

# Expert System Model Structure for Feasibility Study

## *Using Strategic Planning and Systems Engineering Principles*

Mohammed Salem Alzahrani

Industrial Engineering department, College of Engineering at Al-Leith

Umm Al-Qura University

Al-Leith, Makkah, Saudi Arabia

msjzahrani@uqu.edu.sa, salemyom@gmail.com

**Abstract**— Feasibility study is a powerful tool to persuade stakeholders to invest in a project. Techniques that are used to present proposal and feasibility study is the main key of convincing stakeholder to accept the project offer. This article is very handy for project managers and engineers to highlight the strengths and weaknesses of any project. This article differs from other feasibility study articles by adding two new main helpful features. First is capability of using it as ready general template for project proposal and feasibility study. Second is taking the project to higher level by setting it as one system unit to change it from project to complete system by creating expert system using this model structure. Techniques of Systems Engineering principles and fundamentals of strategic planning are used to build the model structure for feasibility Study template.

**Keywords**— *Systems Engineering Principles, Feasibility Study Template, Hybrid Feasibility Model, System Concept, Risk Management, Risk Factors, Strategic Values*

### I. INTRODUCTION

It is very attractive to professional person to have a quick experience without carrying burden of financial losing consequences or suffering from falling down with his or her career. The reason of falling down with that attractive project is that the person sees the project feasible without doing any study and without clearing the doubts surrounding the chosen project. Risk analysis and feasibility study is the solution from any doubtful and attractive projects. Feasibility study can be used to give recommendations wither the intended attractive project is feasible as defined in the project scope, vision, mission, goals and objectives. Feasibility study brings in many factors, inputs, outputs and views. Not only financial element is always the key, but many other elements as much important as financial element or some times more important as in social responsibility projects. Systems engineering (SE) principles, tools and techniques along with strategic planning (SP) are the inevitable integration channel between all fields of studies that contribute in any project feasibility study. The adding topping of this article is the merging of SE and SP as one hybrid tool for new feasibility study structure.

The main objective of this scientific paper is to gather SP and SE tools, techniques and methods to create and suggest an expert system for a feasibility study model structure for small and medium business projects. In addition to that, this article can be used as ready template for a project proposal report or a feasibility study for small and medium business that tracks and crosschecks list of SP and SE tools, techniques and methods. In each section or subsection of this article, guidelines are given for that specific principle. Future research and developing of this article should be creating software coding that converts this model structure into electronic expert system. Fig. 1 shows all SP and SE principles that are used in this article.

### II. EXECUTIVE SUMMARY

*In this summary, you should write only major outline and brief enlightenment of:*

- The main goal of the project.
- In very few words, write the methodology that you used in your feasibility study.
- New addition and advantages of your proposed project and its product or service including:
  - How the project can help community.
  - How the project can improve the current situation.
- Final Cost, Revenue and profit for at least 2 upcoming years for small projects and 5 for medium.

Writing an executive summary is very precise and vital part of a proposal report or feasibility study. It can lead to project rejection or acceptance only by looking at it. Writing as an engineer all the time is not preferred because some projects are nontechnical projects, which will affect readers view and opinion. However, it is preferred to write as an engineer if the project is technical and contains statistical analysis figures and charts. To write as an engineer, it is recommended to follow [1].

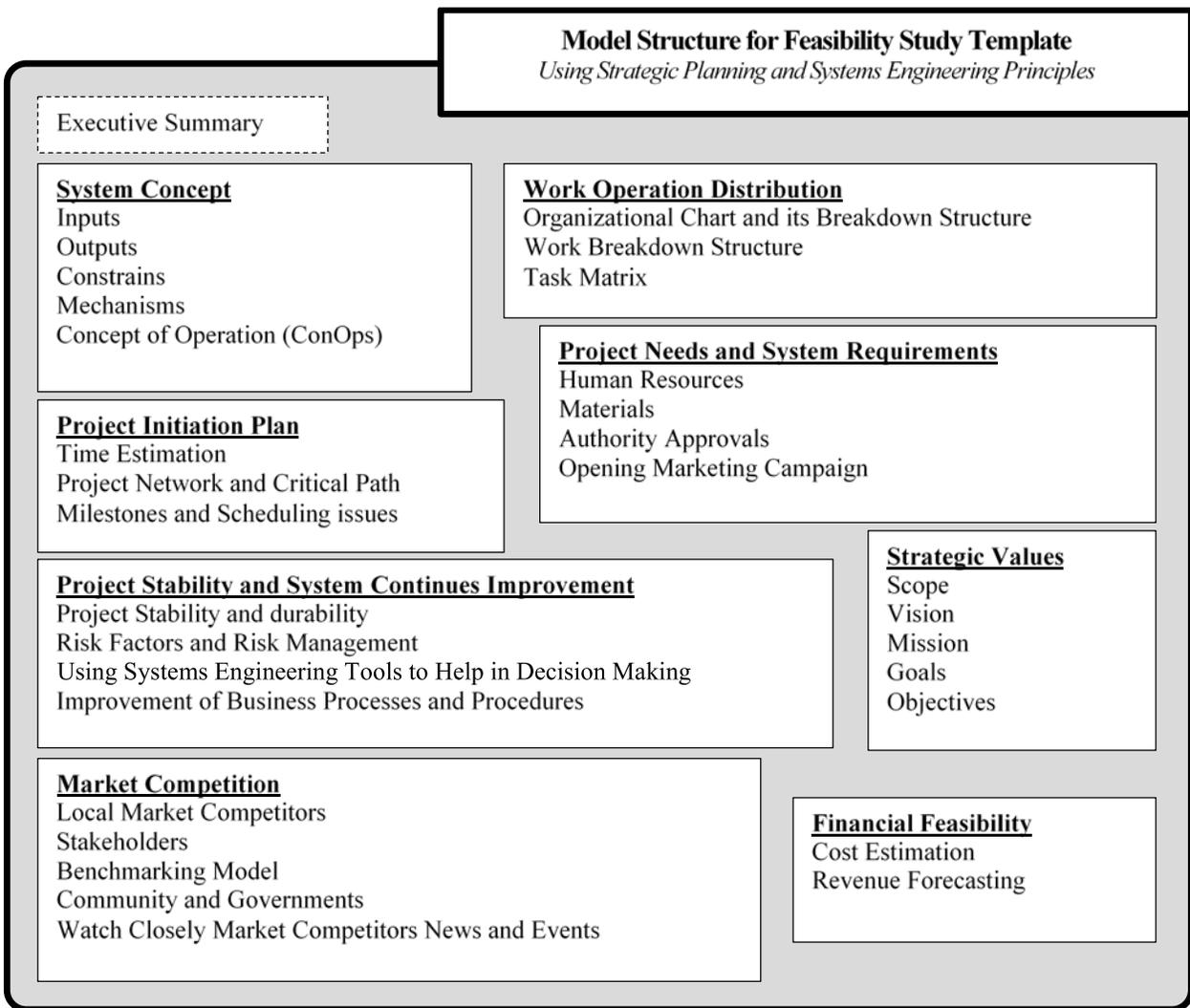


Fig. 1. Strategic Planning and Systems Engineering principles that are used in this article

### III. STRATEGIC VALUES

*In this section, you come up with your project sold shape where you determine and document your project's Scope, vision, mission, goals and objectives.*

To set the project on a solid ground even if it is small one, then it is indispensable to set up clearly project's scope, vision, mission, goals and objective. Any deviation from that elements of strategic planning will result in a project delay and consequently additional cost associated with that deviation is expected. If the project is nonprofit or public project, then it is recommended to read [2]. Figure 1 shows simple illustration of strategic planning values.

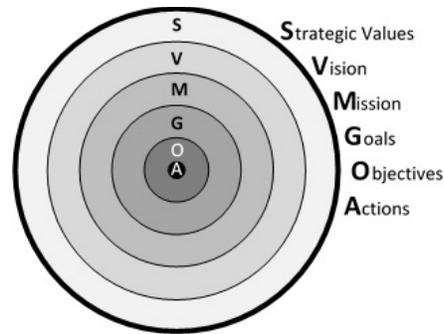


Fig. 1 Strategic planning values

#### A. Scope

*In this sub-section, you state your project scope.*

Project scope as defined by [3] is the work that needs to be accomplished to deliver a product, service, or result with the specified features and functions. It is a general term that can hold all project goals, objectives, requirements and specifications. In most projects' proposal reports and feasibility studies, scope is defined and explained by writing project's vision, mission, goals and objectives. If you are intending to write project's vision, mission, goals and objectives, then it is not recommended to write scope because it is redundant. Special tools are built to create a strong scope specially for construction projects as done in Project Definition Rating Index (PDRI) which is explained by [4]

#### B. Vision

*In this sub-section, you can write your ambitious feelings by writing you project vision statement. Make your vision statement concise, inspiring and aim your vision for 5 to 10 years ahead.*

Your project vision statement is the only room to write your positive wild expectation about your project. Vision statement should derive inspiration to all stakeholders special those who are working within the project. However, vision statement should be clear, concise and inspiring. To write a vision statement for profit and non-profit projects, it is recommended to read [5] and [6].

#### C. Mission

*In this sub-section, write your mission. Make sure to mention your targeted client, your product or service, and most important is your distinctiveness in supplying your product or service.*

Mission statement as defined by [7] is a sentence describing a company's function, markets and competitive advantages; a short written statement of your business goals and philosophies. On other words, a good mission statement should include the answers of four questions:

1. Who we are? (proudly name your project)
2. What we do? (Name your project future product or service)
3. Why are we different? (Distinction)
4. Who is our client? (Targeted Market)

Dealing with mission statement issues for small and medium business project are a burden to those who wrote it without planning and consulting with all stakeholders specially those who are within the project boundaries. An example of study shows how important mission statement to all organization's employee especially managers of small and medium enterprises can be found in [8].

#### D. Goals

*In this sub-section, Your build your goals. You should make it broad but states method, measure and timeframe.*

Goals is the keys to achieve project's mission and vision. Each goal should contribute with one part or more towards project mission. Goal should clarify its time-limit to be accomplished, "what to do?" and "how to do it?". Expected, each goal has more than one objective. In some articles or project reports, goal can be named as aim or target.

#### E. Objectives

*In this sub-section, you set your project objectives. It should be SMART.*

Writing one objective is not an easy task. Objective should be specific, measurable, achievable, and realistic and timely bounded (SMART).

#### IV. MARKET COMPETITION

##### A. Local Market Competitors

*In this sub-section, you list and study your local market competitors.*

The first step toward success is to enter the local competitors and to know your expected project's market share. In some cases, market competitors can be one of the project stakeholders. This paper suggested that you list your market competitors to study their affect in your project initiation and continuity.

##### B. Stakeholders

*In this sub-section, you should list all your stakeholders. Include both direct and indirect stakeholders.*

A project stakeholder is an individual person or group of persons who have an influence in the project or the project has an influence on them. Simply, any one has a relationship with the project is a stakeholder with some degree. Because of stakeholders affecting importance, many articles and scientific papers are published in the field of stockholder theory including its definition and main arguments to define stakeholder without misperception as in [9] and [10]. It is vital to know and list project's stakeholders during the project planning phase and do not start your project without legal document that shows a list of project's main and direct stakeholders. Stakeholders can be determined and limited to those who have the power, legitimacy and urgency relationship with the project [9].

##### C. Benchmarking Model

*In this sub-section, it is recommended to define your projects benchmarks; usually your tough competitors are the best benchmarks. You may have more than benchmark and you may have a benchmark for each process.*

One of the best tools leading to a unique and different success is to benchmark against market competitors. Benchmarking is not copying; benchmark but do not copy your competitors to have the best project, product or service. Put a unique mark or advantage to the project so it be positively different from the others. Overcome new issues comp up during project execution becomes easier if benchmarking technique is used. In most cases, benchmarking saves very satisfactory amount of money if it is used in a professional manner.

##### D. Community and Governments

*In this sub-section, you add issues related to community concerns and social responsibilities matters.*

In most countries, governments (which can be considered as one the most important stockholders of almost all projects) owns or have the highest authority over main public service entities. Social responsibility is a duty for all individuals, private sectors as well as governmental sectors. Establishing new public service entity or developing existing entities needs a proposal including solid feasibility study from all aspects including financial, social and other required aspects . Some countries goes beyond feasibility study and put a social impact financing procedures as in [11]. Finance issue is not always the main concern as in [12] where the family support is the main issue that needs a feasibility study. Another example of community and social responsibility feasibility study is measuring outcomes of services or educational organizations that over service to communities as in [13].

##### E. Watch Closely Market Competitors News and Events

*In this sub-section, plan and determine your contact media and event watcher planner.*

Watching the market news and events is certainly positive advantage over your competitors. Make sure to plan it and document your planning. Imposing your watching plan into your strategic planning will give it more execution weight.

#### V. SYSTEM CONCEPT

*In this section, you give general idea about your system definition but do not explain how it works. System concept of operation (ConOps) at the end of this subsection will give you full space to explain how your system works.*

In general, any system can be easily defined and recognized by its inputs, outputs, constrains, mechanisms and its concept of operation (ConOps). A system as defined by Cambridge academic content dictionary is a set of connected items or devices that operate together [14].

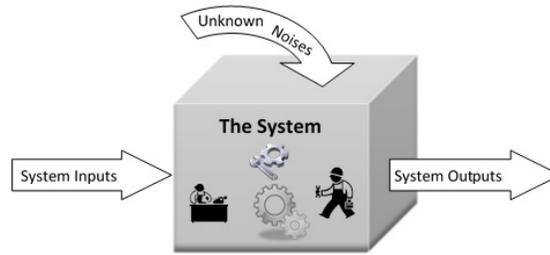


Fig. 2 System Concept

### A. Inputs

*In this sub-section, you list your system inputs.*

System inputs are raw element(s) of a product or service that you are looking for to have it as your final output. A simple example of a daily used system is the coffee making system. The inputs to the coffee making system are coffee, sugar or milk along with water. Inputs are mixed all together with a defined processes to produce a cup of coffee as your final output product.



Fig. 3 Coffee Making System

### B. Outputs

*In this sub-section, you list your planned system outputs.*

Output is the main result of your system whether it is product or service that you expect by the end of the project. Any system may have one or more outputs. For some systems that are unplanned or do not have robust systematic feasibility study, one or more unexpected outputs are shown by the end of the project. For that main reason, strategic planning and systems engineering principles are strongly recommended for building a feasibility study and proposal reports to take in consideration all desirable and undesirable outputs.

### C. Constrains

*In this sub-section, you list project's constraints.*

Constraints are the boundaries that any project does not exceed. In other words, constraints are the project's limitations. One of the main constraints in almost all projects is budget. There are some common constraints in all projects such as culture constraints, time constraint and resource constraints. Planning is the key solution to those types of constraints because they should be known and negotiated before the project starts.

### D. Mechanisms

*In this sub-section, you list all your needed resources including human resources, instruments, tools, equipment or machines.*

Mechanisms section illustrates and lists all needed resources that make your project run efficiently. It is recommended to list them along with their manufacturing specifications to use them in the requirements writing section where every single detail counts to have a good requirement setting.

### E. Concept of Operation (ConOps)

*In this sub-section, you write in details, how your system works during its operation.*

Concept of operation shows the integration of all system components and illustrates every single task assigned and how it is done. ConOps should state the following:

- General representation for all system processes along with its integration tools.
- Tasks Assigned to each component.
- Procedure for each task to be processed.
- Integration method between each process.

## VI. WORK OPERATION DISTRIBUTION

*In this section, you should include all your project structures including organizational and work breakdown structures.*

To cover all project aspects even assigning tasks and job titles, you should go in details with the project structure level from top to bottom of your project for both organizational and work structures. Some project managers add one more breakdown called budget or cost breakdown. This paper shows only organizational and work breakdown structures.

### A. Organizational Chart and its Breakdown Structure

*In this sub-section, you draw and fix your project organizational chart.*

As professional and sold project, no contract will be signed between project owner and project stakeholders without knowing who is who in your project. The professional way to distribute the authority power of the project is via fixing an organizational chart or organizational breakdown structure (OBS). For more help how to come up with a project organizational chart, please see [15].

### B. Work Breakdown Structure

*In this sub-section, you list all tasks and sub-tasks in order from primary and secondary tasks in hierarchy chart.*

Work Breakdown structure (WBS) is the overall view for all tasks in a project with a systematic way using ordinal relationship between tasks. WBS can be written as major and minor cascade task list. It can be also charted as hierarchy graph showing all primary and elementary tasks. In most of the project management softwares, WBS is seen as list along with Gantt Chart [16].

### C. Task Matrix

*In this sub-section, you assign one task or more from WBS to organization title in OBS. Job assignment should be in table matrix form.*

Task matrix is the key solution to tasks assignment follow up. Once all tasks are assigned, the tracking issue will be much easier using task matrix. It is considered as a work directory. The importance of task matrix gets more necessary when the project is too large and have large number of employees. Task matrix is used to assign tasks to human or machine. Task matrix can be known as Resource Task Matrix or Responsibility Task Matrix. There are number of ways to built the task matrix. It depend on the project type and size. One simple way of building task matrix is shown by [17].

## VII. PROJECT NEEDS AND SYSTEM REQUIREMENTS

*In this section, you list all needed resource to start your project operating.*

Make sure to prepare all needed resources before you start operating the project. List all project resource requirements in details to prevent any future delay during operation time. By the end of this chapter, create a list that summarizes all needed resources.

### A. Human Resources

*In this sub-section, you list your human resources requirements.*

It is more professional to write a job description for each job title and number of employee needed for the job. It is recommended to use the following checklist to cover all-important aspects in hiring process for the project:

- Job Title: position
- Job Vacancy: number of employee needed to fill this job.
- Job Responsibilities: role
- Job Type: full time, part time, contract, other.
- Job Location: complete address
- Job Level: CEO, director, manager, supervisor, other.

- Job Salary: determine both currency and period e.g. 10,000 US Dollar per month.
- Job Requirement Description including but not limited to:
  - Educational Qualifications
  - Experience.
  - Skills.
  - Recommendations and endorsements.
  - Special Requirements.

Make sure to plan your human resource needs and requirements in a professional manner. For more help in this section, please see [18] to know how to manage your human assets. It is rich with applicable simple and easy steps to follow.

#### *B. Materials*

*In this sub-section, list all needed materials. Writing this section should follow scientific and professional method of writing requirements and material specifications.*

Materials include all project assets such as (Machines, tools, and buildings, lands etc.) and expendable materials. It also include raw materials needed to operate the project. All materials should be ready precisely on time. It is recommended to list all needed materials in one provisional material purchase order before the project initiated including the following vital information:

- Material Description.
- Material Type: consumable, expendable, asset, etc.
- Quantity.
- Unit of Measure.
- Unit Average Price.
- Special Instructions.

#### *C. Authority Approvals*

*In this sub-section, you gather all required approvals from all authorities to run your project.*

Document all needed approvals from local authority such as municipality, ministry of commerce and ministry of labor. In addition to that, authorized facilitator approvals are essential in some cases such as approvals of profession authorities like communities' associations, organizations, councils etc.

#### *D. Opening Marketing Campaign*

*In this sub-section, you plan for your opening marketing campaign.*

It is a strong push for success to have a marketing campaign before you initiate your project. Planning the marketing campaign saves money, time and resources. The sweet topping of the opening marketing campaign is ending it with an appropriate opening celebration. Cost analysis for the campaign should be included in this section in details.

### VIII. PROJECT INITIATION PLAN

*In this section, before you start initiating the project, you should write and document your project plan in details.*

This section is the critical for your project initiation and continuity. The planning, documentation and follow up is usually assigned to project management office (PMO). PMO has a specialized employee to do planning and follow up project status with regular project reports. Any deviation in the scope or delay in the project PMO raises flag to the project owner to take actions. For a clear framework of PMO please read [19]

#### *A. Time Estimation*

*In this sub-section, you should draw a time schedule for all tasks that are necessary to start up your project. It is highly recommended to use Microsoft project or similar project management software to help you manage and schedule project time and resources.*

Preparation for a project initiation is a huge step to run the projects operation. Time estimation is controlling how much will it cost to start up your project. Project should be planned with time schedule for each single initiation task.

**B. Project Network and Critical Path**

*In this sub-section, you build project's network including time scheduling, assigning resources, Budgeting, defining major milestones and other pieces of your project network.*

In each project, a critical path during project time is found within the project network. Determining critical path is one way to highlight time risk associated to the project. Make sure to have all resource available especially for those tasks that are considered on the critical path.

**C. Milestones and Scheduling issues**

*In this sub-section, you list all of your project milestones with some details about scheduling issues and proposed solution analysis.*

Any project has some major milestones that are considered breakthrough for your project. At the beginning of each milestone, make sure to have all your project resources available up on request and write initial report to have a full view about upcoming tasks. At the end of each milestone, you should celebrate your success and reevaluate your project progress via a report addressed to project owner. Moreover, at the end of each milestone, try to minimize your unnecessary resource as much as you can without harming the project predetermined quality and time scheduling.

**IX. PROJECT STABILITY AND SYSTEM CONTINUES IMPROVEMENT**

**A. Project Stability and durability**

*In this sub-section, you mention how stable and durability is the project, product or service that you are proposing to initiate.*

To have a successful business project, all factors and risks must be taken in consideration and necessary grantees to assure project stability and reliability. Feasibility study must cover and forecast the future issues, demand, supply and other disturbing business factors.

**B. Risk Factors and Risk Management**

*In this sub-section, you list and study all possible risks and their process to manage them.*

One of the early signs of any successful project is the way of studying its risk management. In some cases for small projects, making big deal of risk management may become a hinder instead of a positive insurance advantage of the project. It is recommended to have a logical scale of how much time, effort and cost spent to study risk in any project according to project sensitivity and budget. For small and medium projects, the following elements of risk management study should be clear:

- Description.
- Symptoms.
- Impact.
- Possibility.
- Reaction.
- Actions.

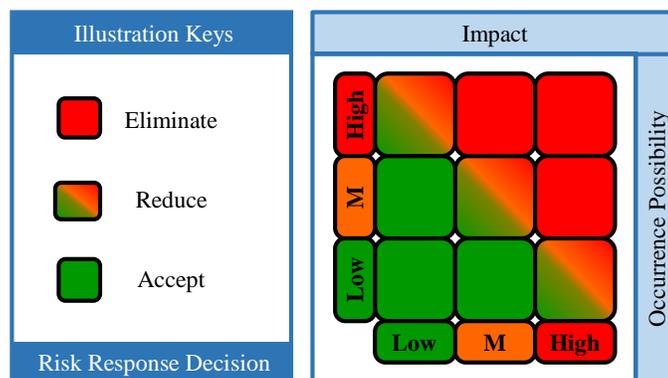


Fig. 4 Risk Response Decision

### C. *Using Systems Engineering Tools to Help in Decision Making*

*In this sub-section, you explain SE decision-making techniques used in your feasibility study report.*

This section is recommended to be included if the proposal has many alternative opportunities or risk analysis solutions. To make the selection criteria more objective, scientific and professional than personal judgment with high subjectivity then the best solution is to use SE decision tools and techniques. Selecting the right SE decision technique is determined according to problem type. However, all issues and problems must be tackled and solved with systematic approach. To have a clear idea about decision making in systems engineering, it is recommended to read [20].

### D. *Improvement of System Processes and Business Procedures*

*In this sub-section, you create specific process steps for improving your project.*

To improve your project, you should set up a key performance indicator (KPI) for each goal. KPI could be tricky but you can overcome that problem by having more than one KPI to a single goal. The second step after measuring the goal, you relate each process to that goal and work in improving it. For creating professional KPI, please see [21].

## X. FINANCIAL FEASIBILITY

*In this section, you show the sum up of main project cost, revenue and profit with its associated financial risk. Best to show off with numbers and charts more than words.*

The first element comes in mind when investors and project researchers hear feasibility study is financial feasibility study. However, that is not always the case, because there are many non-profit projects are studied from other point of views like social responsibilities and community services projects. Regardless of project type, financial aspect of the project is always there and sometimes uses the big word of budget limit. Many scholars, expertise and academic books contributed toward project financial feasibility studies in very professional and detailed view as in [22].

### A. *Cost Estimation*

*In this sub-section, you list every single cost source in your project.*

Cost estimation is the best way to forecast your future cost. Use one of the professional method in estimating your cost. It is highly recommended to show your cost breakdown structure (CBS) to simplify reading and reviewing your project cost details. Please read [23] for more information about cost estimating and budgeting.

### B. *Revenue Forecasting*

*In this sub-section, you list all project source of income and revenue planning including sales forecasting.*

Revenue forecasting can be done using the same techniques for sales forecasting as in [24]. For some projects, revenue can be measured by system outputs or identifiable KPI's. Revenue is not always a financial output but it could be time spent to serve community or any other outputs. For general about forecasting, it is recommended to read [25].

## XI. CONCLUSION

Feasibility study is an endless process that is created before project starts. Benchmarking and smart model can be very useful to build a feasibility study for the same type of projects with some minor changes. This paper created a general model structure that can be customized for any small and medium project. The model can be used as ready template for a feasibility study that emphasizes in using fundamentals of strategic planning and systems engineering principles. It has a feature of upgrading the small and medium projects to one unite complete system. This article makes a hybrid feasibility study of SP and SE techniques. This article is shortened for quick reading to capture ideas for creating the suggested mode. To cover the shortening, it supports sections and subsections with very useful references to use them as main references.

Creating this model structure, gives wide-ranging view for supporting decision using feasibility study reports. Not only that but also using it as ready template for that report and ready expert system model structure.

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#### BIOGRAPHY

**Mohammed Salem Alzahrani** is an Assistant Professor and College of Engineering Vice Dean for Development and Quality, Umm Al-Qura University, Al-Leith, Makkah, Saudi Arabia. He earned B.S. in Systems Engineering with concentration on Operations Research and Industrial Engineering from King Fahd University of Petroleum and Minerals, Saudi Arabia. He earned M.S. and Ph.D. from Florida Institute of Technology in Systems Engineering and Operations Research. He worked for Shaqra University as the Dean of Admission and Registration. He had an industrial background in Quality Assurance during his service time for Saudi Arabian Airlines.