A conceptual model of performance measurement for power plant projects [1]

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Abstract

This study is focused on the importance of performance measurement in projects. Projects are considered as temporary organizations with specific goals and objectives. Generally, power plant projects are considered as high-tech and large-scale projects and construction of them require a great amount of financial resource, human resource, materials and equipment. Also, they are considered as one of the strategic infrastructures of a country and any delay in these kinds of projects results in huge cost overrun as well as negative social and economic impacts. So, it is important to use a robust performance measurement system to help project managers to manage them effectively to achieve goals and objectives of projects. In this study, by using literature, a conceptual model of performance measurement was developed and then by using the company vision, the KRAs of the project were identified. Also, according to the project contract, the long-term and short term objectives were identified. To assess the performance of process and systems a set of KPIs identified.

Keywords: power plant projects, project success, performance measurement, vision, KRAs, KPIs

Introduction

Each of the project stakeholders may have its interpretation of project success; a project can be considered successful by its contractor, whereas it might be considered unsuccessful by its client or end user (Toor & Ogunlana, 2009, pg.228). These stakeholders may measure the project success on basis of its preference, values and degree of effects by project, and this can lead to different results; the project manager considers a project successful when it was done on time, within defined cost and quality; the users will concern about immediate impacts of the project; and investors may worry about its long-term profitability. Project success can be divided into two interrelated dimensions as project management success and product success. Project management success means achieving defined goals and objectives; product success refers to values which the project deliverables will create in future (Goatham, 2017, pg.1). Samset & Volden (2016, pg.300) categorized project success into strategic and tactical successes (Fig.1).

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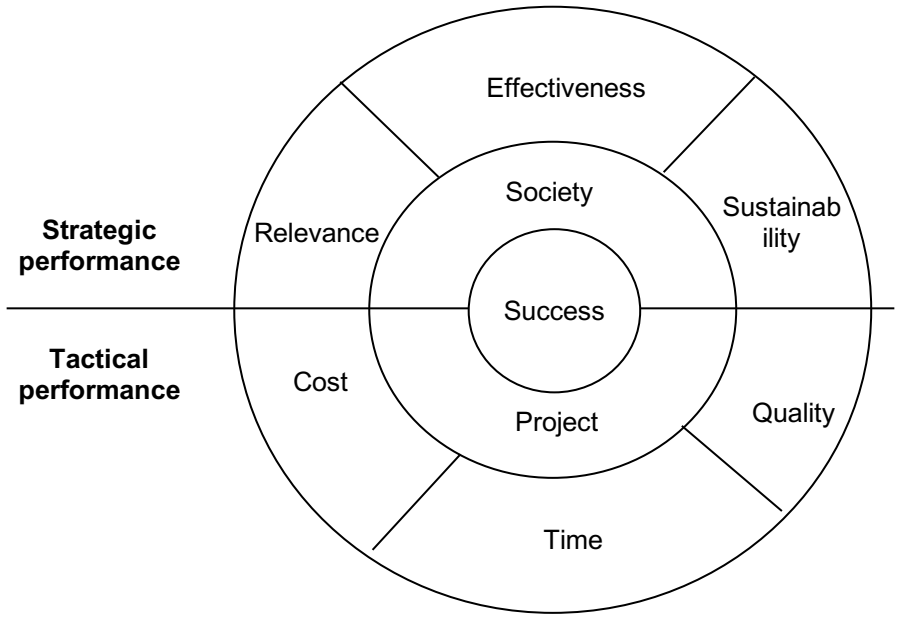

Fig.1: Strategic and Tactical performance

Tactical success refers achieving the short-term performance targets, whereas strategic success means meeting long-term objectives and whether the project would provide a sustainable benefit and remain in an effective operational condition). In other words, tactical performance is related to the execution stage of the project and focuses on the time, cost and quality objectives, while strategic performance covers a broader perspective and focuses on the long-term function of the product and its effectiveness and sustainability (Samset & Volden, 2016, pg.300).

Literature view on the performance measurement

The business environment is very dynamic and organizations are faced with many challenges; to survive within this challenging environment, they need a proper performance measurement system to assess the functions and process to ensure that they are in line with their strategies and objectives (Parida et al, 2015, pg.3; Song & Lee, 2005, pg.360). Performance measurement can be defined as “the process of quantifying the efficiency and effectiveness of past organizational actions” (Star et al, 2016, pg.151) or “a set of metrics used to quantify both the efficiency and effectiveness of actions” (Parida et al, 2015, pg.4). Using performance measurement system brings benefits for organizations such as enabling them to identify goals and objectives, resolve problems, monitor and adjust process, define progress steps, measure efficiency and productivity of programs, process, people and sections, and evaluation of goals and objectives (Star et al, 2016, pg.155). Performance Pyramided Model is an appropriate framework to define a proper performance measurement system (see Fig.2).

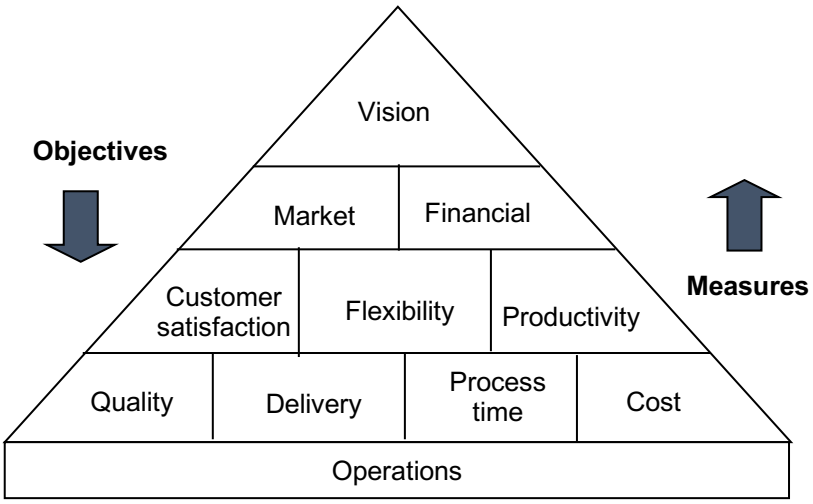

Fig.2: Performance Pyramid (Cross and Lynch, 1989, pg.25)

This model was introduced by Cross and Lynch (1989) to measure the cooperate performance; it indicates that organizations are only competing on three fields: customer satisfaction, flexibility and productivity; also, it specifies that the four critical functional performance criteria are quality, delivery, process time and cost (Kippenberger, 1996, pg.10). The top level of the pyramid is company's vision which refers to the future perspective of the company and its strategic area of work which is determined by top managers. In the second level, in line with the vision of the company, the goals of business units are defined and then strategies to achieve these objectives are outlined. This process continues from the top to lowest level of the pyramid. Also, for each level of the pyramid, in accordance with defined goals and objectives, required measures are drawn (Cross and Lynch, 1989, pg.26). In overall, this model shows a hierarchy of goals and measures in which the goals and objectives are broken top-down and measures are rolled bottom-up.

Kaplan and Norton developed a performance measurement model called the Balanced Scorecard model (BSC). This model is based on the idea that there is no single performance indicator can determine all complexity of performance of organizations; it deciphers the vision of organizations into goals and performance measures in four categories: financial, customer, internal business and innovation and learning (Watts & McNair, 2012, pg.228). Scholars have different opinions about effectiveness of this model; some of them argue that it strongly ties organizational strategy with measurement, but some others refer to its weaknesses such as lack of proper connection between functions and strategic goals, lack of providing accurate feedback, and lack of proper involvement of key users during the development process, and argue that it does not a proper model (Star et al, 2016, pg.157).

Strategic Framework is another performance measurement model which was introduced by a company in the UK working in the production of camera and imaging equipment industry. According to this model, the vision of the company is divided into several key result areas (KRAs). KRAs can be defined as "the key capabilities we need to achieve our vision" (Sinclair & Zairi, 1995, pg.79). Also, KRAs are interpreted into several key result measures (KRMs); KRMs can be defined as "the goals we must achieve to develop and sustain our key capabilities". Proper actions

are required to deliver performance in the KRMs, and this process might be developed into detailed KRAs, measures, targets and actions down to the operational level (Sinclair & Zairi, 1995, pg.80).

Performance measurement includes both “hard” and “soft” metrics; the term of metric, measure and performance indicator (PI) can be used interchangeably (Parida et al, 2015, pg.5). PIs can be defined as “instruments that tend to denote the health, progress and/or success of a project, process, or area of service delivery; they focus on resources and processes that are most likely to lead to successful outcomes and are usually short, focused, relevant, measurable, repeatable, and consistent” (Star et al, 2016, pg.154). PIs are used to underline deficiencies in an organization and to analyse it carefully to find issues which caused the indicators to be low; in other words they are used to measure the performance of processes and systems through comparing the actual conditions with reference ones and finding the gap between them (Parida et al, 2015, pg.6). In addition, they are not declared in financial terms; they are assessed on a short-term basis; they are related to specific activities and/or teams; and the activities that they are associated impacts organization’s success factor(s) (Star et al, 2016, pg.154).

KPIs are defined as “the compilations of data measures used to evaluate the performance of an operation” and managers use these tools to evaluate performance of staff of special task; the assessment process includes comparing the actual and anticipated performance in terms of efficiency, effectiveness and quality of products and skills (Yeung, 2007, pg.120). Also, KPIs characterize a set of measures which focus on the aspects of organizational performance that have a huge impact on the current and future success of the organization (Star et al, 2016, pg.154). The difference between PIs and KPIs can be described as PIs are at the functional level; however, when they are accumulated to the higher levels are called KPIs. In fact, KPIs can represent the performance of KRAs (Parida et al, 2015, pg.7), and also “once the KRAs are agreed, then measures (KPIs) can be developed to support them” (Yeung, 2007, pg.121). According to Yeung (2007, pg.122), in the process of developing KPIs in projects, following factors should be taken into account:

1. KPIs focus on the main aspects of outcomes
2. The number of KPIs should be limited
3. KPIs should be used systematically in projects to obtain a desirable result from them
4. Data gathering process should be simple and easy
5. The size of samples should be enough to reduce the effects of specific variables of projects.
6. All measures and indicators should be understood and accepted by the project team.
7. KPIs should be refined and improved continuously

This literature view provides a conceptual approach regarding the process of performance measurement in organizations. To do this, it is important that the vision, KRAs, strategy, long-term and short-term goals and objectives organizations be defined clearly. It also needs to define an appropriate set of KPIs to assess the performance of process and systems appropriately. The performance measurement

system should be implemented systematically to help managers to find potential difficulties and deficiencies and remedy them.

Case study

Introducing the Hormozgan power plant project

The aim of this project was establishing of an open cycle power plant in four units with a capacity of 648 MW in ISO condition in the south of Iran. The area had suffered from power shortage and according to the study was conducted by the ministry of energy, construction of this power plant was vital to stabilize the power network and also supply the electricity for the local area. The client was Iranian power development company (IPDC) and MAPNA Group was responsible to construct this power plant under an EPC contract. It should be noted that the MAPNA-MD1, as one of the MAPNA Group subsidiaries, was the general contractor for the project and other companies in MAPNA Group were supplied the main equipment of the power plant and technical services. The project was started in June 2012 and duration of the contract was 33 month. According to an agreed schedule, the first unit of the power plant must be commissioned after 24 months of the project start date and other units with an interval of two months of each other. I, as a member of the project team, was responsible for planning and project control activities.

Scope of work of the Project

Normally, an open power plant consisted of Power Block, Common, and General (civil) sections. In this project, power block consisted of four units each with a capacity of 162 MW in ISO condition. The common section included fuel, fire-fighting, water, substation and relevant electrical and control systems. Also, the general section consisted of all civil work of the project as primary earthing, industrial and non- industrial buildings, cable and fuel routes, landscaping, green area, internal roads, lighting etc.

The main stakeholders of the project

Figure 3 shows the key stakeholders of the project. It should be noted that there is a kind of top-down government system in Iran and the stakeholder’s decisions and actions were mainly affected by this.

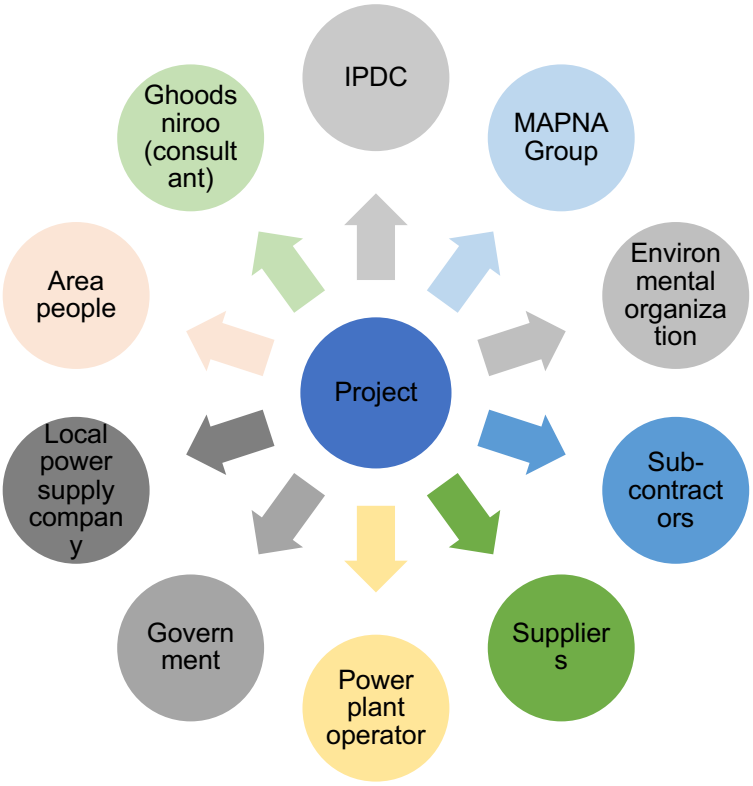

Fig. 3: Key stakeholders of the project

Fig.4 shows a conceptual model of performance measurement of the project which was developed by using literature review. It has a systematic approach towards performance measurement and entails defining of the project vision, KRAs, strategies, goals and objectives, and relevant KPIs.

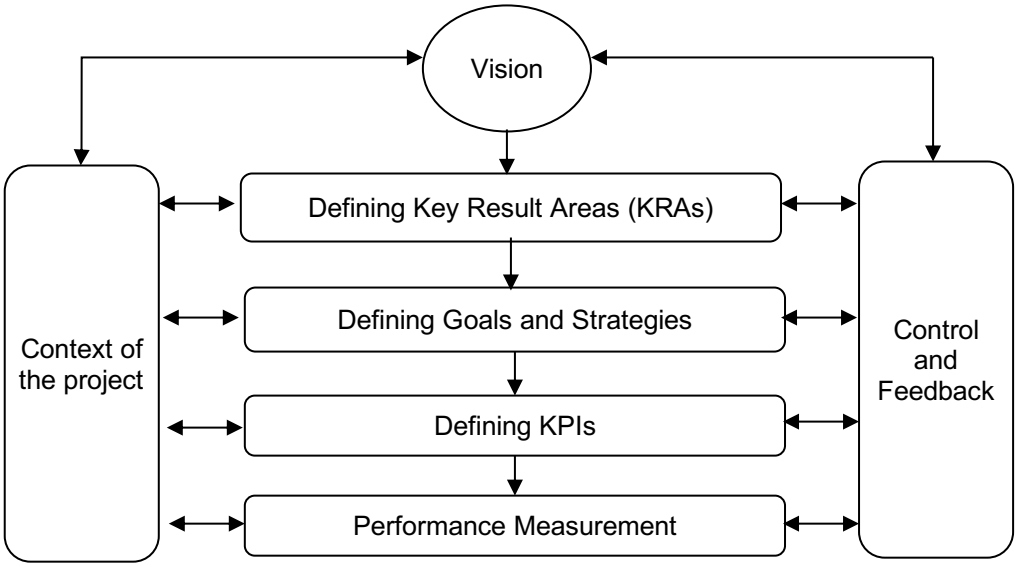

Fig. 4: The model of performance measurement of the project

First of all, the context of the project should be studied to find the influential internal and external factors of the project. As the project was financed by the government, the influential factors were mainly limited to the project main stakeholders. The

project did not have a special vision and the company's vision was used to shape the system. The vision of MAPNA–MD1 Company, as the general contractor for the project, was "By 2021, we will be a reputable EPC company in the domestic market with sustainable presence in our target international markets, focused in the Middle East, North Africa and regional countries" (company' website).

Normally, power plants were designed to work about 30 years in a safe and normal condition. So, the project might be fulfilled all its stakeholders' expectations successfully to be considered as a successful project. Some of these stakeholders were involved in the construction period and some others were involved in the operation period of the power plant. So, on this basis, the KRAs of the project would be as following:

- Project Benefits
- Stakeholders Management
- Project Management
- Human Resource Management
- Safety and Environmental Sustainability
- Social Commitments
- After Sales Service

These KRAs are used to help the project team to focus on the most important areas of the project to fulfil the vision of the project. The number of the KRAs should be limited to be managed easily and properly and also represents the main areas of the project. Table 1 shows the KRAs of the project along with defined objective, goals, strategies and KPIs for each of them.

Table 1: The KRAs, Objectives, Goals, Strategy and KPIs of the project

KRAs	Objectives	Goals	Strategy	KPIs
Project Benefits	15% reduction in total project cost	5% reduction each year	Value engineering, using local suppliers to save transportation costs, innovation, Using appropriate cost control system	Actual against plan, CPI, SPI
	9% reduction in project duration (90 days)	Engineering 15 days decrease, Procurement 45 days decrease, Construction 30 days decrease	Using skilled engineers, Using local suppliers, Controlling of manufacturing process effectively, Using packaged systems to avoid extra civil and erection work, Using robust project control system	Actual against plan, CPM
	Increasing quality of activities	Maximum 3 revisions for drawings, 20% reduction in failed tests, 10% reduction in rework and defects	Applying engineering standards in design, Using robust quality control system, using high-quality equipment, Using proper suppliers/ contractors, Using of lesson learns, executing construction activities	Number of revisions, number of defects /rework, number of failed tests

			according to defined standards,	
	Supplying power to local people and industries	30 years power supply in safe and normal condition	proper operation, defining appropriate maintenance strategy	Number of overhauls, inspections
Stakeholders Management	Stakeholders satisfaction	20% decrease in number of claims/conflicts with stakeholders each year	Establishing communication channels, meetings	Number of meetings and contacts
Project Management	Achieving the project objectives	variation of plans < 5% each year	Using project management standards such as PMBOK, knowledge management, using project control system, using computer-based systems, communication	Number of reports, meetings, effectively managed risks, recorded lesson learns, time and cost indexes, less paper work
Human Resource Management	Effective use of human resource	Increasing of level of satisfaction of employees by 10% each year, decreasing number of conflicts 15% each year	Training, job rotation, job promotion,	Number of training hours per person, number of lay-offs, satisfaction rate, average salary level, number of conflicts among team members
Safety Environmental Sustainability	Providing a safe working condition, less environmental issues	Decreasing the casualty rate by 10% each year, less pollution occurrence, decreasing greenhouse gas emissions by 10% each year	Using HSE plan, training, measuring pollution levels, observing safety and environmental standards.	Number of casualty, level of greenhouse gases, pollution occurrence
Social Commitments	Engaging in social activities and providing job opportunity for local people	70% of the project people are local people in construction and operation periods, donating of 1% of power plant income to charities and social events	Recruiting local people, supporting social and sports event financially	Percent of local people working in project and power plant, social events costs, sports events costs
After Sales Service	Guarantee and providing after sales services	20 years spare parts and technical services	Communication with power plant owner, training programs, providing technical services, inspection and overhaul facilities	Communication, training hours, spare parts costs, number of inspections

Impacts of using performance measurement in the project

Executing a power plant project is a complicated process and many contractors and people are involved in it. This temporary organization is complicated and must be managed effectively to achieve its objectives. It is important that all process and functions of the project be assessed appropriately to find potential deficiencies and

resolved properly. Some of the advantages of using an appropriate performance measurement could be as following:

- Performance measurement focuses on results instead of behaviours and functions, and individuals are assessed based on their outputs.
- It aligns the project activities and process with the project goals and objectives and reveals any variations and deficiencies.
- It provides a clear perspective of the project and enables managers to act systematically.
- As outcomes are assessed against defined standards and possibly best practices, it provides meaningful measurements to study results and evaluate the quality of the project deliverables.
- It is contributed to the motivation of individuals, promote the performance improvement culture as well as facilitate learning process in the project.

Conclusion

Each project stakeholder may have its interpretation of the project success which might be different from other ones. Basically, projects will consider successful if they achieve their time, cost and quality objectives. To achieve these objectives, it is important that projects manage successfully in their lifetime continuously. Therefore, they need an effective performance measurement system to assess and guide them towards achieving goals and objectives. Performance measurement is a systematic approach which evaluates the performance of the project process and systems and helps project managers to find the gap between the actual and planned outcomes. In this regard, the project vision, KRAs, strategies, long-term and short-term objectives must be defined clearly to provide a benchmark for performance measurement process. It also, needs a set of key performance indicators to monitor results, show areas of project issues and deficiencies and helps project managers to rectify them.

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