searched in the question sheet then the answers are selected. After that the vendors are determined as per the cost of the construction and the vendor that has the lowest cost will get the contract of the project. The code is simulated in the MATLAB environment and each question is incremented in the answer options. By applying the Genetic Algorithm it was determined there is reduction in time as well as cost with increase in efficiency.

Keywords: *Public-private partnership model, cost- time relationship, Larji Project, Genetic Algorithm, Efficiency*

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List of Symbols

GUI	Graphical User Interface
RAM	Random Access Memory
MATLAB	Matrix Laboratory
PFI	Private Financial Initiative
PPP	Public Private Partnership
Km	Kilometers
GDP	Gross Domestic Product
VSTP	Varanasi Sewage Treatment Plant
HATP	Haridwar Sewage Treatment Plant
PSO	Particle swarm optimization
EVM	Expected Value Mode
IRR	Internal Rate of Return
GA	Genetic Algorithm

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Chapter 1

INTRODUCTION

1.1 General

The concept of PPP (public-private partnership) has become a viable option especially in developing countries. Public-private partnerships are becoming an inventive policy means to make up for this shortcoming in conventional public service. They represent the public's request need to understand and assess the resources.

Public-private partnership is also denoted by PPP, 3P and P3. These are cooperative arrangements between two or more public and private sectors, often of a long-term nature. Governments throughout the history have used both public and private efforts. However, in the late twentieth and early twenty-first centuries, governments all over the world have seen a clear trend towards using more PPP arrangements [1]. There is no contract on how to describe PPP. PPPs can be implicit as governance mechanisms and language games. When understood as a language game or brand, PPP terms cover hundreds of separate types of long-term contracts with a wide range of risk allocations, funding arrangements and precision requirements. As a brand, the concept of PPP is also closely linked to concepts such as privatization and management service outsourcing [2]. When understood as a governance system, the PPP concept includes at least five potential families, one of which is a broad-term infrastructure contract in the UK's Private Financial Initiative (PFI) model. Different countries have different types of actions at separate times.

1.2 Need of Study

PPP (public-private partnership) model is a planning between public and private sector to provide services to the public. The construction projects that run without P3 model have many disadvantages such as higher construction cost and time duration to complete the project. P3 model provides better public services throughout the working operation. P3 also helps to deliver the project on time and within the budget. The present cost and the future cost is analyzed. The importance of P3 model is defined below:

I. The financial support is provided for maintaining the regulatory of the proposed work.
II. Viability gap funding plan is created for P3 projects by the government that offer financial support at the phase when the project is completed up to 20 %.
III. Long term debt is provided by the Government under the “India infrastructure finance company limited” scheme. The financial support is provided for transportation, communication, social and commercial projects.
IV. To raise the construction level of India P3 model plays a very important role.

1.3 Definition

Different countries defined PPP schedule in different ways. Some of the definitions are defined below:

Brazil's new PPP law provides for public-private cooperation in its Article 2. The contract is an agreement between the government or public entity Private entities, establishing a lawfully binding responsibility to manage (either complete or in part) services, utilities and private activities in the public in which the department is liable for financing, investing and managing.

Ireland definesP3 as any assertion made by a state specialist and a private accomplice to work works inside the order of the state organization, and including unmistakable mixes of configuration, structure, activities and financial matters [3].

In South Africa, a P3 is portrayed in law as an understanding between an administration association and a privately owned business where the last plays out an institutional part and handles state property, and where important undertaking dangers are exchanged to the third organization.

The UK‟s PFI (Private Finance Initiative) in which people in general region buys co-task from the private zone under long haul contracts is the best-known the fragment of that nation's P3 program

The definitions defined above concluded that P3 is comprises of many definitions. They broadly related to long-term, contractual connections among the public and private sector companies, specially targeted towards funding, designing,

implementing, and operating structure facilities and duties that were conventionally implemented by the public sector.

Thus in Indian context one can say that the P3 (Public Private Partnership) projects are the project that depends upon the contract or the concession agreement among the government and the private companies and delivered the project on the payment of user charges [4].

1.4 Models of Public Private Partnership

India's participation in the PPP in an authentic way began in 2006. PPP requires a private sector company to create resources in the middle of the day through money, innovation and administration. For this reason, few models that have welcomed their collaboration have been pushed for various tasks. Part of the types of PPPs that are normally accepted include the exchange of work (BOT) and its variations, produces the change of rent (BLT), plans the exchange of production work (DBFOT), work and replacement (OMT), etc.

These models work in various conditions in the private division regarding the level of risk, ownership control, shared opportunities, particular joint effort, duration of the task, financing arrangements, treatment evaluation, cash flow management, etc. The following are the basic PPP models.

I. Built operate and transfer :

This is the simple and ordinary PPP that shows that private services depend on the configuration, construction, work (in the contract period) and the exchange of the office with the people in the general segment. Part of the private division is to bring the company back and take responsibility for developing it and taking care of it. This is general part of the company, will allow you to get revenue from customers. National highway companies contracted by the NHAI under the PPP scheme are a notable case for the BOT demonstration.

II. Built own operate :

This is a alternative of the BOT and the difference is that the ownership of the newly built facility will rest with the confidential party here. The public

sector colleague agrees to ‘purchase’ the goods and services produced by the project on jointly approved terms and circumstances.

III. Built own operate transfer :

This is likewise on the lines of BOT. After the arranged timeframe, the foundation resource is exchanged to the administration or to the private administrator. This approach has been utilized for the advancement of expressways ports and dams.

IV. Built operate lease transfer :

In this approach, the government grants a concession to a private body to build a structure (and possibly even design it), own the structure, rent the structure to the public sector and then, at the end of the rental period, transfer ownership of the structure to the government.

V. Lease develop operate :

Here, the government or public sector entity maintains ownership of the newly created infrastructure structure and receives payments in terms of a lease with the private developer. This approach is mainly followed in the development of airport facilities.

VI. Rehabilitate operate transfer :

With this approach, governments / local authorities allow private developers to regenerate and manage a facility during a concession period. After the concession period, the project is transferred to local governments / agencies.

VII. Management contract :

Here, the private developer is responsible for a full range of investment, management and maintenance functions. It has the authority to make daily administrative decisions as part of a benefit sharing or fixed payment agreement.

1.5 Evolution of Public Private Partnership

The participation of the private sector in the transmission of public services is not a single concept; The PPP was used for more than three decades before the initiatives of the 1970s in the United States. Originally focusing on the economic base, P3 has evolved to involve the acquisition of activities of social foundations and non-essential assistance related. P3 has been extended to home, health, energy, water and waste treatment. P3 policy has also been developed around the world by the public sector generating the necessary skills base to get through P3 infrastructure, including the ability to generate and maintain an administrative framework. The restricted area also has often become innovative in many experienced countries, so it adds significant value to public ownership. The United Kingdom has been a contemporary instigator of this wave of association of private areas, with the presentation of the Private Finance Initiative (PFI). PFI have been practiced to produce and supply all kinds of foundations and services. The growing use of VTI has pushed governments around the world to choose P3 modes. The Australian government has adopted P3 to offer various social foundation projects; Ireland used them for the foundation of transportation; in the Netherlands, communication programs for housing and urban reconstruction have been transferred via P3 agreements; India is investing heavily in motorways through the P3; Japan has several new P3 in preparation; in Canada, many of the new foundations are designed, developed and managed by the private area; is a guide with outsourcing and started experimenting with other P3 methods; even the emerging Central European communities are doing the same [6].

During the preceding two decades, P3s has become the chief route for delivering public co-operation in both improved and growing countries. Between 1985 and 2004, there was a entirety of 2096 P3 projects globally with a complete capital value of almost US$ 887 billion. Countries globally with P3 knowledge insert Australia, Hungary, Italy, Germany, Japan, Korea, Spain, the USA, and the UK. Amongst these countries, the UK has broadly viewed as the one with the most comprehensive P3 (or PFI, which is the similar term used in the UK) experiences.

For example, during 2003 and 2004, the P3 investment of UK is the highest. Although P3s have been performed in many countries, they are not implemented

equally in all infrastructure areas. In most countries, P3 projects focus on shipping projects like roads, airports, subways, railroads, and bridges. However, the use of P3s has been developed across different sectors in modern years. For an example, in Korea, P3s are utilized in the construction of schools, hospitals, and government housing; in the U.S., P3s are observed in sectors like jails and water supply and wastewater processing. In growing countries, contracting out was launched in the mid-1980s during the initial wave of governmental privatisation of state industries, under architectural improvement programs. Policies were selected to address the anticipated lack of managerial capability in government, as well as the necessity to stop the proceeded relationship of state enterprises on state payments [7].

1.6 Evolution of Public Private Partnership in Asia and India

In Asia, major infrastructure services in the highest of countries are not only short-term but low-key. The difficulty is more critical in low-income countries in Asia; Infrastructure buildings in the middle-income countries of the area are also not satisfactory. Countries in this area have identified the obligation to improve the quality and capacity of their physical infrastructure; understand the fact that the foundation plays a fundamental role in facilitating commercial expansion and international competitiveness. Given the various financial constraints, the governments of the area have changed their strategies to generate an environment conducive to the sustainable participation of private areas in their infrastructure areas. This varied public policy has included the participation of the private sector in its infrastructure areas.

The importance of investments in infrastructure for the long time economic growth required governments in these countries to determine alternative ways to support infrastructure facilities. The World Bank's stated that the PPI (Private Participation in Infrastructure) Project Database, although some developing countries began infrastructure projects with private assistance in the mid-1980s, in the 1990s the course turned into a wave, which swept the amount of the developing world. In Asia, countries like China, Malaysia and Thailand inaugurated some projects along with private assistance in the mid-1980s in one area or so, but later on, in the 1990s utmost of the countries in the zone involved the private sector in the preparation of one or more of the infrastructure tools. Following the early 1990s, emerging countries across the earth

including Asia have started upon public area reforms and have interjected private investment in the physical foundation. Table 1.1 underneath shows trends in private financing in the elected group of Asian countries from 1990 - 2007. The report is based on World Bank PPI Dataset [8]

Table 1.1 PPI in South and Asia from 1990 to 2007 [8]

Country	**Total investment in (US $ millions)**	**No. of projects**	**Population million**	**Income Category**
Bangladesh	3566	24	148	Less income
India	96132	305	1131	Less income
Nepal Pakistan	402	7	27	Less income
Pakistan	21714	46	168	Less income
Srilanka	2641	21	20	Middle income
China	99968	806	1318	Middle income
Indonesia	40679	86	231	Middle income
Malaysia	50205	95	27	Middle income
Philippines	42242	87	88	Higher income
Thailand	31946	95	65	Higher income
	389495	**1572**	**3223**	

Public-Private Partnerships (P3) have brought much attention in modern years as possible medians to handle large and expensive projects, like the construction of latest infrastructure. From a European prospect, the transportation division has been particularly influenced in this respect. This can be described by various factors. The progress deregulated transportation businesses, resulting in a developing role of private area ownership and engagement, coupled with the funds-restrictions of various EU member states, might be considered as the most influential ones. The major goal of P3 projects is to obtain resolutions to problems in which the profits of the private sector

like as economic assets, efficient management, the capacity to innovate and entrepreneurship are connected with the benefits of the public sector like social and environmental interest.

To be economically practical, a P3 project should produce a combination of designating efficiency and fruitful efficiency that is excellent to a uniquely public or completely private project. We will begin by considering the different forms of P3s as they are expressed in the literature and discuss the commonly observed benefits and disadvantages. The Indian Railways is estimated the lifeblood of the nation and, therefore, the onus of leading the economy on its shoulder lies with the railways. The inflation in the economy has effected in a dire requirement of improvement and enrichment of infrastructure in the country. As part of the entire strategy of restructuring the foundation, a significant thrust has been given to P3 [9].

In India there is no exact date and year which could speak of the beginning of PPP but it is said that the PPP story began with private sterling investments in Indian railroads in the latter half of the 1800s. By 1875, about £95 million was put by British organizations in Indian "ensured" railroads. Then again we could follow it to the mid 1900s, when private makers and merchants developed in power sector in Kolkata (Calcutta Electric Supply Corporation) and in Mumbai with the Tata playing a prominent role in starting the “Tata Hydroelectric Power Supply Company” in 1911 [18].

Latitude and longitude of dam are 32°29' N and 75°10' E

Fig. 1.1 Route of site from JUIT Waknaghat [19]

1.7 Public Private Partnerships in India

India had an important P3 as old as the nineteenth century. The Great Indian Railway Company operating between Mumbai known as Mumbai and Thana met Thane in the year 1853; The Mumbai Tramway Company operated the tramway in Bombay in 1874 and the production and distribution companies in Bombay and Calcutta knew it as Kolkata. At the beginning of the twentieth century are the first cases of P3 in India. Moreover, before obtaining freedom from British rule in 1947, sixty-five percent of energy production was created by private companies. After independence, a wave of nationalization dried up across the country and part of the private area in the provision of infrastructure was quickly marginalized. At that time, private companies were limited to being contractors and, in some cases, to infrastructure service engineers, particularly in key infrastructure segments such as transport, electricity, telecommunications and public infrastructure.

As India try and develop a sustainable road and transportation networks for the future, Public-Private Partnerships (P3) are supposed to play an essential role in this extension story. It is well understood that P3 in the road foundation is the largest P3 segment in India till now. The P3 segment in this sector has a chance to bank more than US$ 25-30 billion covering 3.3 million kilometres (Km) of road interface. Data collected from surveys explain that there were many projects that have not progressed forward past the scholarship stage either because they have been discontinued or remained dormant. Of these, a number of persons had no good offers future in response to succeeding requests for expressions of interest [10]. As this number is not very much high compared to the number of projects undertaken, it nonetheless implies that there might be meaningful benefits from capacity building in association and preparation of P3s to assure that longer bankable projects are delivered to market. There is an extremely-established need for foundation investments in road formation in India.

In modern years India’s administration has undergone a period of rapid economic growth, the steps toward economic liberalization made in 1991 are as follows.

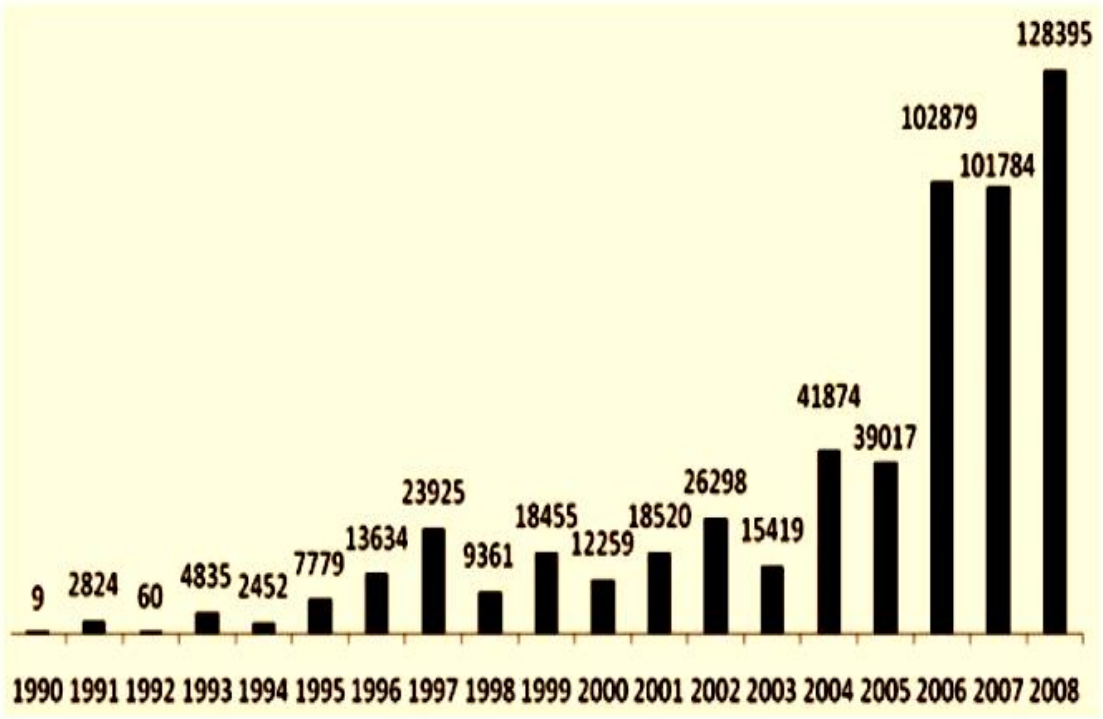

Fig. 1.2 PPI dataset,World bank group (Private Investment in infrastructure) [20]

In the 10th phase of the five-year plan between 2002-2003 and 2006-2007, the average growth rate in India was 7.6% compared to 5.5% produced during the duration of the Ninth Floor between 1997-1998 and 2001 -2002. The tests of the eleventh five-year plan started in the period 2007-2012 have recorded an even greater growth with 9%. This level of growth requires rapid development and expansion of the capacity of the economic infrastructure. However, the ability of the infrastructure to support the active expansion of the economy has been limited by the availability of funding. Initial investment was only 3.7% of GDP in 1999, with individual investments offering only 0.9% of GDP. Understanding that the share of private investment needed for progress is wider, the Indian government has launched a policy to encourage private funding in infrastructure through P3 (public-private partnerships). The Indian government (GoI) has imagined that investments in foundations could rise to 8% of GDP for the period 2011-2012 and that, in this way, the investment of private resources would offer about 1.2% of GDP [11].

The difficulty of maintaining this level of growth has brought to centre-stage the problem of inadequate infrastructure in the country. India's foundation spending for 2006-07 was expected at approximately 5 percent of GDP. By contradiction, this is far backwards some of the other fast-growing economies like China, that has a foundation

spending of 9 percent (%) of GDP. Within the circumstances of India's own growth path, the modern rate of investment is estimated to be very slow.

Consequently, demand for capacity enlargement and also replacement of subsisting assets in infrastructure zone comprising transport, urban foundation, water and cleanliness, ports and many others, cannot be exceeded. The Eleventh Plan expects infrastructure spending in the area of USD 514 billion equal to 24 lakh crore to succeed infrastructure bottlenecks. Given the restricted capability of the Government to produce infrastructure services, about 30 percent (%) of the whole infrastructure investment in the Eleventh Plan is conceived to be produced by the private area. The P3 policy action is a key enabler and operator of private investment in India‟s infrastructure [12].

1.7.1 Prevailing Status of Public Private Partnership Projects in India

According to the report announced by the Secretariat of the Infrastructure Planning Commission, GoI (Government of India) in March 2010, while 241 projects with a spending of Rs. 66.627 million rupees were completed, 292 projects with an investment of Rs. 2,41,111 crore (cr) were in progress. Other projects 412 including a Rs investment. 3.76.561 crore (cr) were in the pipeline. Evaluation of the sectoral configuration of the P3 projects in India, both at central government level and at the state level, where the growth of the public-private partnership is more marked in some sectors than in others.

1.7.1.1 Rank of Public Private Partnership Projects at Intermediate Level

The Constitution of India has determined the subjects on which the Centre and the States can constitute and frame management. The important infrastructure zone like railways, national highways, airports and main ports are Central subjects and, for, the Central Government has been beginning measures to meet the developing demand for infrastructure in these areas. Aside from public sector projects, various P3 projects have also been granted, and in different cases, these P3 projects are in progress.

In the Central sector, a total of 65 P3 projects involving an expenditure of Rs. 25,343 crore had been finished up to December 2009, 83 P3 projects with an expenditure of Rs. 75,914 crore were currently under implementation and another 160 P3 projects with an expected expenditure of Rs. 1,84,807 crore (Cr) were in the

pipeline. Finished projects: Up to December 2009, 39 P3 projects of national roadways with an expenditure of Rs. 13,698 crore (Cr) and 23 P3 projects in the port area with an expenditure of Rs. 5,762 crore (Cr) has been achieved. In the civil aeronautics sector, airports including a total expenditure of Rs.5,883 crore (Cr) have been developed through P3 mode at Cochin, Bangalore and Hyderabad airports. Above 200 projects have attained financial closing among 2008-2010 alone with entirety determined project cost of US$18 billion [13].

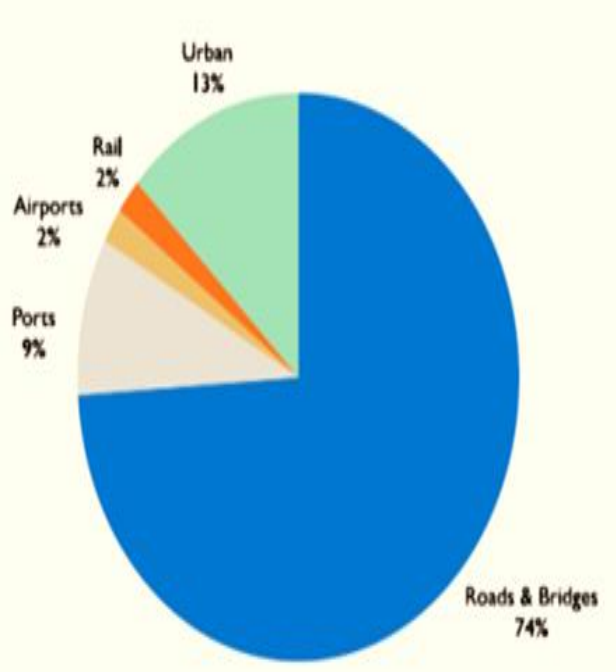

Fig. 1.3 Number of awarded PPP's by sector (Total=86) [21]

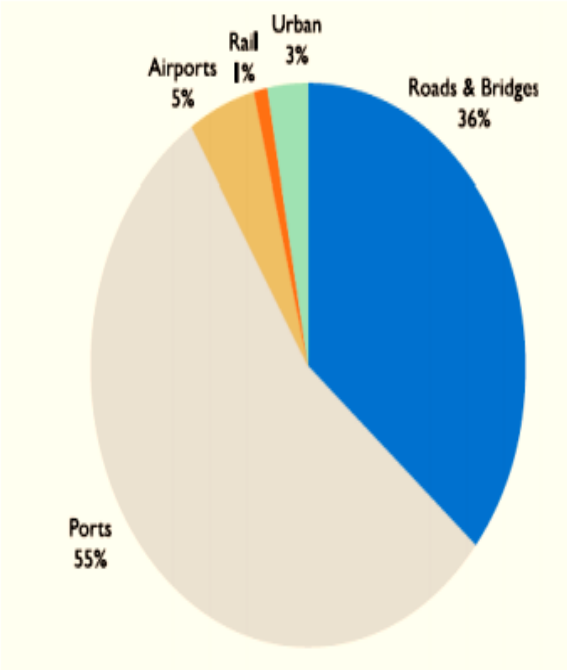

Fig. 1.4 Project cost of awarded PPP's by sector (Total= Rs. 339.5 billion) [22]

1.8 Challenges of Public Private Partnership in India

Supervisory Environment: There is no autonomous P3 regulator as of now. In order to invite more domestic and worldwide private funding of the foundation, a more robust supervisory environment with an autonomous regulator is necessary.

An absence of information: The P3 program requires a comprehensive database about the project to be granted under P3. An online database available on sites, comprises of whole the project documents, consisting feasibility report, authorization agreement and the state of various clearances are needed.

Project development: The deficiency of adequate project improvement by authorities guides to decreased interest by the private area, mispricing and several time obstructions at the time of execution.

Deficiency of institutional capacity: The limited institutional capacity to undertake extensive and complicated projects at various central ministries and particularly at state and local bodies' level hinder the translation of spot into projects. Financing availability: With investment banks reaching the sectoral disclosure limits, and extensive Indian infrastructure companies being extremely leveraged, supporting the P3 project is getting complicated [14].

1.9 Organization of Thesis

The first chapter has described the general overview of the PPP model (an agreement between public and government sector), their need, features, the projects that used P3 model in India along with their cost and duration.

The second chapter presents the literature review in the field of public private partnership model along with their outcomes and methodology process. The summery of work done by different authors have been discussed on the basis of which objectives are made.

The third chapter comprises of work plane that is prepared before the staring of the thesis and the methodology of the proposed work. The flow of the work performed from the starting of the work up to the process to calculate the performance parameter.

The fourth chapter described the results obtained for the proposed work. The performance of the P3 model is measured in terms of cost and time. Also the relationship between them also discussed. The comparison with and without optimization of P3 model is also discussed.

The fifth chapter presents the conclusion and future work of the proposed work followed by the references and screen shots of the code used in the proposed work.

Chapter 2

Literature Review

2.1 General

In this chapter, the previous work performed by various authors in the field of "Public –private partnership" project are discussed in detail. The methodology used by different author's along with their planning work and outcomes taken from the papers are discussed in detail. The fund invested by the Government of India (GoI) in P3 model is discussed. In the area of public road, railway project, airport, civil aviation, tourism, building and sport. The benefits of P3 models are also discussed. The factors affecting the P3 model, P3 model used in different states is discussed.

2.1.1 Public Private Partnership Model

Das and Sikidar [3] found that P3 mode achieve a level of success through the last ten-year span and the model would proceed to serve the community in creating construction input for the planned generation with sustainable improvement sans damage. The researchers find that a better PPP can have a number of benefits as listed below.

- Good PPP's have lessened the life cycle price of projects
- Injected state of the art scheme
- It essentially improved clients service
- Corporate are intentionally seeking techniques to increase the accurate impact of their plans by offering CSR initiatives. It might be considered here Companies Act 2013 has mandated
- Upon the organizations to mandatorily contributed 2% of their profits CSR associated activities.
- In the case of VGF (viability gap funding). The ministry of economics allows priority to socio-economically acceptable projects viable below the P3 format and the Government enlarges budgetary grants and monetary resources help to the projects.

Khan and Ojha [1] found that PPP is important to both public and private area to take more Fruitful, initiative, participative in the improvement of foundation in predicted time. Delivers on social co-operation through the P3 projects in time without delay is foremost focus of the research. Different challenges such as project assessment, transparency, risk and return, time matter, acquisition of land and another exist in P3 is the main point of the research. Government take action to remove all these difficulties and provide several rules and regulations to resolve the dilemmas between Central- States Government and organization valuable financial credit means to provide the private areas, by which private area (domestic & foreign investors) would take more attention in investment P3 project in India. The Government might also take necessary levels to achieve the P3 project in many states of India to promote social welfare and infrastructure. The relationship between various parties and government is essential to frame India as well as the economics. Infrastructure is immediately proportionally to economic development.

Nanda [2] discussed the idea and the present status of P3 projects in India and analyzes the different P3 projects. The researchers gathered data from different sources. The data have been collected from Government of India websites and the committee on infrastructure, Planning _commission, finance ministry and savings commission of India. The Dataset has been taken from the ministry of finance from Government of India having duration from 2008 to 2013.

Table 2.1 P3 AC approved projects [2]

	2008-2009		**2009-2010**		**2010-2011**		**2011-2012**		**2012-2013**	
Zone	**Total project**	**Entire cost**	**Total project**	**Entire cost**	**Total project**	**Entire cost**	**Total project**	**Entire cost**	**Total project**	**Entire cost**
public road	90	86335	124	123692	169	167480	180	175014	225	235438
Railway project	1	8500	2	8501	1	8502	1	8502	2	8501
Air port	6	3682	9	11347	11	11347	19	18383	27	22478
Civil aviation	3	1000	3	1000	2	1000	2	1000	3	1000
Tourism	2	146	2	149	1	149	1	149	2	149
Building	0	0	0	0	16	8343	17	7300	18	7300
Sports	0	0	0	0	6	2476	6	2476	6	2476
Total	102	99663	140	144689	206	199297	226	212824	283	277342

Prashant [5] The Uttarakhand irrigation division has appointed IL and FS as a novel TA (Transactional Advisor) for the multipurpose hydra scheme of the river SONG in Uttrakhand district in Dehradun with a view to creating it on P3 (public-private partnership) model. "The word of an award to IL and FS has been announced for being elected as the transactional advisor on the SONG dam," a top executive of the irrigation committee said. The company would judge the viability of building the dam on P3 (build-operate-transfer) BOT model, the official combined. The project is being introduced at village Sondhana village which is near to Maldevata region with an investment of Rs 500Cr-600 Cr by the state irrigation section.

Zitron [10] studied the use of P3 is being embarrassed by the public region's lack of perception of how possible private sector bidders observe contracts. From the literature and the experimental evidence intimates that bidders concern themselves with two hazard assessments, the risk of associating in the bidding manner and the risk of the scheme itself. Nevertheless, the literature is under development in connection with the bidding method and to contracts not granted simply on price. Except the public sector has a distinct understanding of bidder decision making, it risks breaking to address the dilemma of low bidder response. Singular initiatives like as procedural standardisation might bring advantages but might not address engagement problems. This research has been exploratory but its resolutions suggest that there is a strong research schedule that must contribute both to improving P3 procurement and to the advancement of the literature on civil contracting. The factors that are influencing the P3 projects are illustrated in figure below.

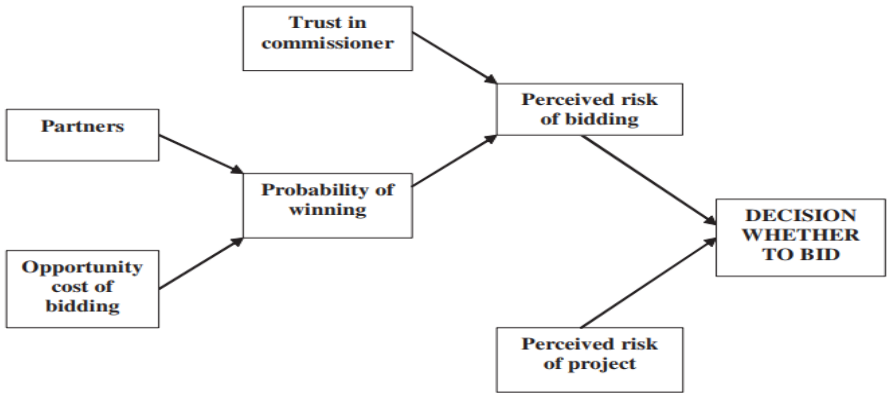

Fig. 2.1 Factors affecting the private sector bidding for P3 contracts [10]

Varnavskii and Tsvirkun [11] studied the economic difficulties in Russia Modernization of the massive-scale foundation. The point of analysis is P3 (Public-Private Partnerships) in Russian foundation in the framework of the central laws on acknowledgements and P3s started into the legitimate force in 2005 and 2015 individually. Specific attention has been paid to the organizational system of selection of property projects to implement state support. The researcher's general determination is that despite the present problems in Russia and throughout the world P3 s remains one of the common primary instruments for supporting growth large-scale foundation.

Feng et al [12] focused on public plans, public area reform, and social difficulties, leaving how P3s re-create values have been studied in detail. P3 (Public-private partnerships) have received the particular concentration in the region of public administration, business administration, and policy.

The researcher's studies examination of P3s and value-based plans including value re-creation and examines how P3s re-create value. In this research of Hwang Sun Enterprise in cultural and productive industries, authors provide a knowledge of how the main firm initiated and supervised a P3 with public areas such as Tainan City Government and educational sector such as Kun Shan University Incubation Centre, how the firm moved from the role of producer to service provider, and how the company combined its centre technologies from auto-machinery with humour culture from Anping, and how people re-created value. Depend on induced structure, authors specify a theoretical structure for value re-creation of P3s and symbolize that heterogeneity and country goods features of P3s have impacts on value re-creation. Joining co-specialized assets and the effective ability of the focal firm has moderating influences on how P3s re-create value. At last, theoretical enrichment, implications, and constraints have been discussed.

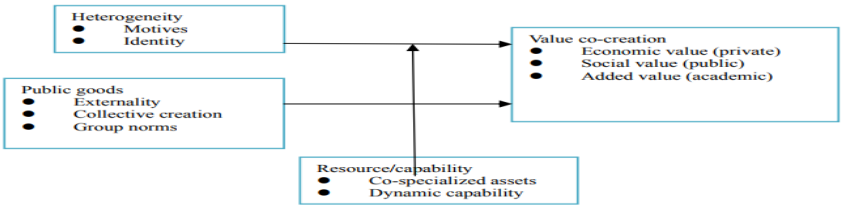

Fig. 2.2 Frame work of research work [12]

The research is mainly focused on to join the two theoretical perspectives namely P3s and value-based strategy – for investigating the phenomena of government and private collaborations in artistic and creative infrastructure. Research on imperative management is mainly focused on the two aspects and presented rich insights.

Bao et al [13] utilized HHM (hierarchical holographic modelling) to recognize the risks factors in transportation P3s under the viewpoints of contractual nature of P3s, education and cultural situation, and inadequate supervision. After that researcher proposed that the traditional monetary audit approach could not efficiently control risk on P3s, and moreover, authors provide an analytic structure of audit supervision for transport P3s by joining the methods of modern risk-orient and production audit to control the hazards.

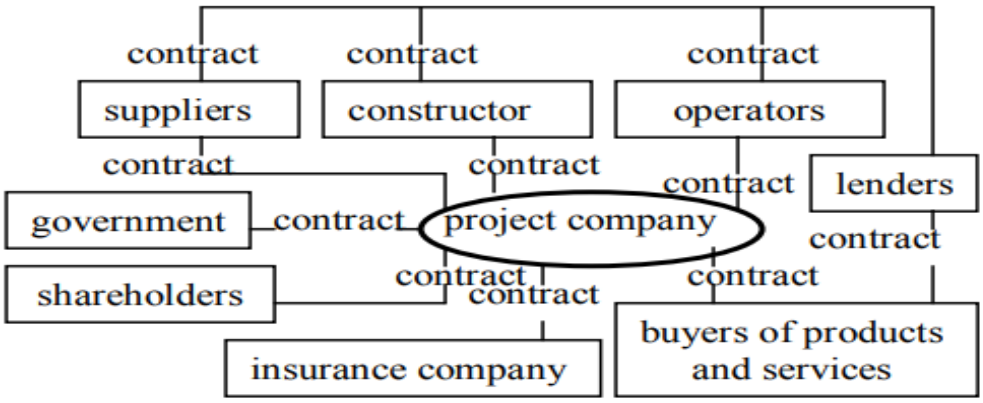

Fig. 2.3 The classic schematic for a transport PPP transaction [13]

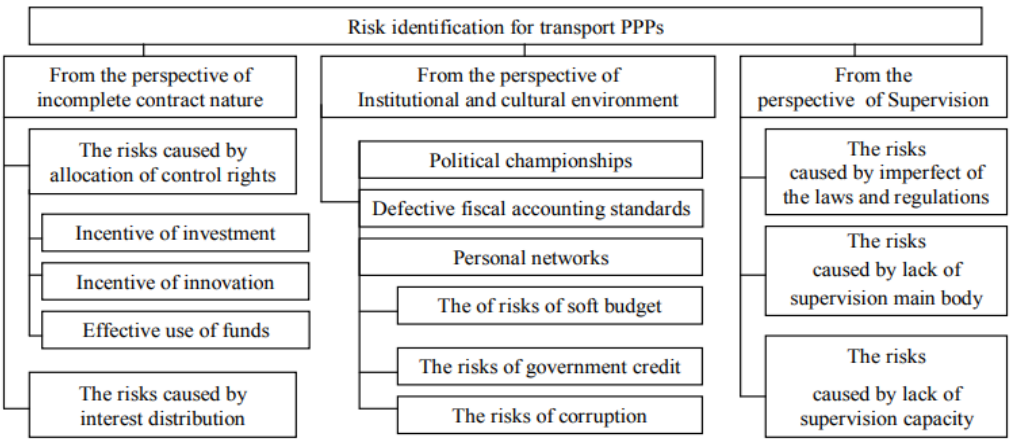

Fig. 2.4 Risk recognition depends upon HHM method [13]

Atmost of the transport P3s have the tendency of the charge and the advantages are usually formed in the performance period. Many portions will vary throughout this time like the changing of purchasers and traffic inquiry, economic growth, the variation of the extension rate, as well as the development and modification of service. In brief, a number of factors would affect the operation benefits positively or negatively. Because of the contract is not completed and the inadequate rationality of man, it is impracticable to make precise predictions for the change of future when engaging the initial contract, neither to list the reasonable interests allocation courses for the stakeholder in a part. Therefore, these will enhance the risk of maintained and wholesome construction as well as efficient operation of P3s.

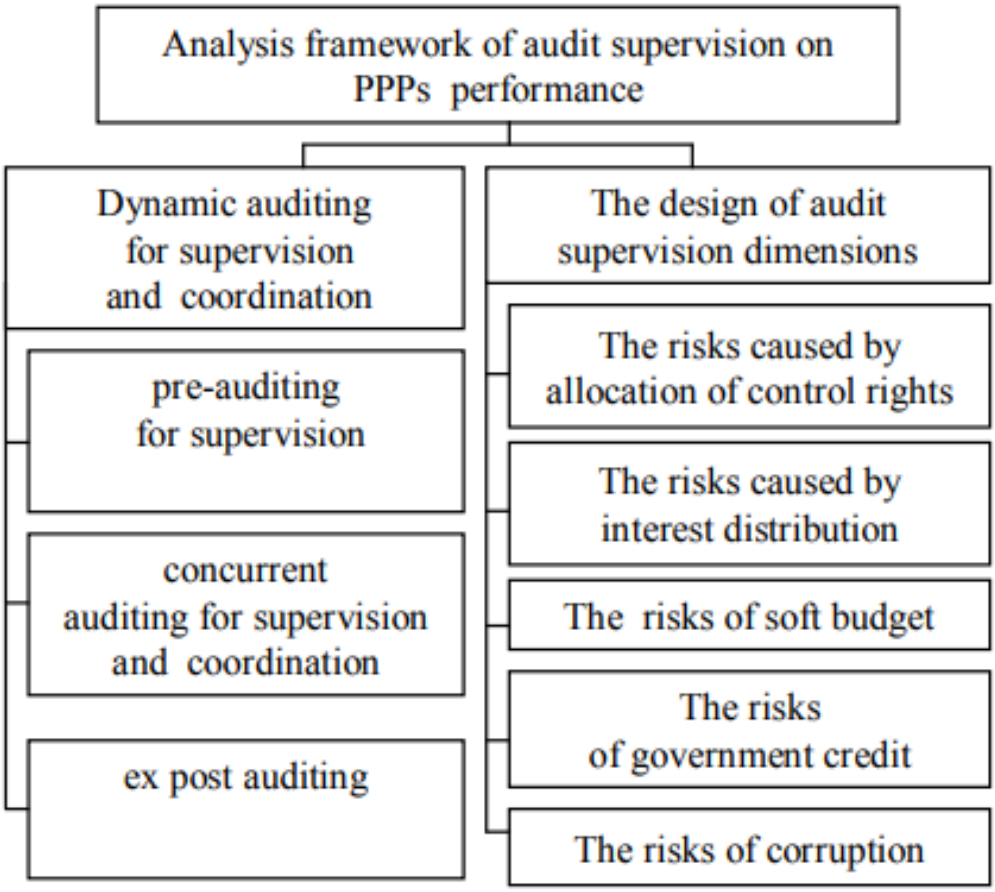

Fig. 2.5 Structure of audit supervision of transport PPP [13]

The transport P3s is a character of the typical complex system. As P3s involve plenty of areas in the process of construction and development, participation subjects and aims of every sector change frequently and fights are easily generated. Consequently, the management on P3s is very difficult. So, we demonstrate that

strengthening the inspection supervision is a great way to maintain it efficiently. But conventional audit approach limit to economic audit that is a kind of ex-post examination method. The researchers thought that, with only ex-post examination on P3s, satisfactory supervision influence is hard to be achieved. Initially, the lack of pre-audit and parallel audit, with only ex-post audit, this examination could not help to strengthen the quality and occurs quickly to the loss of surveillance effectiveness.

The quality is mainly determined in the manner of construction and development of P3s. Post- changing is hard to give fundamental help. Further, financial audit involves about the accuracy and agreement of use of the fund and concentrate on efficiency in the utilization of funds. But, in extension to the efficiency of use of the fund, the administration of P3s highlights on project quality and the budgetary, social and eco-friendly benefits of construction and co-operation that are not only monetary indexes. Therefore, the economic audit cannot provide scientific evaluation results to P3s.

In these circumstances, the researchers proposed that the current risk-oriented audit has been also known as business risk audit program and administration audit approach shall be applied in transport P3s.

Kuriyan and Ray [16] studied the theory and experiment of PPPs (public-private partnerships) by using the standard of information and communication technologies and construction (lCT4D) in India. The authors also provide a comparison between the relationship and the roles of, the state and small-scale contractors in ICT4D struggles in Kerala and Andhra Pradesh (A.P) in India. During this observation, it shows how the political economy inside the P3 model's works, and indistinct the state's relative importance on financial versus social objects, resolves who benefit most from modern ICT4D projects.

It is determined that notwithstanding pro-poor intentions, and inconsiderate of levels of state engagement in projects, the advantages of these projects are essentially captured by the intermediate classes. Micro-businesspeople who work ICT enabled companies and maintain close relationships with the state are also likely to profit from P3s through improved incomes. The authors also argued that, through these certain ICT4D projects, states in India are seeking to reshape themselves into

business-friendly, effective entities that traditionally described the private area. It has been concluded that in this negotiation, the state is not privatized, but preserves a sense of its personal development program and remains important for the reliability of P3s in civil society.

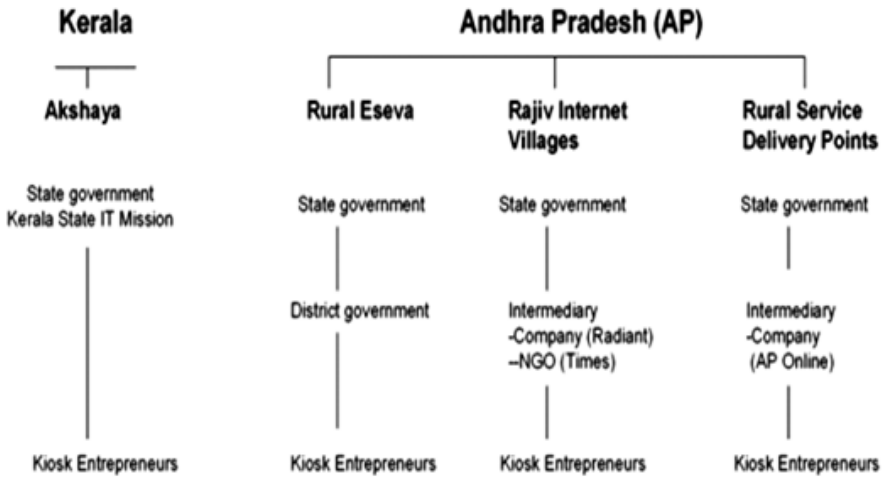

Fig. 2.6 P3 Kiosk model in Kerala and Andhra Pardesh [16]

The researchers have measured the coupling of the P3 model with ICT4D efforts in the knowledge of how it facilitates a reshaping of the state and concerns entrepreneurs and houses in India. From the literature review of PPPs, it is concluded that there is light substantive knowledge on how PPPs work in practice or judgment of the specific functions of the private and public areas in these businesses. This paper contributes the P3 analysis by critically investigating the theory and practices of these organizations, particularly with respect to the association of the state to administrators, through comparing the construction and administration of ICT4D kiosk schemes in Kerala and AP.

Singh [7] India has observed an entire metamorphosis over the latest decade. Sprawling towns, flourishing businesses, a higher standard of living are all signs of unparalleled growth, globalization, urbanization, extension and diversification. Foundation modernization and improvement are said to be the principal driver of all the extension and economic movement. The public areas alone can’t match the needed funds and technology for the schemes. Therefore the Government determined

to accomplish this industry by co-operating with the sector which could give this requirement that was none other than the private people. Thus P3 developed as a joint collaboration of the public & private areas. The Indian foundation sector is at an inflexion point and there are extensive opportunities for the private area. The P3 has come into existence for over a decade but it has given remarkable outcomes in past 5 to 6 years. Practically every sector is included where P3 needs to be performed. Several foreign companies also give their interests but their assistance is not much as the homemade private corporations. The sectors included in this research are health, scholarship, power and transportation.

Kumar [8] Non-critical fields in the Indian Railroads should be recognized and private sector cooperation should be allowed in the equivalent. The Indian Railways has mainly focus ed on the centre activities of driving and operating the trains. The forecasts remain gloomy for any significant policy change due to a greatly weak record of execution of contracts in the extended run. Corporatization of Indian Railways is the greatest idea to take the restructuring of the Indian Railways forward.

The IR (Indian railways) should also choose GAAP (General Accepted Accounting Principles), the performance of the Indian Railways Regulatory Authority (IRRA) should be encouraged and it should be empowered to decide the expenses to be charged from the passengers with a stipulation for adequate compensation from the Union Budget for holding fares reduced to fulfil its goal of social welfare. Construction of locomotives and carriages should also be within the P3 Model.

2.1.2 Public Private Partnership Model On Dam

Ullah [17] analyse the situation of hydro-power projects in India, P3 policies and hydropower projects started through it, and prosperous examples of world hydro-projects within P3 models, which provides tremendous possibilities in India.

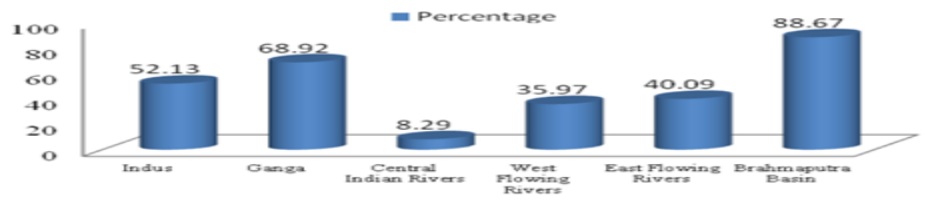

Fig. 2.7 Hydro-Power Capacity to be taken up for Construction [17]

The principal Indian states have the greatest established capacity of 81 percent (%) under work and about 10 percent (%) is under formation stage, though in the utmost of the month, the region receives uncommon monsoonal rain. The west running rivers have also 63 percent (%) under working condition but only 1 percent (%) is under construction. These areas have a number of small streams that provide a large possibility for hydropower development. The Ganga River supports many branches both from the Himalayan along with the peninsula area but only 25 percent (%) of latent hydro-power is in administration.

Almost of the waters of this area are employed for horticulture purpose as the Indo-Genetic area is the most productive region of the world. Accordingly, there is less possibility for hydropower expansion in these regions. The east running regions have also famously developed projects notwithstanding many inter-state disputes. But, if the researchers look at all India information, it can be noticed that about 68 percent (%) of hydro-power capability is yet to be realized. It can be viewed from the figure above that there are large differences among various river basins in the entire installed power capacity. It presents enormous potential for hydropower growth in the expansion of these areas.

Kwak et al [4] discussed the Hoover Dam project that is very prosperous in the 1930's despite the recession for several reasons. Unluckily it is highly feasible that a comparable megaproject would not be flourishing if it started now. This is due to many factors, comprising changing connections between government and industry, technological improvements, and outsourcing. Additionally, regulations about safety and overtime do not support the same methods that were employed in the formation of the Hoover Dam.

With respect to individual features of the Hoover Dam project, including the position of the site, its geologic and topographic characteristics, and the unique size of the dam construction that required the use of latest construction technology and material, the project company encountered significant technical and managerial problems in the planning, layout and construction phases. Despite all these difficulties, production of the

Hoover Dam directed out to be a great achievement and conducted significant advantages to the owner, contractor, and other interested people associated with the

project. The most significant characteristics of the project, that are supposed to have the greatest participation in the progress of the Hoover Dam, can be reviewed as follows:

• Project construction activities including utility study, site collection, and conceptual plan necessary for providing authoritative requirements as a sequence of which project mission, scope, and difficulties are clear for all the participants those are concerned with the project and supported them to overcome project issues.

• The close correlation between project members especially Bureau of Reclamation and Six Companies, Including both at the field level and the managing level.

• Ensuring the plan and construction activities by selecting a plan review board and executing effective change administration processes that are minimized rework and delay during development;

• Setting a clear series of command in the master and contractor associations to adjust relations both internally and externally.

• Maintaining the project by guarding adequate yearly funding and appropriate legislative and administrative means.

2.1.3 Optimization Using Genetic Algorithm

Xu and Zeng [6] proposed an unknown optimal control model in which material failure time is created assuming a Weibull distribution for trading with the DEAP in the Shuibuya Hydropower Project. The collection and management of the Weibull distribution for modelling have been justified by using the chi-square morality-of fittest. The two parameters such as scale and shape have been used for Weibull concentrations are estimated based on maximum-likelihood estimation.

A breakdown probability work time equation has been presented to illustrate the relationship among equipment malfunction probability and anticipate the time to work. To convert the unknown optimal power model into a deterministic one, the EVM (expected value model) is introduced. Then, the Particle swarm optimisation (PSO) method is applied to examine for the optimal resolution of the DEAP, in which

initializing and synchronizing methods are employed to withdraw infeasible solutions.

The results of this study designate that the proposed optimization technique is very practical and effective in solving the DEAP, with possibilities. The main goal of this research is to provide an alternative and efficient system for optimizing the DEAP in a building project.

Ng et al [9] proposed a system by which both simulation and the fuzzy algorithm could be combined to install the most adequate concession item choices for P3 projects. By consolidating the complex impact of hazards involved, a suitable concession period could be inferred by a simulation based on the lowest expected IRR (Internal rate of return) and tariff regime.

Nevertheless, as the actual Internal rate of return and tariff regime have not be identified at the proposal solicitation stage, alternative scenarios require to be generated for reflection. The goal of the fuzzy comprehensive evaluation method is to enable judgments-makers to choose the most excellent alternative from a list of feasible scenarios, like the concession period can be used for plan invitation, while the similar tariff regime and investment results could serve as a foundation for proposal evaluation at the following stage.

The simulation method and the application of fuzzy system have also been demonstrated through a hypothetical example. The proposed simulation design helps decision-makers organize a concession period for a P3 project that is satisfactory to both the public and private partners for an example

(i) To assure the concessionaire gains a moderate return

(ii) To provide the public client to restore the facility at an appropriate time. After devising various possible alternatives of the permission items using the simulation system, choices-makers could then estimate the three concession items named as IRR (Internal rate of return), tariff regime and concession period of every alternative. The decisions would provide the fuzzy connections among the three items and choices. Then, within the fuzzy composite system, the non-inferior resolution could be achieved to maximize the achievement of all the three companies.

While the introduced simulation design and fuzzy MOD could provide choices-makers with a helpful tool for establishing a better alternative of yielding

items for a P3 project, further development might be required to make the method more implementable.

Zheng et al [24] Diminishing both venture cost and time ~duration! is basic in a focused situation. Be that as it may, an exchange off between venture time and cost is required. This thus requires contracting associations to painstakingly assess different ways to deal with accomplishing an ideal time-cost harmony. Albeit a few systematic models have been created for time-cost advancement ~TCO!, they mostly center around ventures where the agreement term is settled. The advancement objective in those cases is in this manner limited to recognizing the base add up to cost as it were. With the expanding prevalence of elective undertaking conveyance frameworks, customers and contractual workers are focusing on the expanded advantages and chances of looking for a prior undertaking finish. The multiobjective model for TCO proposed in this paper is fueled by systems utilizing hereditary calculations ~GAs!. The proposed show coordinates the versatile weights got from past ages, furthermore, incites a hunt weight toward a perfect point. The idea of the GA-based multiobjective TCO display is represented through a straightforward manual reproduction, and the outcomes demonstrate that the model could help leaders in simultaneously touching base at an ideal venture span and aggregate cost.

This paper introduced a novel multiobjective approach that plans to advance aggregate time and aggregate cost at the same time by using proper GAs ideas and instruments. The model presents a MAWA ~modified versatile weight approach! to supplant customary settled or on the other hand arbitrary weights, and coordinates time and aggregate cost into a solitary objective for reenactment. This approach gives the GAs with more prominent opportunity to look in the multiobjective space that overcomes the disadvantages of single target TCO, i.e., a neighborhood ideal in HCA ~hill-climbing calculations!, and the vitally proposed multiobjective approach created by Gen and Cheng ~2000.

The basic manual recreation in view of the application display proposed in this paper affirms that the GA-based multiobjective TCO consolidating the MAWA could help leaders in setting up ideal aggregate time and ideal aggregate cost simultaneously. MAWA can acquaint more noteworthy seeking weights with oppose the natural merging energy of GAs, contrasted and the already proposed

AWA. Additionally the versatile weights have handy significance in the new approach speaking to the relative significance of every foundation to the entire venture. These weights will direct the calculations to look through a more extensive territory against the targets that have a moderately little investigation space in past ages. In doing as such, the approach can ensure the decent variety of investigation and productivity of abuse of verifiable data. The MAWA display proposed isn't without shortcomings, and some further refinements are important to enhance its foreseeing precision.

For example, since the model uses GAs as the pursuit motor, the arbitrariness inborn in GAs could influence the dependability of results and additionally the wellness of the proposed approach for taking care of the TCO issue. Likewise, the proposed demonstrate requires the chiefs to decide the last best arrangement. In any case, as a solitary leader might not have sufficient information to help his/her determination and the relative components are much of the time excessively loud by and by life, a choice emotionally supportive network is profoundly alluring to help chiefs in picking the best arrangement from an extensive rundown of nondominated arrangements as indicated by his/her exceptional condition. More innovative work endeavors are expected to guarantee an unfaltering execution of the model while applying to extensive scale ventures.

Romildo et al [23] This paper exhibits a methodology to streamline the development of mass solid structures utilizing hereditary calculations. Because of bond hydration, warm and shrinkage strains occur in concrete at early ages and, in the event that they are controlled, ductile anxieties create in the solid structure. As an outcome, breaks may show up if the greatness of the created stresses achieves the solid rigidity. In this investigation, transient hydration and warm and stretch fields were ascertained utilizing a coupled thermo-chemo-mechanical model executed in a 3D limited component code. The improvement standard is development cost and the choice factors are material composes, described by their mechanical and hydration properties; putting temperature, the tallness of lifts and time interims between lifts. The requirement forced on the choice factors is the early age breaking of the structure

. A dynamic punishment plot that permitted a specific level of breaking for the preparatory ages ended up being effective in driving the hereditary calculation to

an ideal arrangement. To demonstrate the capability of the proposed philosophy, the development period of a little hydropower plant dam was upgraded. The outcomes demonstrated that the strategy can be effectively utilized as a part of the plan of gigantic solid structures.

This paper shows a technique to upgrade the development of mass solid structures utilizing hereditary calculations. Because of bond hydration, warm and shrinkage strains occur in concrete at early ages and, on the off chance that they are controlled, malleable anxieties create in the solid structure. As a result, breaks may show up if the extent of the created stresses achieves the solid rigidity. In this examination, transient hydration and warm and stretch fields were ascertained utilizing a coupled thermo-chemo-mechanical model executed in a 3D limited component code. The streamlining measure is development cost and the choice factors are material writes, portrayed by their mechanical and hydration properties; setting temperature, the tallness of lifts and time interims between lifts. The requirement forced on the choice factors is the early age splitting of the structure. A dynamic punishment conspire that permitted a specific level of splitting for the preparatory ages turned out to be productive in driving the hereditary calculation to an ideal arrangement. To demonstrate the capability of the proposed approach, the development period of a little hydropower plant dam was upgraded. The outcomes demonstrated that the system can be effectively utilized as a part of the plan of monstrous solid structures.

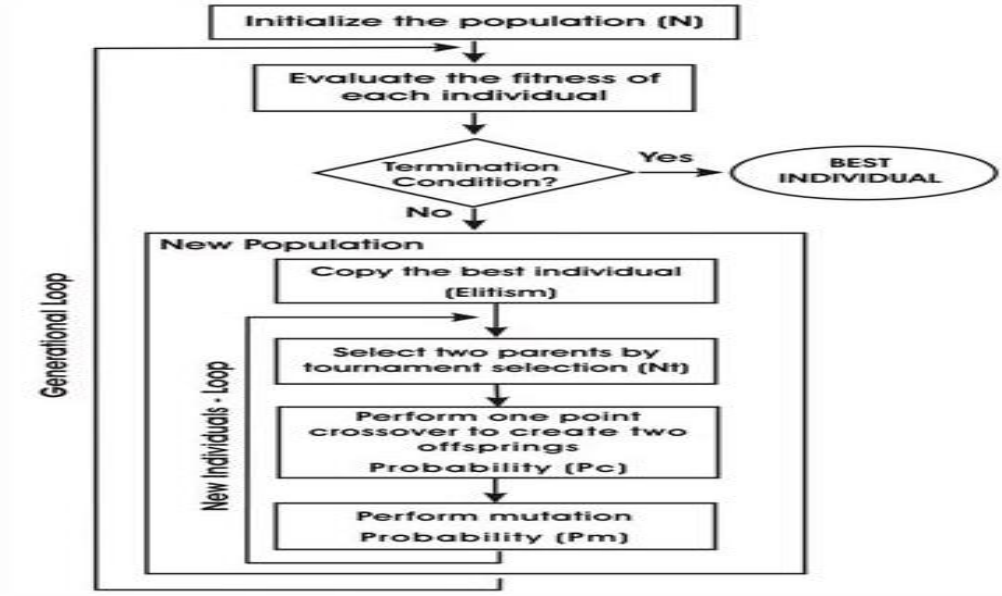

Fig. 2.8 Flowchart of Genetic Algorithm

2.2 Summary of Literature Review

Arrangement of value foundation administrations at sensible cost, is a fundamental condition for accomplishing maintained financial development. Interests in foundation includes high hazard, low return, colossal speculation, high incremental capital yield proportion, long payback periods and unrivaled innovation. The Eleventh Five Year Plan imagined add up to interest in physical foundation to increment from around 5 for every penny of GDP in 2006-07 to 9 for each penny of GDP before the finish of the arrangement time frame.

These essentials represented a limitation on the administration's effective conveyance of value foundation administrations. Government is moving from its conventional part of supplier of administrations to facilitator and controller of administrations. This has given route for open private association models. The accomplishment of the administration's endeavor at foundation improvement fundamentally relies upon the achievement of Public Private Partnerships (PPPs) ventures. With the GOI and the Govt. of A.P focusing on the requirement for development in framework for economical improvement, it is viewed as a well-suited time to attempt an investigation in the zone of PPPs.

The present examination would be valuable to the administration, engineers, budgetary establishments and temporary workers in understanding the basic achievement factors and basic hazard components to be thought about with the goal that the rare assets are ideally used for the fruitful consummation of the undertaking. It will likewise enable the implementers to comprehend the impression of the clients towards the PPP street to extend and towards paying toll, with the goal that they can develop better systems for producing future incomes.

The following points are determined from the literature review are:

1. In India, Uttarakhand Song dam to be built on PPP model.
2. In the literature review there is no comparison between the construction of dam with PPP model or without PPP model.
3. No optimization algorithm has been used for optimizing the P3 model.

2.3 Objectives

Objectives of the present work based on the literature review are:

1. To study the feasibility of PPP model at Larji dam.
2. To compare the construction of Larji dam with and without PPP.
3. To study the optimization of Larji dam construction by PPP model.

Chapter 3

METHODOLOGY

3.1 General

In this section, the process of proposed work is discussed in detail. The process includes work plan, collection of data from dam construction site, preparation of data sheet, and formation of code in MATLAB simulator tool.

3.2 Work plan

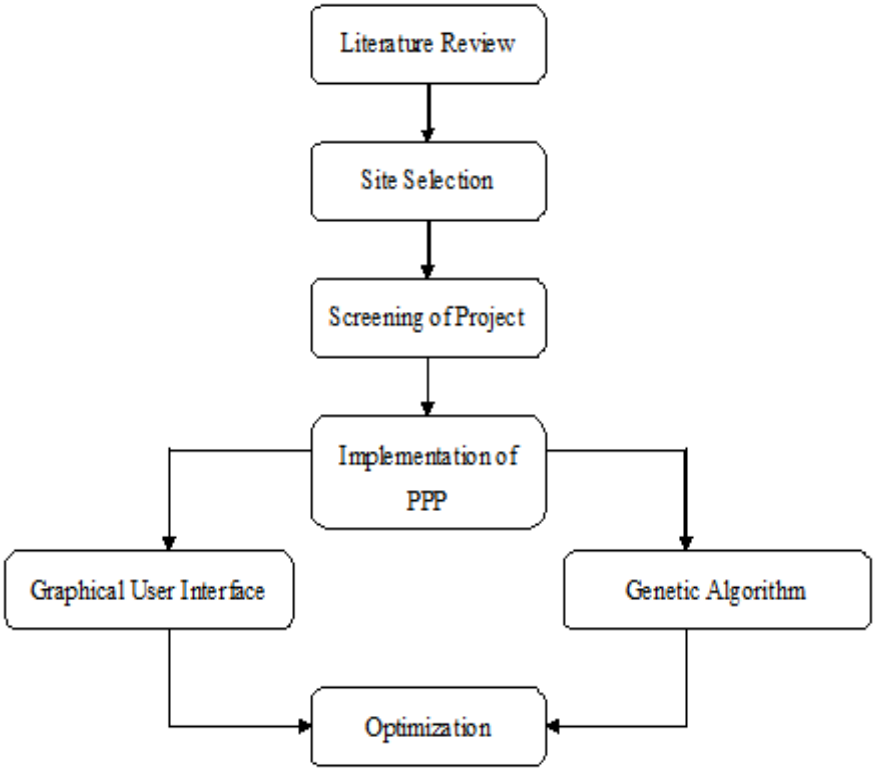

Fig. 3.1 Sequential diagram of work plan

As shown in Fig. 3.1, the research work is started from the reading of different research paper. Most of the research paper contained the information about the highways, railways and building infrastructure. Very few of the research paper working on the construction of dam with Public Private Partnership model. After reading the

research paper, the dam site is selected. All dam and reservoir projects proceed through a similar sequence of activities during their development leading up to construction. After the investigation of site , there is identifications of the major components of the project to fit the site.

After the completion of site selection and screening of project, the PPP model is implemented in MATLAB. There is reduction of cost and time to the original cost of the dam. With the help of GUI and Genetic Algorithm we can optimize our results more efficiently.

3.3 Methodology of Proposed Work

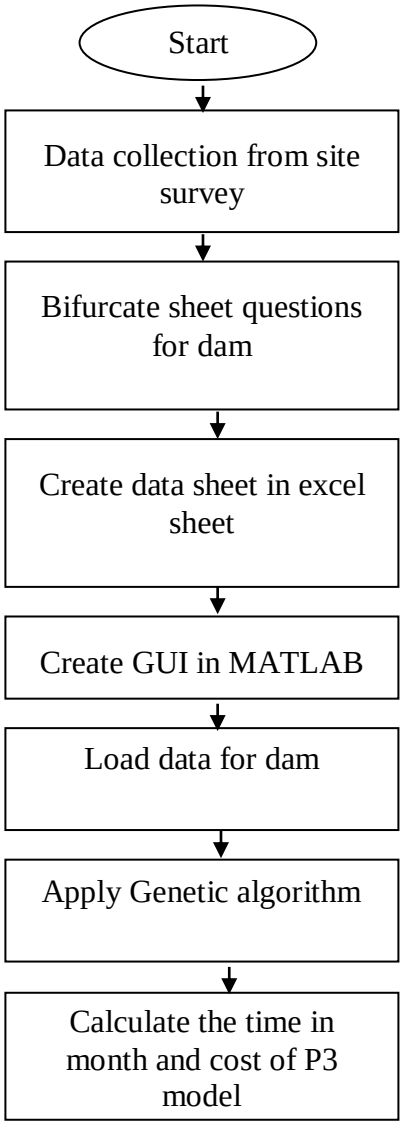

Fig. 3.2 Sequential diagram of proposed work

The figure 3.2 represents the work description of proposed P3 model. The sequential diagram represents each and every step of the methodology.

There are two sheets in the project. The first sheet is contained work description and second sheet contain nodes and vendors of dam construction.

1. Read sheet data for all questions
2. Bifurcate sheet questions for dam
3. Display them into the GUI in different segments
4. For each question in each type, there are three answers

- Vendor 1
- Vendor 2
- Vendor 3

5. Identify the question selected at the GUI and search the question in question sheet.
6. Extract all answers for that section
7. Find all the vendors according to the cost of the construction and the vendors whose have the lowest cost will get the contract.
8. In such a manner for each question there would be an increment in the answer options.

While working on the MATLAB, after collecting the data from the site, that data is uploaded on the excel sheet. The excel sheet is directly link with MATLAB and it loaded the cost and time of dam from the excel sheet. Genetic algorithm is used to optimize the cost and time which came from the implementation of PPP model.

Next step is to apply genetic algorithm along with three elements named as fitness function, mutation and crossover function. The screenshot of Genetic algorithm code is shown in figure below:

3.3.1 Genetic Algorithm (GA)

According to Goldberg et al., 1989, GA (Genetic Algorithm) is mostly utilized in the applications where the examined space is big. The benefit of a Genetic Algorithm is that the process is fully involuntary and avoids home-grown minima.

The main mechanisms of Genetic Algorithm are named as the crossover, mutation, and a selection function. The border operations are used for making a novel chromosome from parentages sets while the change operators add the difference. The suitability function performs a chromosome reliant on the principles already defined. A better fitness value of a chromosome raises its existence chance. The people are a chromosomes group. An original population is approved out by using normal genetic operations similar single-point crossover, mutation, and selection operator.

```
global GareducedFeatures
options = gaoptimset('PopulationSize', 50,'SelectionFcn'...
    ,@selectionstochunif,'MutationFcn',{@mutationuniform, 0.05},'CrossoverFcn'...
     ,{@crossoverintermediate, 0.8});
   [r,c]=size(damcost);
     damcostnew=[];
    damcostnew=damcost;
for i=1:r
     Ft=mean(damcost(:,3))
     Fs=damcost(i,3);
      FitnessFunction = @(e)fitness_fn(e,Fs,Ft);    %calling fitness function
    numberOfVariables = 1;

     [x fval] = ga(FitnessFunction,numberOfVariables,[],[],[],[],[],[],[],options);
      if (x>0)
         damcostnew(i,3)=abs(damcostnew(i,3)-x);
      end
end
```

Fig. 3.3 Screenshot of Genetic algorithm code [25]

Steps of Genetic Algorithm

Step 1: To reset random population having chromosomes.

Step 2: To compute suitability function in the population.

Step 3: To develop the novel population of persons.

Step 4: To choice parent chromosomes for greatest fitness function.

Step 5: To do crossover to have the duplicate of parents.

Step 6: To do the alteration to mutate novel off springs.

Step 7: To place novel offspring in the people.

Step 8: To repeat the steps to get a fulfilled solution.

Pseudo Code of Genetic Algorithm

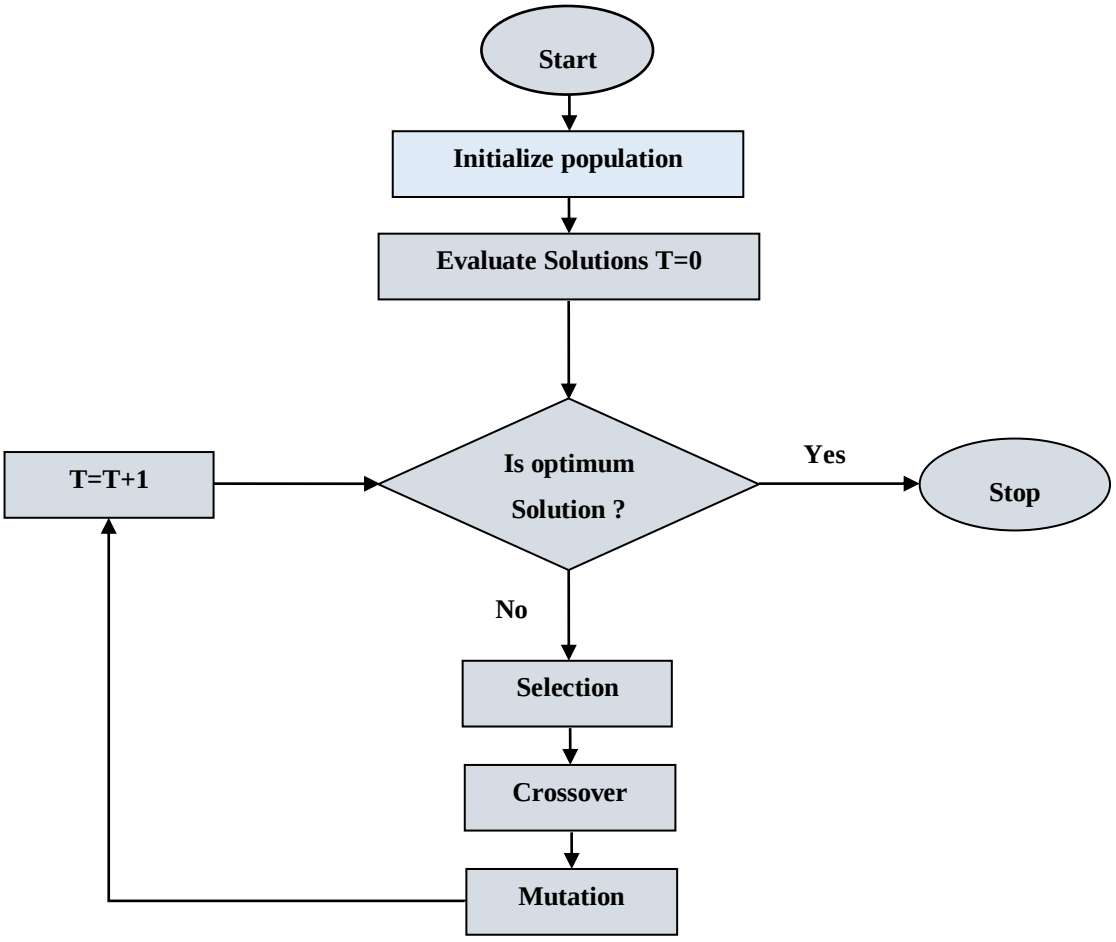

Fig. 3.4 Flow Chart of Genetic Algorithm

Function of GA ()

{

Initialize population;

Calculate fitness function;

While(fitness value != termination criteria)

{

Selection;

Crossover;

Mutation;

Calculate fitness function;

}

}

end

The terms used in the genetic algorithms are discussed below:

i. **Population:** It is a group of all possible coded solutions for a given problem. The population of genetic algorithms is similar to the human population. In addition to replacing humans, we have candidate solutions that represent humans.

ii. **Chromosomes:** It is one of the solution to the assigned problem

iii. **Gene:** A gene is the element location of a chromosome.

iv. **Allele:** It is the gene value taken for a specific chromosome.

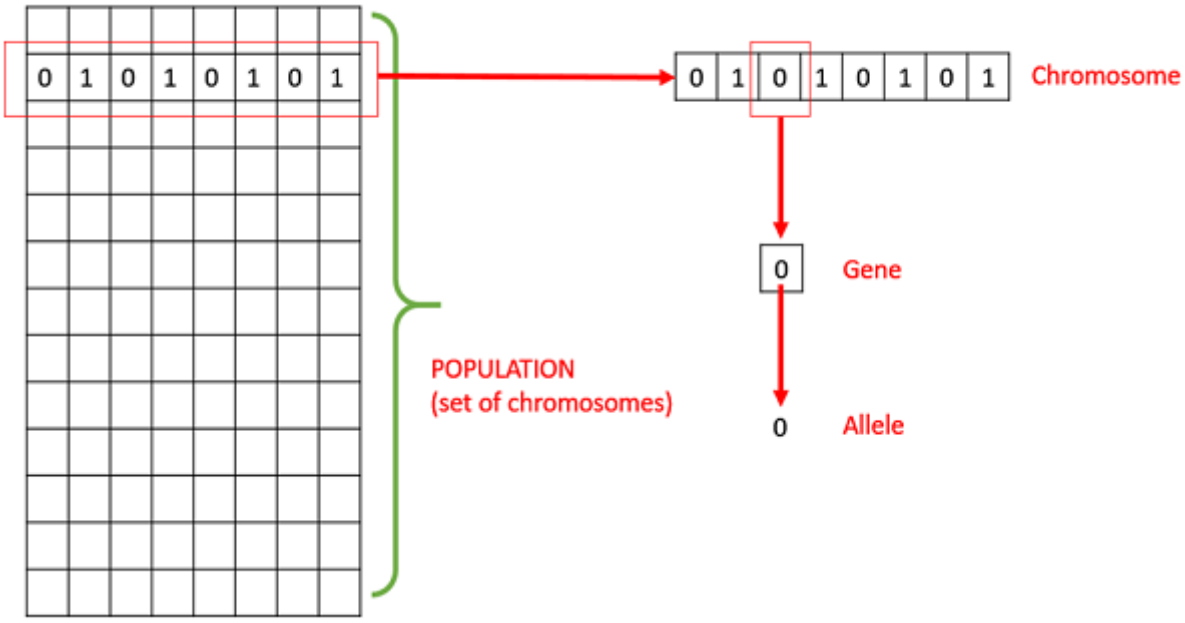

Fig. 3.5 An example of population, chromosome, gene and allele

v. **Fitness function:** It is defined as a function to which input is the solution and the output is generated as a suitable solution. Fitness function and objective function of genetic algorithm may by same in some condition or may be different in other conditions depends upon the type of problem.

vi. **Genetic operators:** The genetic operator comprises of crossover, mutation and selection.

vii. **Genotype:** It is the population in the computation region. In the computational region, the results are represented in such a manner that can be simply understand or manipulate by using computer system.

viii. **Phenotype:** It is the population in the real world solution which represents the solution in such a manner that the solution appear in the real world.

1. Representation

Representation and evaluation function are two components of GA that are related to the problem. With the coding, the GA manipulates the problem so, representation is also known as a problem. Therefore, the encoding scheme and character set are utilized. The binary set is used as it has the prevalent schemata for some defined matrices resolution for the enhancement of the implicit parallelism. In GA, the individuals are shown as the fixed length strings which shows the fixed length strings for expressing fixed binary strings that shows the schema as pattern for alphabet {0,1,*} and depicts a binary strings set in the search space. So, every string has 2^L schemata, where L is the binary string length.

a. Binary representation

This is one of the most commonly used representations in Genetic algorithm in which the input data is represented in the form of bits. For the problem, in which the solution region includes Boolean decision variable named as Yes/No, represented as 0 or 1.

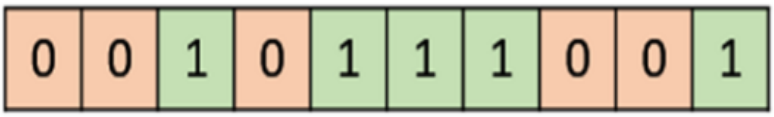

Fig. 3.6 Binary representation

b. Real value representation

This type of representation find application where the researcher wants to represents the real value instead of binary value. The real value representation is most natural.

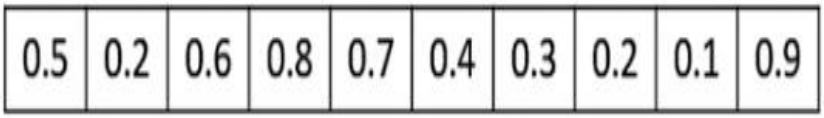

Fig. 3.7 Real value representation

c. Integer representation

As the binary value representation find application in the area where there are only two possibilities such as yes or no, but in case if the number of possibilities are increased upto five then the values are represented by integer number such as {0,1,2,3,4}.

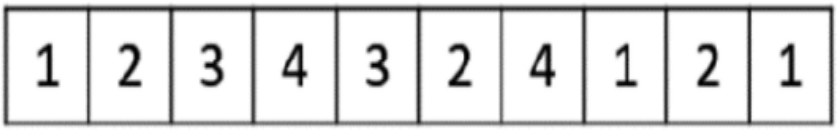

Fig. 3.8 Integer representation

2 Population

Population is defined as group of chromosomes that represents the solution in the current production.

Maintain diversity of the population. The size of population not be taken very large because it result to lower the speed of GA. Whereas smaller population is not to be efficient for obtaining best results thus an optimal population size must be selected to reduce the error. The population size is mainly defined in 2D array.

3. Fitness function

The fitness function is a function that takes the candidate solution to the problem as input and produces the resultant output to know the bet fitted value of the problem taken into account. The calculation of the fitness value is repeated in GA, so it should be fast

enough. Slow calculations of fitness values can have an adverse effect on GA and make it unusually slow. In most cases, the fitness function and the objective function are the same, with the goal of maximizing or minimizing the given objective function. However, for more complex problems with multiple goals and constraints, algorithm designers may decide to have dissimilar fitness functions.

I. The fitness function may comprise of the following two properties:
II. The computation must be fast
III. It determine the most appropriate value for the given problem
IV. The example to determine the fitness value is shown below:

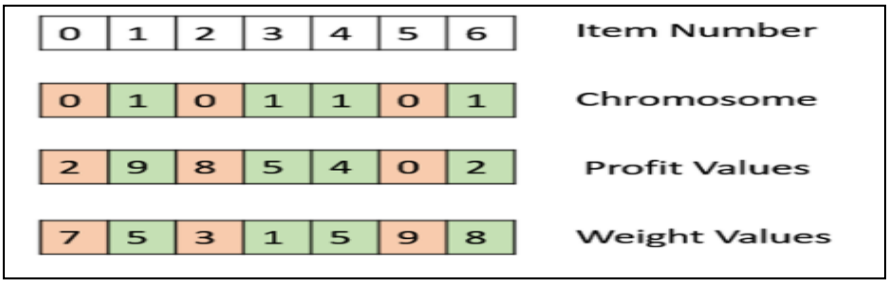

Fig. 3.9 Example of fitness function

4. Crossover

The crossover function is similar to reproduction or biological crossover. In this more than one parent is chosen and more than one offspring are generated by applying genetic material of the parents. GA is applicable with high probability P.

The crossover operators are discussed below along with the example.

a. One point crossover

An arbitrary crossover point is chosen and the tail of its two parents is swapped in such a manner that a new offspring can be obtained.

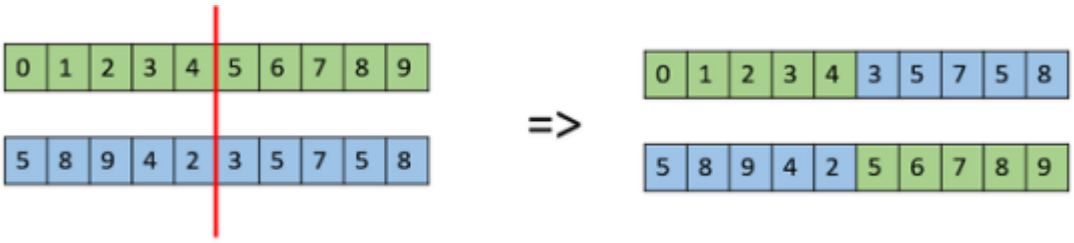

Fig. 3.10 One point crossover

b. Multipoint crossover

In this more than one crossover points are chosen to know the new offspring value.

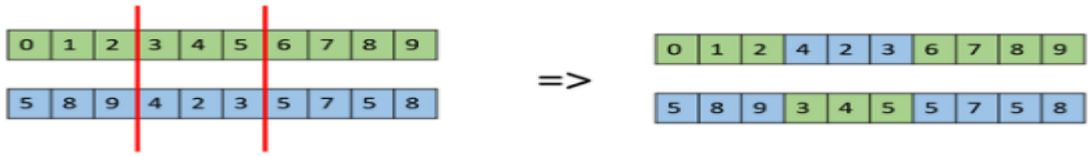

Fig. 3.11 Multipoint crossover

c. Uniform crossover

The chromosome is not divided into the segments and the genes are treated individually.

Fig. 3.12 Uniform crossover

5. Mutation

In short, the mutation may be defined as a small random adjustment in the chromosome to obtain a new solution. It is used to maintain the diversity of genetic populations and is usually applied with low probability P. If the probability is very high, the genetic algorithm will reduce to random search. Mutations are part of the GA related to "exploration" of the search space. It has been observed that mutations are critical for GA convergence, while crossovers are not.

Chapter 4

RESULTS AND DISCUSSION

4.1 General

In this section, the performance of designed P3 model is discussed in terms of cost and time. The cost is measured in Crore whereas time is measured in months. In the proposed work, ten kinds of works have been considered that are named as infrastructure cost, civil work, plant and equipment, construction and pre commissioning expenses, overhead cost, electrical work, mechanical work, electromechanical equipment, transmission, and financial charges. The starting cost, end cost along with vendor is discussed. At last, the comparison between PPP model without optimization and with optimization has been discussed for both time and cost.

4.2 Results

In this section, the results obtained for the proposed work in terms of time, cost and with & without optimization are discussed in details. Also, the calculation of dam efficiency, reduction in cost after applying Genetic Algorithm.

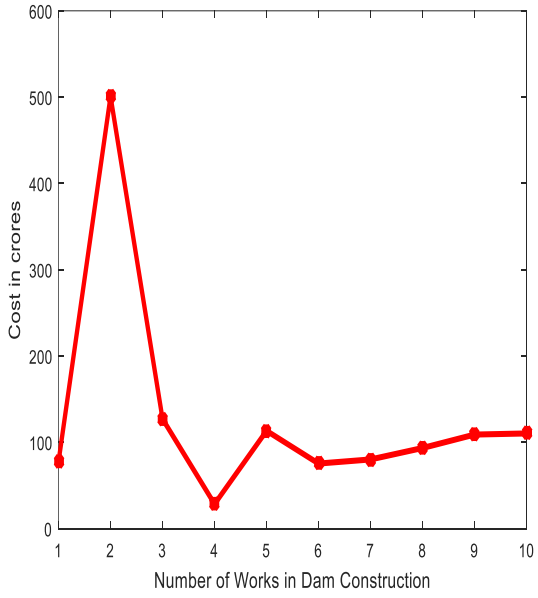

Fig. 4.1 Cost verses number of works in dam construction[25]

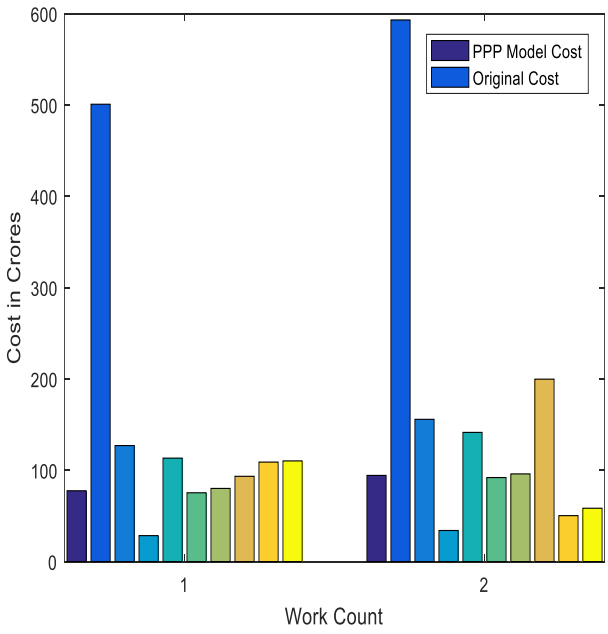

Fig. 4.2 Cost of dam with and without PPP model versus number of works in dam[25]

As shown in figure 4.2 represents the graph plotted between cost of individual work in Crore with respect to the number of works in construction of dam. The cost for second type of work is very high which nearly 500 Crore (civil work) is and minimum for 4^{th} work (construction and preconditioning) about 50 Cr.

Similarly, as shown in figure 4.3 defines the graph plotted between cost and work count. In this figure both the cost of dam with and without PPP model is plotted against number of works in construction of dam. Here dark blue bar depict the cost observed for PPP model and sky blue line defines the original cost of the DAM project. For first work count the value of cost measured through PPP model is 80 Cr whereas for second work count the cost observed through PPP model is 100 Cr.

In Fig. 4.2 work count 1 represents the cost of dam with PPP model against the number of works in dam, where as work count 2 represents the original cost of dam without PPP model.

Numbers of works in dam constructions are

Number of works	**Types of works**
1	Infrastructure cost
2	Civil works
3	Plant and equipments
4	Construction and pre-commissioning expenses
5	Overhead cost
6	Electrical works
7	Mechanical works
8	Electro mechanism equipments
9	Transmissions charges
10	Financial charges

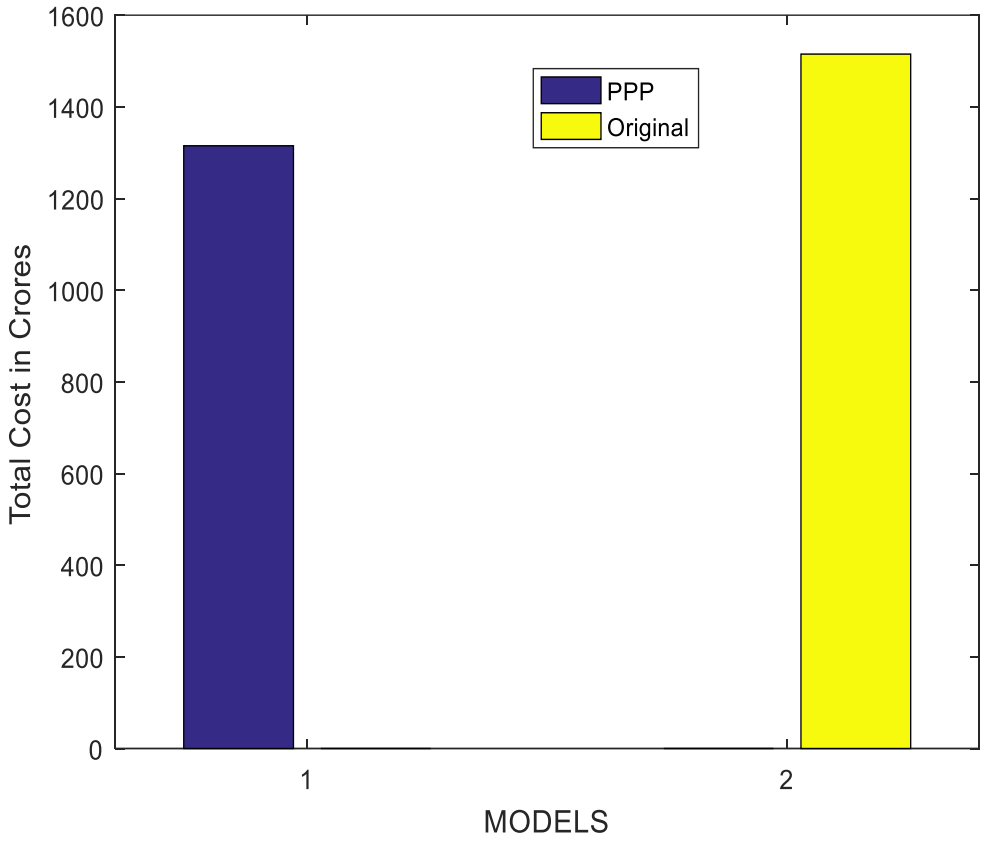

Fig. 4.3 Total cost for PPP model and original model[25]

As shown in Fig. 4.3 represents the comparison drawn between designed PPP model and original model. Here blur bar defines the total cost observed for PPP model and yellow bar represents the cost value without PPP model. The values observed are shown in table below:

Table 4.1 Comparison of total cost with PPP model and original model

Models	Total cost of dam (crore)
Public Private Partnership Model	1300
Without Public Private Partnership Model	1500

In this section, the results obtained for the proposed work in terms of time, cost and with & without optimization are discussed in details.Also the calculation of dam efficiency, reduction in cost after applying the genetic algorithm and reduction in time.

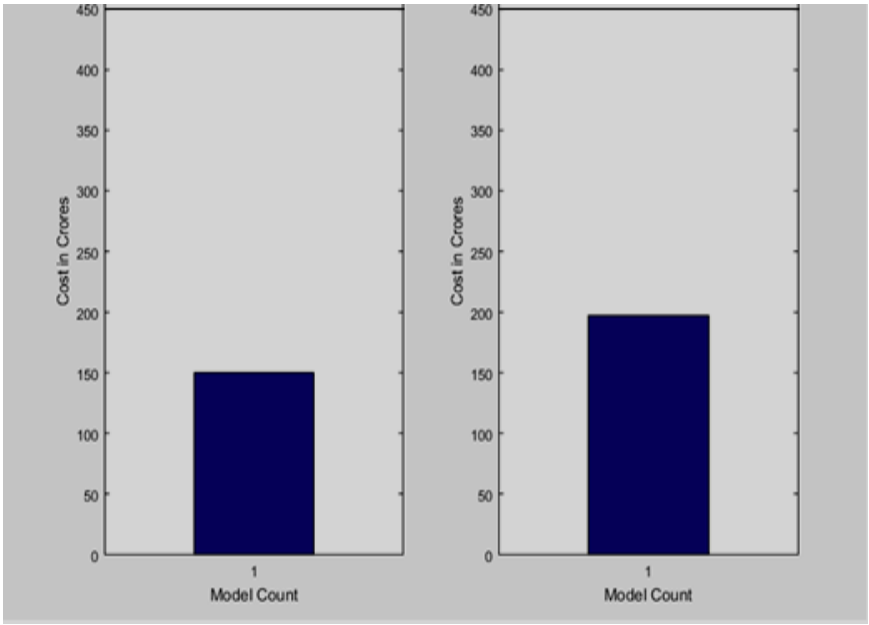

Fig. 4.4 Comparison of cost of proposed and previous work[25]

As shown in figure 4.4 represents the comparison graph between existing PPP model and the proposed PPP model. X-axis represents the model count whereas y axis represents the Cost in Crore. From the above figure it is clear the cost of the proposed PPP model is reduced from 197 Cr to 150 Cr. Where the model count 1represents the original cost of dam without PPP model and with PPP model. Thus we concluded that the percentage reduction of cost from previous to propose is 34 %.

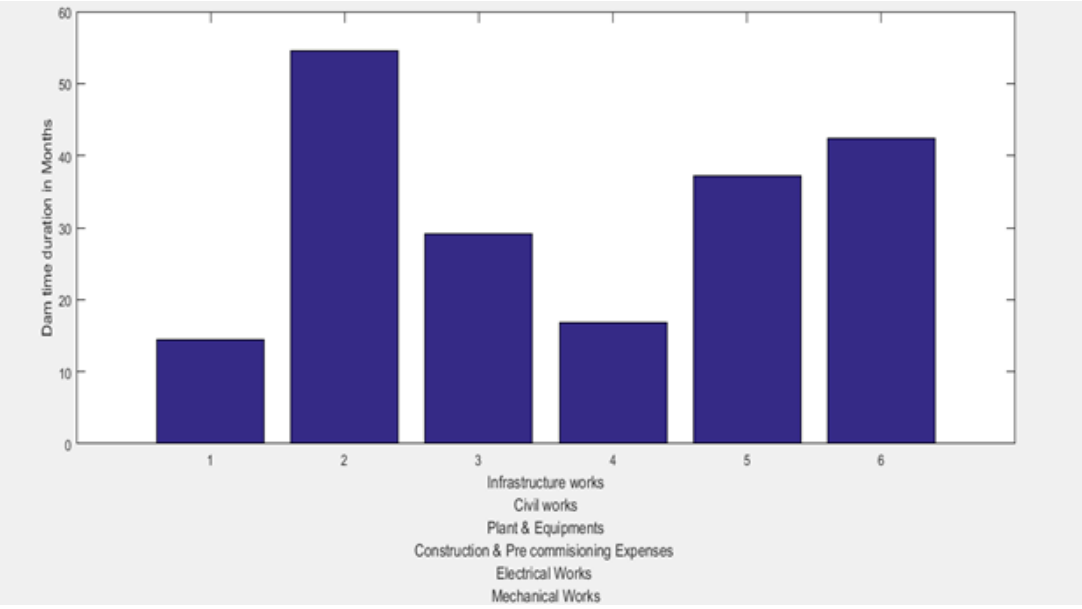

Fig. 4.5 Time duration of dam during construction [25]

As shown in Fig 4.5 represents the graph plotted between time duration (months) and the types of construction work. In the proposed research work, we are considering six types of works named as (infrastructure work, civil work, plant and equipment, construction and pre commissioning expenses, electrical work and mechanical work). The time taken for completing the different work is shown in the tabular form.

Table 4.2 Time duration of dam during construction

Type of construction	**Duration(Months)**
Infrastructure work	15
Civil work	55
Plant and equipment	30
Construction and pre commissioning expenses	17
Electrical work	35
Mechanical work	40

As shown in Fig 4.7 shows the difference between the time with and without PPP model. From the above graph it is clear PPP model is better than the previous model. The X axis represents the two types of models and Y aix represents the times in months. The values observed for the PPP and previous model are listed in table below:

Fig. 4.6 Comparison of time duration with PPP model and without PPP model [25]

Table 4.3 Proposed and previous work time duration

Model	Time duration (months)
Time duration with PPP model	190
Time duration without PPP model	260

From the above table it is clear that the duration of DAM project has been reduced from 260 months to 190 months when PPP model is used. It indicates that when P3 model used in the construction work the time duration reduced and the project is completed within the time limit.

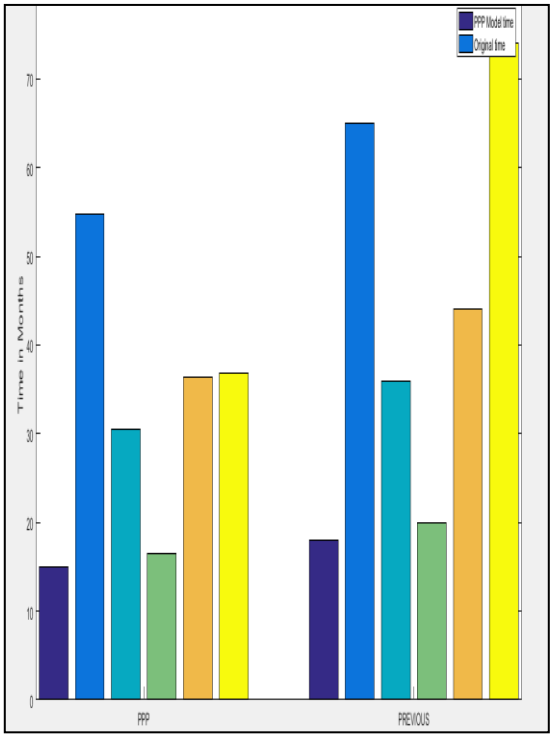

Fig. 4.7 Comparison of time duration PPP model and without PPP model in individual work [25]

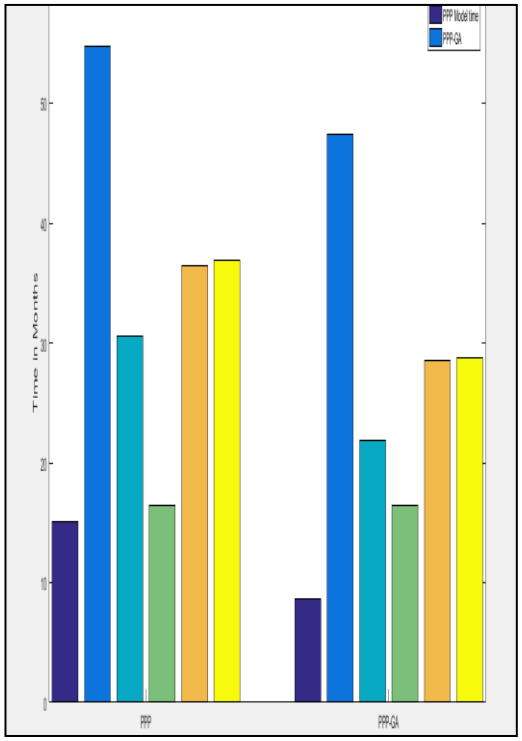

Fig. 4.8 Comparison of time duration of PPP model and PPP model with genetic algorithm [25]

The above figure 4.7 shows the graph of time duration between PPP model and without PPP model. From the above graph it is clear that PPP model is better than the previous model. Here violet color graph represents the PPP model time in individual work. Sky blue bar graph represents the original value of time. It has been observed that after applying P3 model the time duration decreased for both proposed PPP model and previous model. The above graph represents the time calculated for PPP model without

using any optimization technique and the duration of work measured when genetic algorithm has been used in PPP model.

From the Fig 4.8 it has been observed that the project without any optimization algorithm takes 15 months for the completion of the work whereas when genetic algorithm is applied to the PPP model the duration for completing the work is reduced and become 8 months. Thus there is an reduction of 7 months when genetic algorithm is used in the PPP model i.e. 183 month.

Calculations

$$Calculation\ of\ efficiency \tag{1}$$

$$= \frac{optimized\ cost}{optimized\ time} = \frac{157}{183} = 86\%$$

$$Reduction\ in\ cost \tag{2}$$

$$= \frac{original\ cost\ of\ dam - cost\ of\ PPP\ model\ after\ optimization}{cost\ of\ PPP\ model\ after\ optimization}$$

$$= \frac{(210 - 157)}{157}$$

$$= 34\%$$

$$Reduction\ in\ time \tag{3}$$

$$= \frac{original\ time\ period\ of\ dam - time\ period\ of\ dam\ after\ optimization}{time\ period\ of\ dam\ after\ optimization}$$

$$= \frac{(260-183)}{183}$$

$$= 42\%$$

From the eq. no (2) & (3), the total cost and time of project is found to be 210 crore and 260 months whereas when working operations are combined together under PPP model, cost and time is found to have reduced to 157 crore and183 months. Hence it can be concluded that construction of dam cost and time increases without PPP model i.e there is 34% reduction in cost and 42% reduction in time after optimization.

Chapter 5

CONCLUSIONS

5.1 General

In this chapter, the conclusion of the proposed PPP model in terms of outcomes obtained after simulating the code in MATLAB tool are discussed. The conclusion has been drawn in terms of cost and duration when P3 model is implemented or not. Also the scope of future of theses has been discussed in section 5.3.

5.2 Conclusions

From the analysis results carried out for present work using MATLAB with Genetic Algorithm, following conclusions can be derived:

I. The Larji dam project when executed without Public – Private Partnership model costs 34% more than when executed with Public – Private Partnership model.

II. When working operation are taken individually, the total cost of project is found to be 210 crore whereas when working operations are combined together under PPP model, cost is found to have reduced to 157 crore. Hence it can be concluded that construction of dam cost increases without PPP model.

III. The Larji dam project when executed without Public – Private Partnership model time 42% more than when executed with Public – Private Partnership model.

IV. Efficiency of PPP model (cost/time) is 86%.

5.3 Scope for Future Work

Undertaking conveyance strategy for Built-Operate-Transfer (BOT) can build the speed of development. Albeit numerous BOT ventures have been executed around the world, a few tasks have experienced significant snags. Study comes about uncover that the political and the administration issues are the most huge defer causes. A various leveled achievement demonstrate for recognizable proof of basic

achievement factors is created. Examination of the information gathered from specialists is finished by AHP and RII strategy independently. The outcomes are contrasted and the after-effect of past investigations. To approve the outcomes understanding examination was made.

In the primary stage Relative Importance Index strategy was utilized to distinguish the Critical Success Factors (CSFs) from the information of first survey in which the sentiment of the specialists was looked for on a size of 1 to 5. In view of the consequence of RII technique, the second survey was produced utilizing the Analytical Hierarchy Process (AHP) strategy. The CSFs recognized were observed to be steady with past investigations. Individual meetings of the task chiefs, contractual workers, government officials were likewise directed after recognizable proof of basic achievement factors from the field overview.

The specialists met were of the feeling that BOT technique for acquirement does not suggest a hands-off approach with respect to the administration. BOT course of action just exchanges the dangers from the legislature to the private promoter. From the perspective of Government the cash ought to be spent financially, productively and successfully. The administration i.e. people in general procurer looks to use private division cash and aptitude and along these lines accomplish an incentive for cash which may originate from the private segment development and abilities in outline, development and task of the venture. Despite the fact that the Government moves keys hazards in outline, development delays, cost invades and fund and so on to a private segment substance, nonetheless, chance exchange might delude.

1. The identification and positioning of CSF's will help proprietors, experts and governments to give more consideration regarding them with the goal that the rare assets are ideally used for effectively finishing the undertaking.

2. The reasons for postpones perceived can be overseen in order to stay away from time overwhelms of the task.

3. The model created for short posting the BOT promoter can help proprietor, government to set up a positioned rundown of different candidates so the time required amid the prequalification procedure can be lessened.

4. The best esteem technique will give the proprietors to fuse non value factors additionally while choosing the temporary worker who will give the best an incentive to the proprietor.

5. By slamming the task length the proprietor/promoter can build his net revenues and also the office is accessible to the general population prior making win-win circumstances.

6. The rules and suggestions gave can be utilized by the administration, promoters and the loan specialists for a win-win procedure in BOT ventures.

7. Affectability test (sensitivity test) will help the proprietors/govt. to guarantee that the outcomes would be adequately hearty and won't be effectively changed because of slight varieties in at least one weighting factors.

References

1. Khan,M.S. and Ojha,N.K.(2015). "A study of PPP with special reference to infrastructure" *Indian Journal Of Applied Research Volume 5, Issue 1,3*

2. Nanda, S. S. (2015). Infrastructure Development in India: The Role Of Public-Private Partnership. *International Journal of Core Engineering and Management*, *2*(6), 60-70.

3. Das,T.C. And Sikidar,S.(2014). "Public Private Partnership in India-Its operational mechanism and challenges" *Abhinav International Monthly Refereed Journal of Research in Management & Technology Volume 3, Issue 4 ,12*

4. Kwak, Y. H., Walewski, J., Sleeper, D., & Sadatsafavi, H. (2014). What can we learn from the Hoover Dam project that influenced modern project management?. *International Journal of Project Management*, *32*(2), 256-264.

5. Prashant.S.(2013)."BusinessStandard"*http://www.businessstandard.com/article/economy-policy/uttarakhand-s-song-dam-to-be-built-on-ppp-model-111080500023_1.httml*

6. Xu, J., & Zeng, Z. (2010). Applying optimal control model to dynamic equipment allocation problem: case study of concrete-faced rockfill dam construction project. *Journal of Construction Engineering and Management*, *137*(7), 536-550.

7. Singh,K.P.(2011). "Issue and prospects of PPP in India" *International Journal of Multidisciplinary Research Vol.1 ,12*

8. Kumar.K.(2008). "Public Private Partnership In India" *Summer Research Internship Programme Centre for Civil Society ,18*

9. Ng, S. T., Xie, J., Skitmore, M., & Cheung, Y. K. (2007). A fuzzy simulation model for evaluating the concession items of public–private partnership schemes. *Automation in construction*, *17*(1), 22-29.

10. Zitron, J. (2006). Public–private partnership projects: Towards a model of contractor bidding decision-making. *Journal of Purchasing and Supply Management*, *12*(2), 53-62.

11. Varnavskii, V., & Tsvirkun, A. (2017, October). Public-private partnerships in large-scale infrastructure in Russia: Opportunities and challenges. In *Management of Large-Scale System Development (MLSD), 2017 Tenth International Conference* (pp. 1-4). IEEE. V.

12. Feng, K. H., Fang, S. C., Tai, S. C., & Lai, W. S. (2014, July). How public-private partnerships co-create value: The case of cultural and creative industry. In *Management of Engineering & Technology (PICMET), 2014 Portland International Conference on* (pp. 2047-2055). IEEE.

13. Bao, J., Fang, S., Yang, F., & Fang, W. (2010, November). The Risk Modeling and Audit Supervising for Transport Public Private Partnerships in China. In *Logistics Engineering and Intelligent Transportation Systems (LEITS), 2010 International Conference on* (pp. 1-5). IEEE.

14. Bandler, H. (2016). Public-Private Partnerships: Creating New Markets for Industry, Encouraging Social Engagement, and Improving Quality of Life. *IEEE Electrification Magazine*, *4*(1), 2-10.

15. Mingaleva, Z., Pazdnikova, N., & Mitrofanova, E. A. (2014). The development of the concession project management mechanisms in regions. *Asian Social Science*, *10*(24), 257.

16. Kuriyan, R., & Ray, I. (2007, December). Public-private partnerships and information technologies for development in India. In *Information and Communication Technologies and Development, 2007. ICTD 2007. International Conference on*(pp. 1-11).

17. Ullah, A. (2015). Public Private Partnership in Hydro-Power Development of India: Prospects and Challenges.

18. Singh. S "Evolution and needed for PPP in India" *2017 Imperial Journal of Interdisciplinary Research Vol.3 issue 4*, pp. 2

19. Google.Image."http://www.juet.ac.in/Contact/HowtoReach.php"

20. Google.image."http://blogs.worldbank.org/ppps/private-investment-infrastructure-emerging-markets 2015"

21. Google.Image."https://www.slideshare.net/nitinpillamarapu/infratructure-sector-analysis"

22. Google.Image."https://www.slideshare.net/nitinpillamarapu/infratructure-sector-analysis"

23. Romildo Filho, D. T., Ebecken, N. F., & Alves, J. L. (2003). Optimization of dam construction costs using genetic algorithms. In *16th ASCE Engineering Mechanics Conference, University of Washington, Seattle, USA* (pp. 154-161).

24. Zheng, D. X., Ng, S. T., & Kumaraswamy, M. M. (2004). Applying a genetic algorithm-based multiobjective approach for time-cost optimization. *Journal of Construction Engineering and management*, *130*(2), 168-176.

25. MATLABversion6.5.1,(2017),(computersoftware),TheMathworksInc.,Natick, Massachusetts