Key Success Factors for Small Engineering Projects: A Study at Sasol

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Executive Summary

This project involves assessing and evaluating the key success factors of engineering projects for the Sasol Technology project management department. It is important to understand that projects forms a key basis for engineering companies to create and sustain their capital assets. In order to understand the environment and in particular the project management field, research will be conducted on a sample of projects with the view of highlighting areas of failure in the sample of Sasol projects.

The goal of this exercise is to firstly understand how projects are developed from the ground up, and subsequently to research and record the key factors in making sure that these projects turn out to be successful and if not what factors lead to their failure. An in depth evaluation needs to be done on the Sasol project implementation model that Sasol currently utilises for all their projects and subsequently analysing where and why projects fail at different project stages.There are different factors that lead to the success of projects, if they are taken into consideration and are carefully implemented and or managed. All the factors must also be considered in relation to one another to achieve an acceptable balance within the context of the individual project. These factors are particularly critical in the early phases of a project especially as the company's board is tasked with project approval. A project has to be suitably managed over its life cycle to ensure an appropriate balance in terms of cost, quality and schedule. This is all covered in detail during the literature review

Sasol Technology's project management department has a need to understand underlying reasons for the success or failure of various projects. An in- depth study was conducted on failed Sasol projects, using a set of clearly defined questions. These questions were designed after an extensive research exercise on project execution. Senior Sasol project leaders were requested to complete the surveys that were designed to highlight any specific project problem areas ultimately leading to project failure. A fair response was received from two individual surveys and after an in depth analysis, specific problems areas within the Sasol project management process have been highlighted. The report concludes with specific focus areas and recommendations for Sasol Technology project management department.

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1. Introduction & Background

This project is conducted in association with the project management department at Sasol Technology. Sasol is an integrated oil and gas company with substantial chemical interests. Based in South Africa and operating worldwide, the company is listed on the New York Stock Exchange and the JSE stock exchange in Johannesburg, South Africa. Sasol is the leading provider of liquid fuels in South Africa and a major international producer of chemicals. It uses proprietary Fischer-Tropsch technologies to commercially produce synthetic fuels and chemicals from low-grade coal and natural gas.

The project management department within Sasol Technology is accountable for managing Sasol's capital program, which entails a wide variety of projects. Each project leader or manager within the department is in charge of overseeing a portfolio of projects within the entire project basket. This entails overseeing projects from the idea generation phase of the projects right up until supplying specific support during the operations phase. Several billions of Rands are spent every year on a portfolio of projects in order to sustain the company's growth initiatives. In essence the company's board make project decisions and they in turn entrust the assistance and guidance of project managers to ensure that the correct decisions are being made with respect to project approval and subsequently the successful management of the portfolio of projects, which ultimately forms the bedrock of the organizations growth strategy.

2. Project Aim& Objectives

The aim of this project is to investigate the reasons why a number of Sasol's smaller projects fail. This will be done from a project management perspective primarily using research methods and tools. The focus will firstly be on understanding the project management environment through literature review and then subsequently understanding projects key success factors and the main reasons why projects fail. Then an overview & brief analysis of a small portfolio of Sasol projects will be done, and a questionnaire will be designed to delve into the detailed reasons why Sasol's projects failed. The results from the survey will then be analysed and then suitable

recommendations will be made so that project managers can monitor and act on these specific areas .The survey, analysis and final recommendations will he tabled later in the report.

3. Problem Definition

As Sasol plans and prepares numerous projects yearly with an outlay of billions of dollars, it is fair to assume that the company wants a significant return on the investment portfolio. It is estimated that about 20 to 25 percent of all project capital outlay (10 to 20 billion Rand) is lost annually on unsuccessful and or sub optimal project implementation. Focus on investigating failed projects, to improve project delivery is hence pivotal to Sasol in order to sustain its profitability and more importantly future growth strategy.

4. Project Scope

There are several categories of projects within Sasol. Sasol implements mega projects (capital > 1bn), medium (300m<capital<1bn) and small (capital<300m). This project will focus on a category of small projects to get a basic understanding of problems, which occur, and understanding via research and literature study the various ways and means for the projects that failed to succeed. A sample of projects will be looked at to investigate how they went wrong. The projects researched are of a smaller scale but would be useful as a basis to start the investigation, with the view of taking this topic further as a master's thesis when more analysis can be done on medium and larger scale projects and then devising a system to complement the Sasol Business development model. The research conducted will look not only at engineering issues but also planning, management, economics and resource issues.

5. Investigation

An investigation into certain Sasol projects will take place where data from these projects will subsequently be analysed. These projects will be treated as individual case studies from a research perspective. After an in-depth analysis (via the use of questionnaires) success factors will be highlighted with the assistance from literature

studies already conducted in the field. A validation can take place with projects managers at Sasol answering questions about their respective failed projects; this information will be the basis of highlighting areas where and why Sasol's projects fail.

6. Literature Review

6.1 Introduction

The following literature review will relate to previous research conducted on the factors that affect success and failure in project management. The literature review will be separated into the following sections (areas that affect project success) as shown in the figure below. This literature review will be outlining the many faces of success, which is defined generally as getting the job done within the constraints of time, cost and quality. Very few projects are completed without changes to scope or trade-offs regarding cost, time and quality and a balance of the critical success factors has to then be found for the successful management of projects(Kerzner, 2003). In this report it is hypothesized that ways to manage a project, whichever industry, in the right way is common and that best practices for projects are comparable in any business environment. Similarly ways that projects fail are also common and not specific to any type of project and or industry. The following literature will attempt to demonstrate and support this hypothesis and help understand the best practices in project management in more detail.

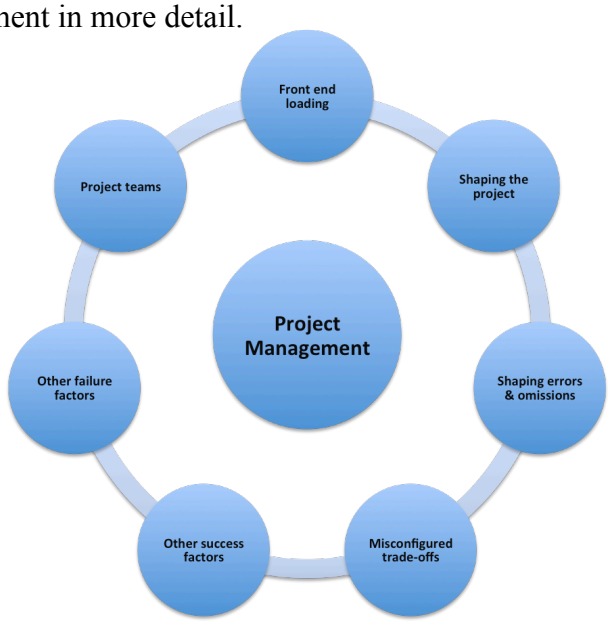


Figure 1: Project management best practices

The point of this literature review is to essentially analyse and record information from a variety of sources on the best practices of project management, which highlight key success factors in running engineering projects while also looking at ways to avoid common errors and failures. It is important to look for similarities between the different sources of information and relate them to Sasol's needs in a way that benefits them in the long run. As noted in the problem statement Sasol looses approximately 20-25% of all project capital outlay because of failed projects, the eventual goal is to have this figure reduced for the benefit of the business.

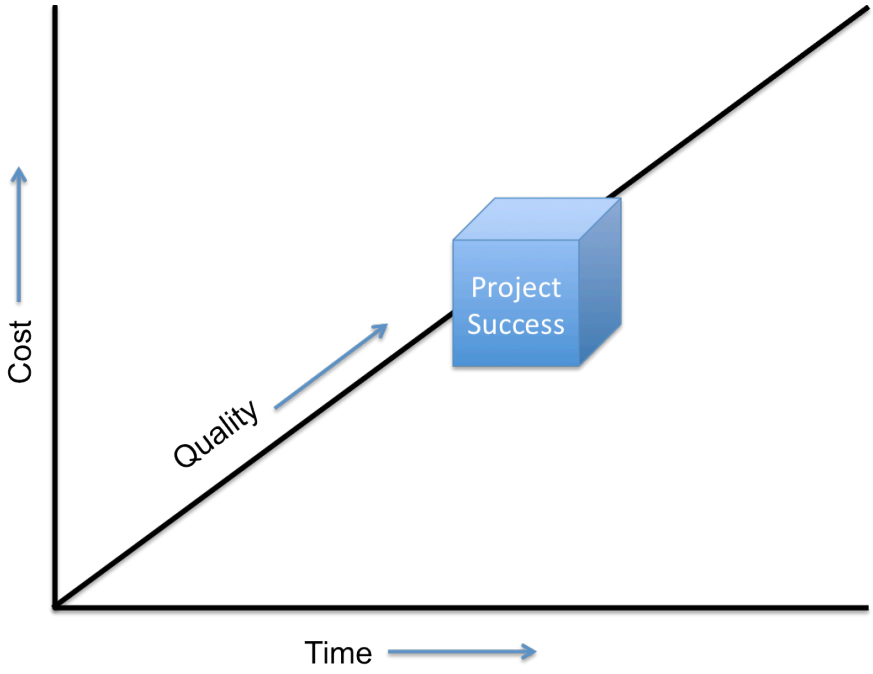


Figure 2: Project Success depends on a balance of cost, time & quality (Kerzner, 2003)

- Section 6.2: Provides an understanding of the basic process that project management adopts, taking an in-depth look at the 'Front End Loading' process.
- Section 6.3: Provides a look into the shaping of a project, this is essentially the beginning of the planning for any project.
- Section 6.4: Shows in detail how shaping errors and omissions can lead to a failed project.
- Section 6.5: Details project trade-offs, how to avoid making mistakes in relation to trade-offs
- Section 6.6: Investigates from previous research other factors of success

- Section 6.7: Investigates from previous research other factors of failure
- Section 6.8: Provides a look at why the correct development of project teams is vital to the success rate of engineering projects
- Section 6.9: A conclusion will be provided evaluating and assessing all the different influences in project management, more specifically which circumstances lead to the success and failure of projects.

6.2 Front End Loading

Engineering companies create their capital assets primarily through projects(Merrow, 2011). These projects satisfy the worlds demand for energy, metals, chemicals and other products, and as a result these projects are always increasing in scale and complexity. Engineering companies spend massive amounts of money on countless projects to, at the end of the day increase their bottom line or profits. These projects increase in size and complexity because natural resources are becoming severely depleted, oil and gas for example can only be found in difficult environments. As the projects have increased in size and complexity they have become more difficult to manage and this results in failures, which deplete capital, don't increase shareholder returns and damage reputations of everyone involved. In this paper, the main objective is to assist Sasol's project management department in optimizing the project management techniques they use so that they are not faced with losses on mismanaged or failed projects.

In the recently published book '*Industrial Megaprojects',*(Merrow, 2011)Edward Merrow takes a look at the reasons why countless engineering projects fail and what should be done by companies to ensure that they don't experience losses to there extensive capital outlays. It is stated that there is a need to recognize problems before they develop and that failures not only affect the company's financial situation but also company reputation and shareholder wealth. To start off with planning engineering projects is a complex and immense task that requires copious amounts of dedication, time, skill and patience for all the people involved, therefore it is better to begin with the basic processes involved in project management before looking at the best practices and causes of failure.

Firstly it is important to understand the project management process that Sasol uses to better understand ways to improve upon it and iron out any faults. Sasol's approach to all of their numerous projects is by using their unique BD&I model. The BD&I model is basically an adapted FEL or front end loading stage gated model, in which there are 3 stages of project management; FEL-1 is devoted to the development of the business case and sorting out the basic feasibility of a capital investment, FEL-2 is the scope development and scope selection phase of the project while FEL-3 is the detailed design and engineering point in the project (Merrow, 2011). The stages in the BD&I model are defined as such, idea generation, pre feasibility, feasibility, basic development, execution, startup, evaluation, operation. This applies to Sasol specifically because it covers oil and gas projects, chemicals projects and minerals projects all of which Sasol have a hand in.

When companies need to start developing processes for project management the starting point is usually a stage-gated process. It is basically the life cycle phases of the project and it is composed of stages and gates. Stages are groups of activities that are can be performed parallel or in series. The gates are decision points at the end of each stage. Good project management provides checklists, forms and guidelines to make sure that critical steps within the stages are not omitted and more importantly done correctly (Kerzner, 2003).

Projects for the most part fail because of mismanagement in between the different gated phases. The system is such that if and when projects are ready to move onto the next phase or gate they should move on. When managers and project leaders are satisfied with the work done and sign off at specific gates. Most problems arise when work is not done on schedule or on budget or of the right quality yet is still pushed through the phases until the end product is not what was planned in the first place. So there are a number of reasons why projects fail.

Project Steps Diagram

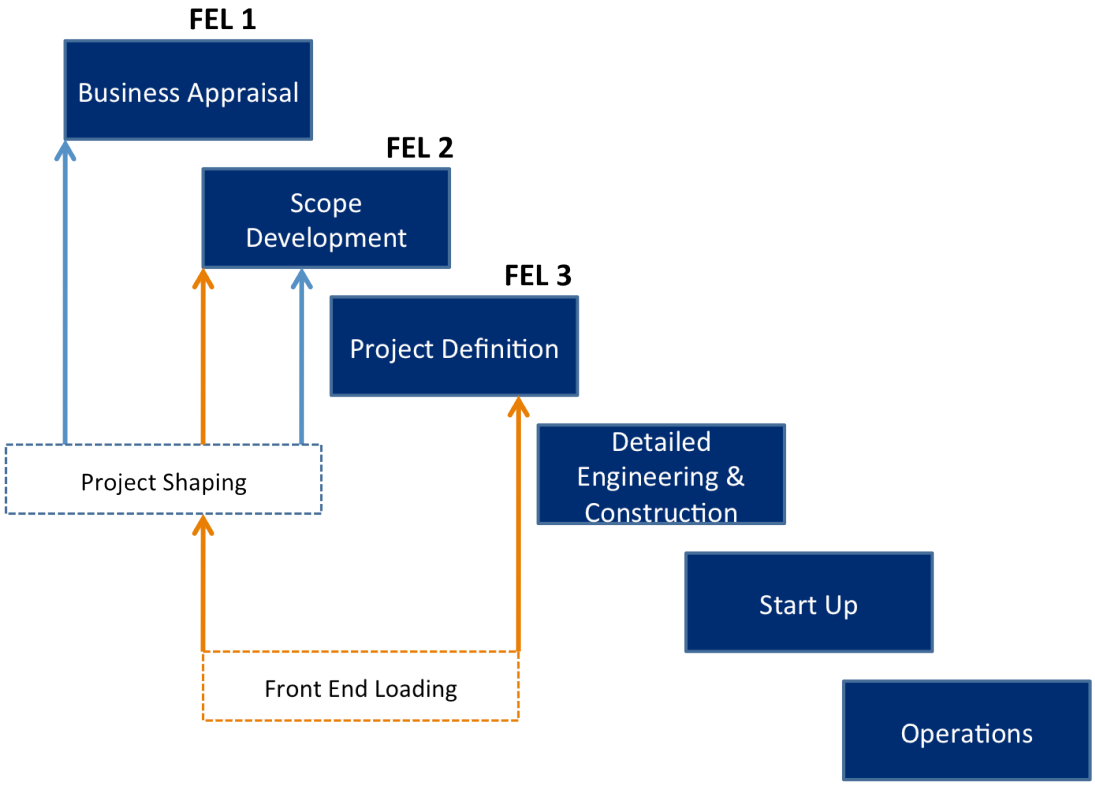


Figure 3: Basic Project Steps Diagram (Merrow, 2011)

The front-end loading diagram is a common project management and engineering process. In a logical sense it follows through from idea generation through planning and development all the way to operation and maintenance. The Sasol BD&I model is a derivative of the general FEL model, which is specific to the types of projects that Sasol starts and runs. It is during the beginning phases of this model where the most project management errors occur and this is elaborated upon later in the literature review. The Sasol BD&I model is shown in greater detail in the figure below.

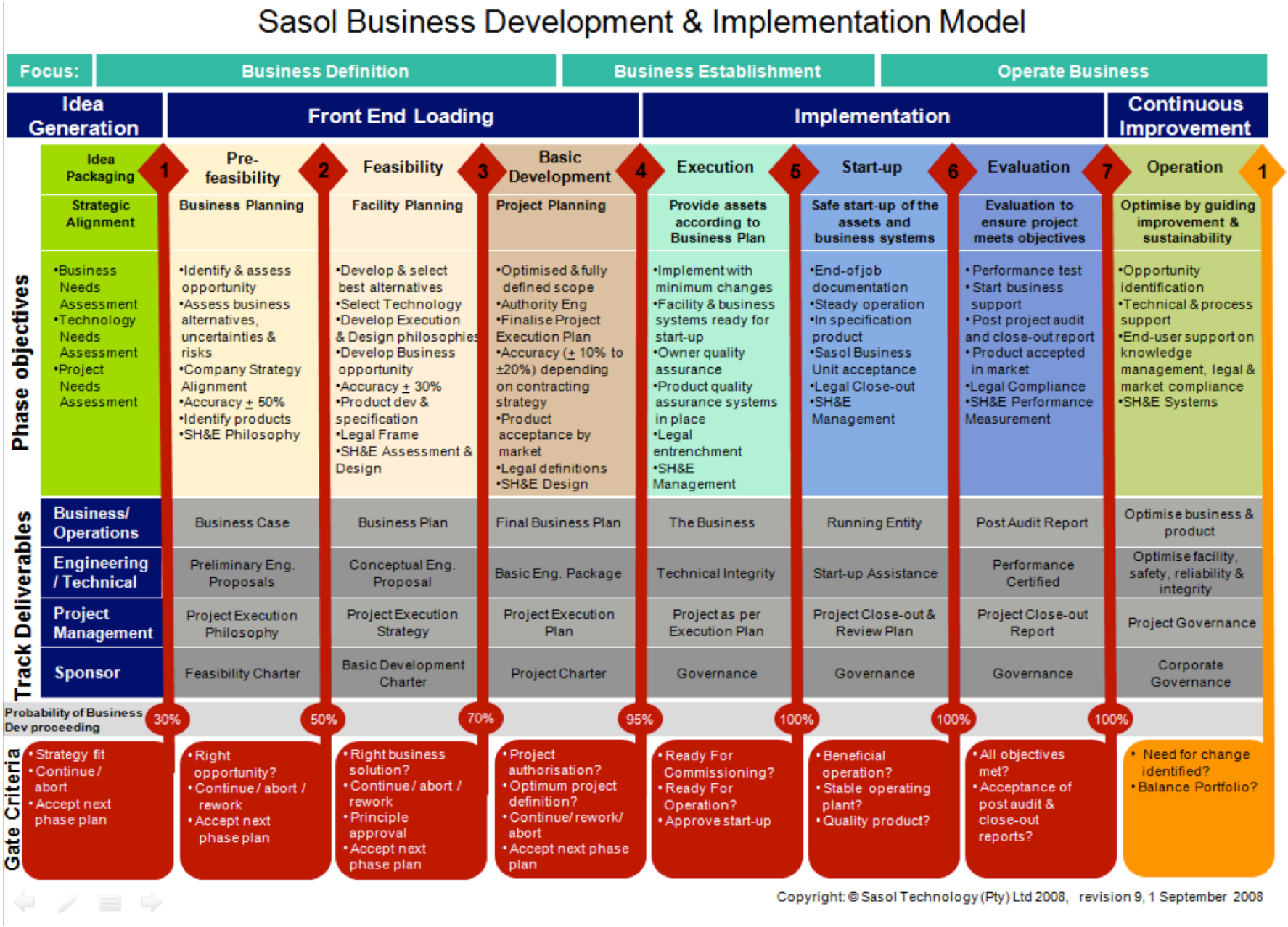


Figure 4: Sasol's Business Development & Implementation Model

There are numerous ways projects can fail, cost overruns, slips in schedule, outdated technology and production problems to name a few, all these failures are caused by deeper underlying issues and most of the time it is because of mismanagement and failure to be held accountable for actions (Merrow, 2011). Because they are unprepared, executives, project directors and project managers often fail to ask a series of key questions at the earliest points in project preparation, the answers to which should shape their assessment of the need to proceed and their fundamental strategy if they elect to proceed. There is a clear need to assess and then shape the opportunity into a reasonable stable platform from which to manage the project.

In project management if the planning is thorough, the project appropriately staffed and the project management stable surprises will rarely affect the project leaders' ability to overcome them, contrariwise if the planning is inadequate or the environment unstable, the process of project management almost always fails. This is why shaping a project or configuring the project in such a way that it is profitable for stakeholder-investors and at the same time stabilizes the project environment is essential. The effective management of large projects requires a stable environment, the requirement to make major changes in objectives, scope, and location after the start of the detailed definition phase or the FEL-3 can result in an unmanageable project. Shaping takes place parallel to FEL-1 & FEL-2 phases to ensure that no changes need to be made to the project once it goes into final engineering (Merrow, 2011).

Whatever the underlying source of the possible opportunity, in the beginning the project is nothing more than that, an opportunity. A successful project is one that eventually fulfills shareholders wishes in being fully functional and operational while also generating a profit on the investment and subsequently an unsuccessful project does not run efficiently and doesn't create a sufficient return on investment. For a successful project it is imperative that all the planning is done in advance and the shaping is done (Merrow, 2011).

6.3 Shaping

Shaping is accomplished in five steps. The ***first step*** is to understand the context or rather the environment, which the project will be executed. The context may be relatively stable and robust with respect to things which affect capital projects such as regulatory regime, labor relations and so on. The context includes the global markets, which is to say unaccommodating of major changes. One of the key tasks of shaping is to assess the context, decide whether the intended will be feasible in that context and then seek to fashion the project and the distribution of its value in a way that will render the environment stable enough for the project to be completed. The context includes the global markets for project inputs: materials, engineering and project management resources and finance. The context includes what is happening regionally as finally the nature of the local situation and a context may change over time (Merrow, 2011).

Failure results when the context is not adequately or correctly assessed or when major changes are unanticipated. If a context does not cause failure what it does do is outline the magnitude of the task that lies ahead. If the context presents major challenges the sponsors strategy for shaping would be different, the needs for staff resources will change and the amount of time needed for development and execution will change as well.

There are several other factors that influence the context when shaping a project. All these factors affect the success or failure rate of projects and are of utmost importance including the physical location, history of prior projects in the area, the nature & perceived value of the physical environment, the political & institutional environment, the regulatory climate and the local continent requirements.

In country advance teams, if a project is in a new venue for the company or if the company has worked in the location before a country advance team needs to be formed immediately. The team should consist of specialists trained to assess the areas of a project context, the country advance teams provides critical information about the context for any project. The country advance team should include marketing and

sales, supply chain, purchasing and logistics, public relations and government affairs and human resources. At least one experienced megaprojects director should always be on this team; it can be a great job for an experienced project manager who is about to retire in a year or two and is therefore unable to take on a new project. Sometimes a sponsor makes the mistake of asking the local contractor to supply the needed advice and expertise but there are a number of reasons why a contractor's expertise cannot substitute. First it's usually far to late during the projects valuation, second the contractor looks at projects from distinctly different viewpoints than the owner and finally the contractor and owner have different interests so putting a contractor in this role is a conflict of interest.

The physical location of a project is also very important; with the weather playing an important role i.e. is the climate harsh or temperate or is it onshore or offshore. Facilities have to be designed with the climate in mind, if it's too cold or too hot it could affect the operations of the facility. Projects fail solely because the whether implications were not accounted for correctly. The second element of the location is the remoteness of the project; this affects the infrastructure, logistics, human resources and the supply chain. Projects can be considered remote, semi remote or not remote. The most successful projects are in the semi remote locations, because projects don't necessarily want to be too far from civilization yet being too close affects projects negatively as well.

Mega engineering projects can be disruptive to the daily lives of those in the immediate area, it is therefore important to discover how the previous projects in the same area were received. The shaping process will be a lot better defined once that situation is resolved. If the community is helpful and supportive the process will be much easier compared to if they don't. Also if the project involved disruption to area that is considered to have a substantial value from an environmental standpoint, the shaping process needs to be carefully orchestrated. Other shaping tools that also fall under understanding the context are, carefully assessing the strength of the political and institutional environment, finding out whether or permit regulations are strict or not, social religious and cultural considerations, local labour availability and quality and competing projects in the nearby areas. All of these factors, when not clearly defined, can lead to the failure of the project in question.

The ***second step*** in the shaping process is assessing the potential value of the project. The potential value of a project is the total net gain that could be developed as a product of the project if it goes forward and is developed and executed well. The shaping process is all about the allocation of the projects value out to various or stakeholders. Knowing the value of the project puts the owners in control of the projects. This is where tools like net present value and rate of return might come in handy in proving to the stakeholders that the venture is financially viable.

The ***third step*** in the shaping process is assessing the comparative advantage and clearly defining the business objectives so everyone involved is on the same page. The question, 'Why do you want to do this project?' ' Why is this project fundamentally better than alternatives?' 'Is this geography stable for the company?' 'Is there really enough enduring business or resource base to make the area interesting long term?' 'What characteristics of the eventual venture and project will be important to success?' These are examples of questions that need to be asked during the shaping process before anything has really begun.

The comparative advantage defines the business objectives, and it exists when a company can uniquely do something of value better than others and can hold that position over time and this will define business objectives for the future. Comparative advantage becomes the core of a bundle of business objectives that will translate to project objectives into the completion of the final project. Clear and coherent business objectives are one of the principle drivers of project management success. Clear business objectives drive project success in a number of ways; unclear business objectives spark a flow of pathologies in the project. Unclear objectives are strongly associated with the project team not understanding project priorities regarding cost versus schedule versus operability. According to Edward Merrow's Mega Projects, when business objectives were rated as very clear, 80 percent of the project teams said they understood the priorities among cost, schedule, and operability. When the business objectives were described as somewhat clear the success rate dropped to 59% and when the business objectives were unclear the success rate of the projects in question dropped to 25%.

Understanding trade-offs among outcomes is essential for effective project management. For example, how much money to spend to gain a month of time and how valuable is flexibility in production rates, these trade-offs guide key focus areas and the building of an effective project management team. Again projects are more likely to succeed if the team understands when trade-offs are clearly defined. Not only does teamwork improve of the trade-offs are understood but also team development is improved if the business objectives are clear and everyone is working together towards a common goal.

The ***fourth step*** in the shaping process is identifying and understanding the stakeholders. A stakeholder is defined as any organization or person that asserts or may assert a claim on the value of the project; this could range from the owners to people who live in the area where the building of the project will affect them. The failure to correctly identify those who will be negatively affected by a project can have tragic consequences. Identifying the stakeholders early and evaluating the size, strength and realism of their claims in at least a preliminary way are essential steps in sponsor decision-making. Knowledge of the stakeholders will inform and guide their strategy toward shaping the project.

The ***fifth and final step*** in the shaping process is thinking about partners or formal sponsor-investors. Roles and responsibilities need to be assigned, partners need to know all the project details and question like the following need to be answered. What kind of partnership this is? What does the partner want/need out of the project? Does your partner have an equity or interest in a competing project or in a venture that will supply this project? What are the partner's capabilities to assist in this project? What is your partners approach to capital projects? Is your partners cast flow constrained? Once these questions are dealt with regarding partners you will have enough information to start devising a shaping strategy. Most importantly after understanding the context project leaders will have a clear understanding of why the project will benefit the company.

6.4 Shaping Omissions & Errors

Shaping is a hugely important aspect of developing a project hence if its not done properly it can lead to project failure. Shaping errors and omissions are the most common areas of ***project failure***. These errors and omissions fall into five groups:

1. Failure to achieve full stakeholder alignment

When the shaping process has not been properly articulated projects are forced through the phases or gates without alignment. Lack of partner alignment on issues, such as owner staffing, completeness of the FEL stages, contracting strategy, financing strategy and schedule ultimately result in late cancellation of the project or project failure.

2. Ceding so much value to other stakeholders that the project has no value

The shaping process has to balance the stability created in the project environment via value allocation with the value created to the sponsor-investors. If a stable project environment comes with too high a price, there is insufficient value left to the sponsor-investors to make a good investment.

3. Failure to develop coherent objectives

Shaping is a process of successive approximations leading finally to a stable 'platform' of stakeholders aligned around a set of understood and coherent objectives. Too often sponsor-investors don't understand that the process of adjusting objectives must stop at some point. Objectives should be defined at the end of the scope development (FEL2). The problem is that objectives continue to be changed even after the scope has been defined. Changes in objectives after the end of FEL2 take many forms, but they are almost always problematic causing lack of alignment & leading to higher costs.

4. Impracticable cost, schedule and quality trade-offs

One key product in the shaping process is the gathering of expected results, among which are how much the project will cost, when will it be done, and how much product it will reliably produce over time. Three outcomes – cost, schedule, and quality – can trade off against each other. The three constitute a complex optimisation problem, which is complicated by several factors. Most of the time the trade off functions are uncertain and are different for different projects and at different times. With regards to the trade-offs, the targeted objectives and results are important because together they establish the expected direct economic value of the project. The targets need to be established at points in which all three outcomes are at least in principle, feasible and taken together constitute a valuable outcome. Unfortunately this is not always the case

5. Setting overly conservative targets

Sometimes project targets are set so conservatively that the value of the project is hugely compromised from the outset. This occurs when sponsors are extremely risk averse with respect to cost and schedule overruns. These megaprojects are most common in the Middle East. The goal is to not have risks associated with cost, schedule and operability transferred to engineering procurement and construction.

6.5 Misconfigured project trade-offs

In addition there are four forms of misconfigured (incorrect project basis) projects. These trade-offs are misguided and some are set so aggressively that the project is more or less bound to end up being a major disappointment. These are:

1. Quality is sacrificed for low cost.

Trading poor quality, which translates into poor production relative to plan, for lower capital cost is almost always unintentional. Trading quality for low cost is usually an

unintended byproduct of accepting a very low lump sum bid. This sort of trade off is not supposed to happen.

2. Cost is sacrificed for fast schedules

The most common misconfiguration is trading cost or schedule. In a study done by the IPA they found out that one would have to gain more than 5% schedule advantage for every 1% of added capital to be a return on investment. In the normal course of events when a project experiences a large real cost overrun, it overruns its schedule substantially as well. The reason is that most large overruns are caused by the discovery of considerably more work to do than expected, which takes time.

3. Quality is sacrificed for fast schedules

Like sacrificing quality for cost, this result is almost always unintended because it degrades the value of the asset substantially. It is however very common. The desired schedule outcome is one of the products of the shaping process. The schedule strategy is generally among the first outcomes fixed in the shaping process. If the schedule that is proposed is too short during the actual production, several paths lead to quality degradation. One is that the front-end loading schedule is so rushed that the scope is not appropriate and the project suffers operability problems. Sometimes execution is so rushed that corners are cut to meet production date targets. But the most common problem is that some of the background technical data, which is essential to correct design, is never fully developed.

4. Safety is sacrificed for speed

The drive for unattainable speed in a megaproject development and execution is a symptom of serious pathology in the modern industrial firm. It has been responsible for the sheer destruction of billions of dollars of shareholder wealth. There are a number of different reasons why speeding up projects is a bad idea, and the blame falls squarely on the shoulders of project leaders who lack correct technical expertise. Ultimately the problem comes down to a simple lack of accountability, business executives who set in motion a process are rarely held responsible if the process fails.

6.6 Critical success factors of projects

Critical success factors are defined as, the limited number of areas in which results if they are satisfactory will ensure the successful competitive performance of the organization, there are a few key areas or activities that should receive constant and careful attention to ensure the best performance to achieve company goals(Fortune & White, 2006).

Some critical factors mentioned in the article that are key to the successful implementation of projects are: Support from senior management, clear realistic objectives, strong/detailed plan kept up to date, good communication/ feedback, user/client involvement, skilled/suitably qualified/ sufficient staff/team, effective change management, competent project manager, strong business case/sound basis for project, sufficient/well allocated resources, good leadership, proven/familiar technology realistic schedule, risks addressed/assessed/managed, project sponsor/champion, effective monitoring/control, adequate budget, organizational adaptation/culture/structure, good performance by suppliers/contractors/consultants, political stability, correct choice/past experience of project management methodology/tools, environmental influences(Fortune & White, 2006).

Success factors can be broken down into different groups; they are needed to identify what is necessary to meet the desired deliverables or objectives. Kerzner states that there are variables for success and that every project manager must be willing to employ a systems approach to project management by analyzing variables that lead to success and failure (Kerzner, 2003).

The figure below highlights the most important elements of project management and essentially what it takes a project to be successful this not only includes clear and well defined goals and requirements but also a strong commitment from everyone involved in the project. Everyone must understand and be motivated to achieve the goals and also be involved actively in making the project work from idea generation to implementation.

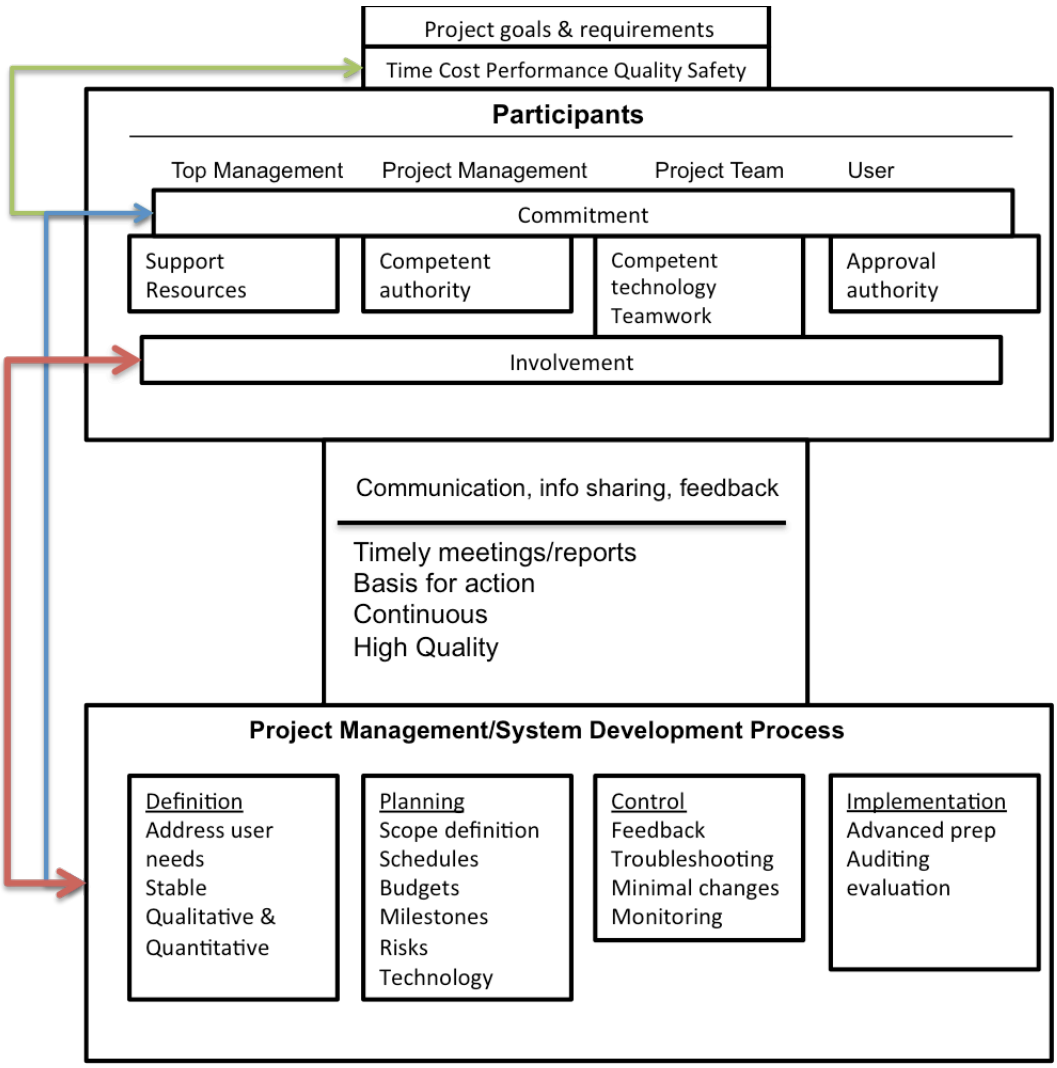


Figure 5: Project Management Process for Success (Nicholas, 2001)

After the shaping strategy is completed the project development can commence, but as stated earlier most of the problems with projects occur even before a project has even begun. In *Industrial Megaprojects,*Edward Merrow states that basic changes need to be made to the approach of project leaders and sponsors when running projects(Merrow, 2011). A few of the most important aspects for successful project implementation are the following;

1. Addressing the business-technical divide

The first and most important challenge is to address the deep chasm of misunderstanding between business and technical professionals about how these projects should be developed, governed and executed. Communication is of utmost importance from both sides of the divide. Project professionals should learn how to

communicate in a language that is clear and persuasive to their business colleagues. The often-covert hostility that has developed between business and technical professionals in industrial organizations is the first order driver for poor megaproject outcomes. Bridging the divide will help restore a spirit of cooperation not only in the development and execution of the projects but more generally in the way the company operated.

2. Formalizing and institutionalizing the shaping process

Most companies lack a systematic approach to shaping that helps them ensure that the right things are getting done for every project. The shaping process is what binds the project together from the corporate boardroom to the production floor. Every industrial firm has a strategy for how it will gain comparative advantage in the competitive world. That strategy includes technology, supply chain, and production assets. In successful firms those elements are tightly woven together. The corporate strategy informs the businesses what sort of assets in what areas around the world would be acceptable and desirable. The business goals for the projects define how the corporate goals around generating comparative advantage will be manifested in the project. And finally the detailed business objectives define the project objectives that the team must meet to be considered successful. Establishing a standard work process for the shaping of large projects and then holding senior business leaders accountable for meeting project requirements is essential.

3. Developing a team staffing strategy

One of the big issues facing industrial sponsors going forward is how to staff the many projects that they would like to do. If the projects are not staffed correctly they will fail. Correct staffing is essential to a successful project.

4. Investing wisely during the front-end loading phases

The investment needed in front-end loading (FEL) is about 3 to 5 percent of the total capital cost and about 30 to 40 percent of the total project time. The value of that money and time is huge; the projects with the best FEL averaged more than four times

the net present value (NPV) per dollar investment of all the rest of the projects. The projects that did not achieve a good FEL were usually NPV negative.The stage gated FEL process is a core business process and businesses should insist on it being done. If FEL is not done well, it is because of schedule pressure, unclear business objectives, unknowledgeable staff and uncooperative project departments.

6.7 Factors leading to the failure of projects

In the journal '*Planning in the dark: Why major engineering projects fail to achieve key goals'* by Prof. Phillip Lawrence he states in his research of why engineering projects fail, that the failings typically occur in eight areas(Lawrence, 2011):

- Poor initial planning
- Lack of clear objectives and deliverables.
- Lack of understanding of dependencies
- Inadequate resource allocation
- Poor risk analysis
- Poor change management
- Lack of "buy-in" from stakeholders
- Poor understanding of priorities

He states how these failings affect all major engineering projects and that most projects have deeper underlying problems that lead to the failings above. He stated that since most engineering managers are competent and well qualified it is something outside the sphere of human competence that is causing these problems. In the article it is stated that the outmoded technology used for project management is the issue (Lawrence, 2011).

The true definition of failure is when the final results are not was expected regardless of the expectations to begin with. Project failure is both quantitative and qualitative. Quantitative failings include, ineffective planning, scheduling, estimating and cost control. But it also includes qualitative failings like poor morale, motivation, human relations productivity or employee commitment (Kerzner, 2003).

Also stated by Kerzner, the main problem with project management is the inadequate or inappropriate risk management. And the failure of most engineering projects is a combination of poor risk management and poor technical ability. This is where project management principles and planning like shaping and front-end loading are important to be done correctly (Kerzner, 2003)

Failure is never in isolation; it is always the product of a system failure. And one can assume poor project management. Failure is always traceable and more often than not defects in the project management system lead to poor design, poor quality control, and inadequate inspection and in the end a failed project(Nicholas, 2001).

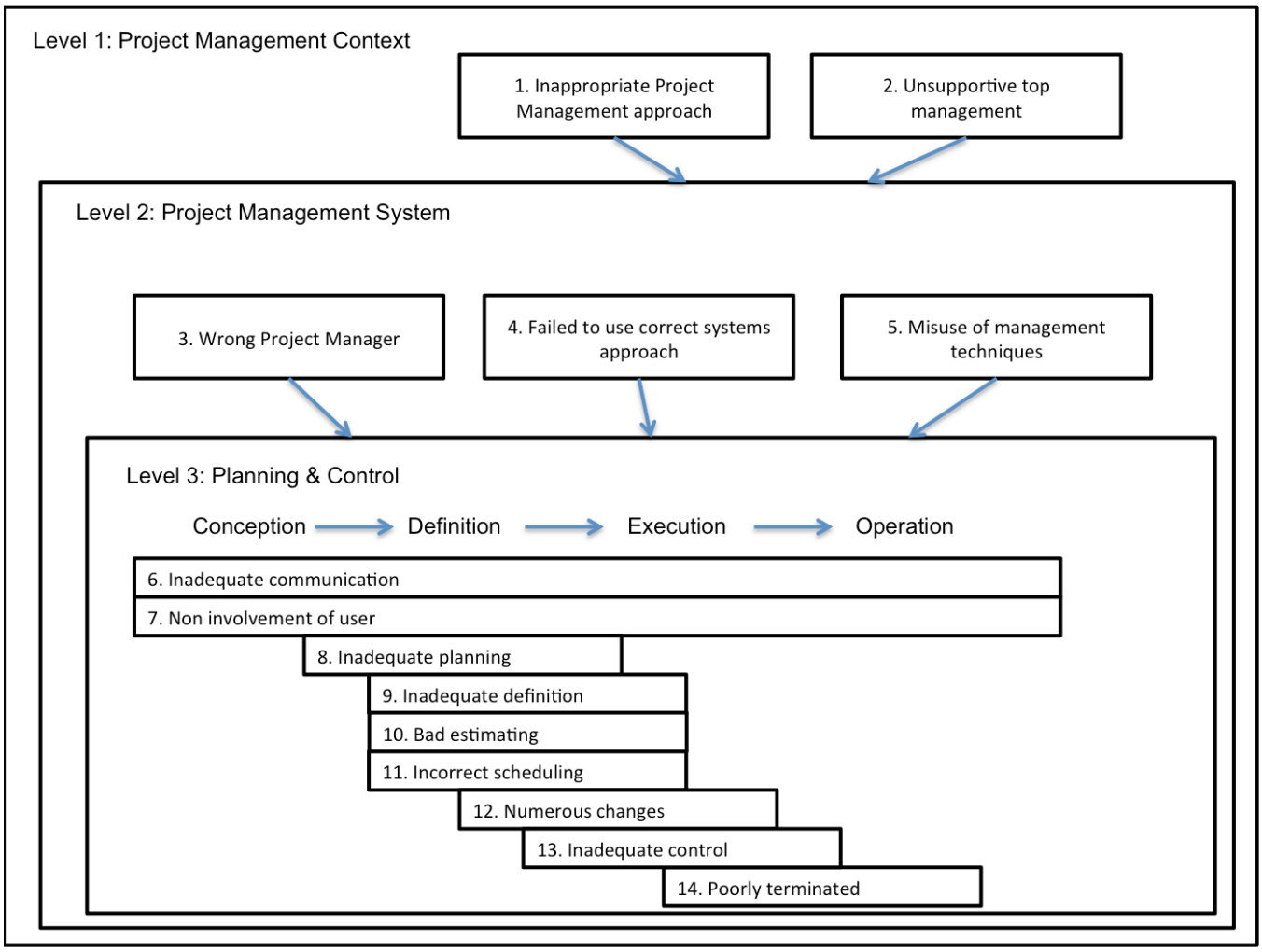


Figure 6: Project management causes of failure (Nicholas, 2001)

In Michelle Symonds' article *'15 Causes of Project Failure'*, she states similarly that there are many elements in project management that could cause failure. The following are her list of causes(Symonds, 2011):

- Poorly defined project scope
- Inadequate risk management
- Failure to identify key assumptions
- Project managers who lack experience and training
- No use of formal methods and strategies
- Lack of effective communication at all levels
- Key staff leaving the project and/or company
- Poor management of expectations
- Ineffective leadership
- Lack of detailed documentation
- Failure to track requirements and progress
- Lack of detail in the project plans
- Inaccurate time and effort estimates and cultural differences in global projects.

Judging by this collection of articles and books that information regarding project management is similar through different industries and projects all around the world. It is therefore the underlying problems that are common in all these projects that need to be removed.

After consulting numerous journals and articles regarding project management, there are a number of best practices that can be followed(Liviu Ilies, 2010). With respect to reasons why projects fail, there are ways and means to run projects so that failure doesn't occur. Shaping, basic data requirements, forming project teams, front-end loading and corporate governance are all areas that need to be controlled correctlyfor the best efficiency in running projects(Casteneda, 2011).

With regards to shaping, great detail has already gone into showing how important it is to shape a project. For the basic data requirements,it is of utmost importance to get

the project parameters correct. This is primarily because these are engineering projects and require a high level of precision in the design. Errors and omissions can lead to safety issues, which could be detrimental to all the people involved. Inaccurate and incomplete basic data compiled for projects is a cause for project failure. It is important that all the data is checked and verified as well as understood by all members of the project team. The basic data needs to be known for the process if it's new or procured from a licensor. If a project requires new infrastructure the data needs to be known for all of them.

There are consequences if the basic data is not well known, there are errors in them, or some data is left out. Basic data problems include schedule slips, cost overruns and ultimately failed projects. The basic data should be complete and available prior to the start of the scope development or FEL2. The data then comprises of the foundation to begin the scope development, as it affects the business decisions and the shaping process, which is essential to running a successful project.

Basic data errors can be caused by the companies drive for speed, as the pressure to complete the project on schedule increases corners get cut. Errors can also occur when there are miscommunications between people and when simple issues get over looked. Basic data that arrives late affects the engineering work, if it arrives after the scope development, it can cause major cost overruns and slips in schedule, and is a major distraction for the project team. If there are changes to the basic data after the FEL3 phase, it can result in the complete loss of an asset. Basically when the basic data needs of a project are not understood during the early or FEL1 stages of the project, at the start of the shaping process, it becomes too late to get quality data as the need arises.

The basic data failures that projects experience are easy to rectify and as a result a protocol should be developed so that all sections of the basic data are covered and fixed early on in the project, and educating project leaders and mangers that basic data is important is essential to project success.

6.8 The importance of project teams

Another area of great importance in the development of successful projects is the creation of **project teams**. Functioning as a team is vital for effective and efficient engineering. There are a number of conditions that are required for effective project management teams, but before a team can be formed, most importantly, coherent project objectives need to be laid out and understood by the project leaders. The key team topics include:

1. Timing of team formation

As soon as there is a chance of project development, a core team needs to be formed. The early formation of the team ensures that there will be technical input available to business decision makers from an early stage. Another reason for the early team formation is the ability to appoint a project leader who will most likely stay with the project from the beginning to the end. During the length of the project there will continually be a turnover of team members, so having a project leader on from the beginning is of great help.

2. Team size

Team size is a misjudged aspect when forming teams. It is very common for project teams to be too small, from the early scope development to the execution and operation. It's usually to save money but that mentality usually affects the project negatively. The more complex the project, the more subprojects the development has the bigger the team. Larger teams are easier to integrate and no key positions are left vacant.

3. Integrated teams

Developing an integrated team is one of the most important aspects of project management as it drives front-end loading. This essentially means that all the

functions of a project team are actively involved in ensuring that the common goals or project objectives are achieved. In '*Industrial Megaprojects'*(Merrow, 2011)Edward Merrow states that 51% of projects with integrated teams are successful versus the 21% of failed projects without integrated teams. Team integration is a necessary condition for effective FEL.

4. Importance of continuity

Even though project teams are continually changing, turnover in leadership during the project can still be disruptive and damaging. Most damaging is the departure of the project director anytime between FEL2 and the completion of the project. It is clear that projects are more likely to fail if the leadership keeps changing than if the team stays whole from the beginning.
Team members are left in the dark, the new director has to catch up with a tremendous amount of work and informal agreements between the director and contractors or consultants won't exist anymore.

5. Team leadership

Strong leadership is key for any institution or project. Project leaders need to be successful at team building, communicating both to their team and to the business directors and to be politically savvy. The leader needs to be trusted by his team and motivate them to achieve their goals within the project scope. The leader also needs to maintain morale, which can be very difficult.

And lastly the most imperative aspect of the project management process is getting the front-end right. Front-end loading is the core work process of project teams prior to project authorisation. The process is divided into phases or stages as stated earlier in the literature review. In between these stages are gates where reviews are made on economic, business and technical aspects of the project. If the aforementioned aspects are acceptable at each stage, the project is allowed to continue on, if not the project should be stopped and re-evaluated or the problems rectified. The figure below shows a basic version of the FEL process.

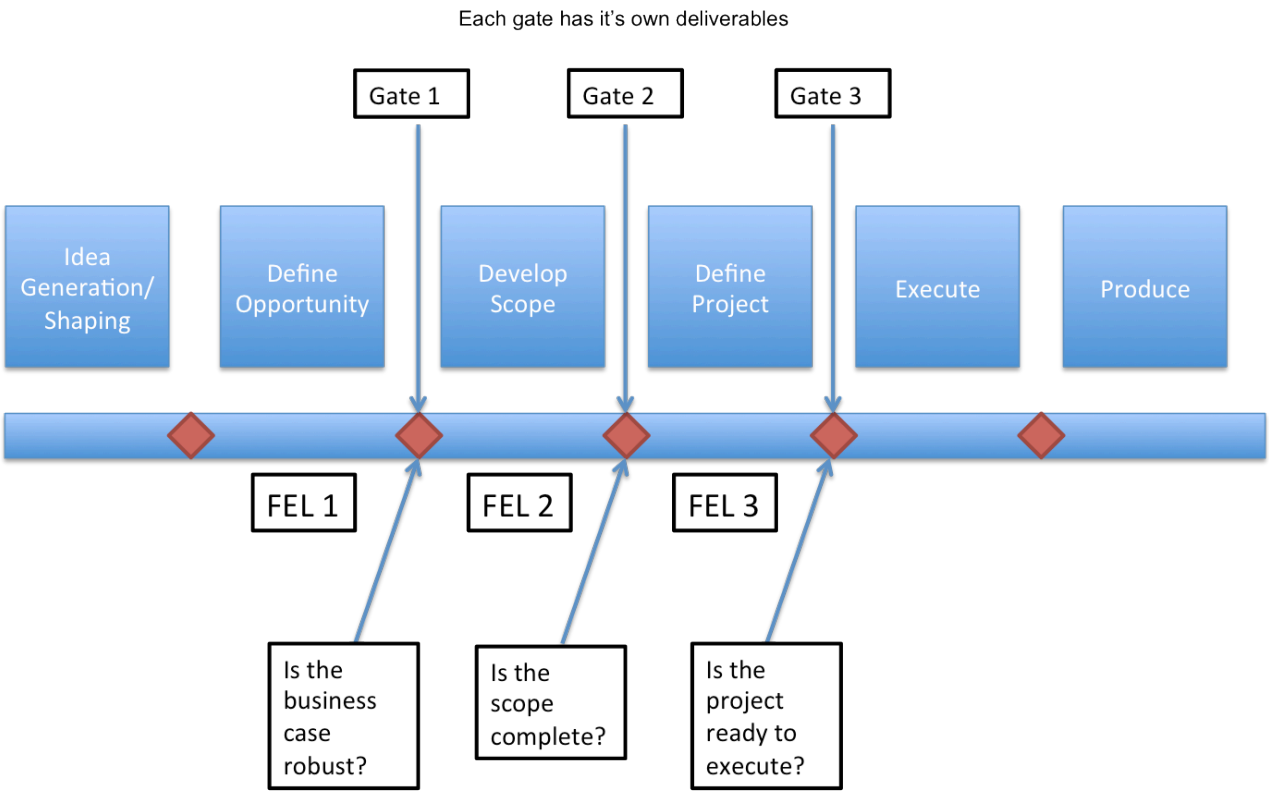


Figure 7: Basic FEL diagram (Merrow, 2011)

Once the project is accepted to execution, the goal is to maintain the business value that has been created in the opportunity shaping and scope development process. Maintaining this value means that the project will be on or close to its sanctioned budget and schedule and will produce as promised after it is operational. This is done through correct front-end loading (FEL).

The FEL affects cost performance, schedule performance, production performance and safety performance, all of which need to be effective if the project is to be successful. In terms of cost and schedule predictability, the better the FEL is handled the less cost and schedule deviation. In terms of production and safety, when the FEL is done well there are less operability and safety issues. Fundamentally well done front-end loading increases the likelihood of eventual project success. Executing a successful FEL is synonymous with project success in the long run.

6.9 Conclusion

In conclusion it is clear that there is a universal need for effective project management. Projects all around the world in different industries and different

companies are experiencing similar problems to their projects. It is also clear that there are areas in project management, which work hand in hand with each other to achieve the best possible outcomes. Understanding the optimisation of these areas is key to implementing and executing successful projects(PMI, 2011). These projects are run by competent and qualified people so there are underlying complications that plague these projects. It is clear that there is a need to address the fundamental problems and not trying the fix the issues that result from it.

In the research that follows a few of Sasol's projects, which failed, will be analysed to see what difficulties and problems caused their failures. The definition of a failed project according to Sasol is a project that hasoverspent or underspent by more than 10 percent, or if the plant does not start-up on schedule. The research will analyse the reasons for those failures.

7. Methods & Tools

For this report a research methodology will be adopted, as the goal is to analyse where and why a sample of Sasol's projects failed. This will be done primarily through:

a. Obtaining and analyzing a set of project results from Sasol (included below)
b. Conducting detailed research (via clearly articulated questionnaires) and comparing the results with similar projects in in other different industries.

The research method will be defined using the following process:

1. Research Design
    a. Choosing appropriate sampling and data collection methods
        i. Collecting a sample of projects from Sasol.
    b. Choosing appropriate analysis methods
        i. Using questionnaires designed to identify where projects do not comply or failed.
    c. Collating the research

i. Gathering and organising information in an understandable manner

2. Management of Research Process
    a. Preparation of results
    b. Data analysis and management
    c. Other issues
3. Evaluating, validating and reporting the results
    a. Results will be analysed and suitably represented (radar diagram)
    b. Results will be presented and discussed with Sasol in the form of a presentation
    c. Final analysis and results after validation will be incorporated into the report

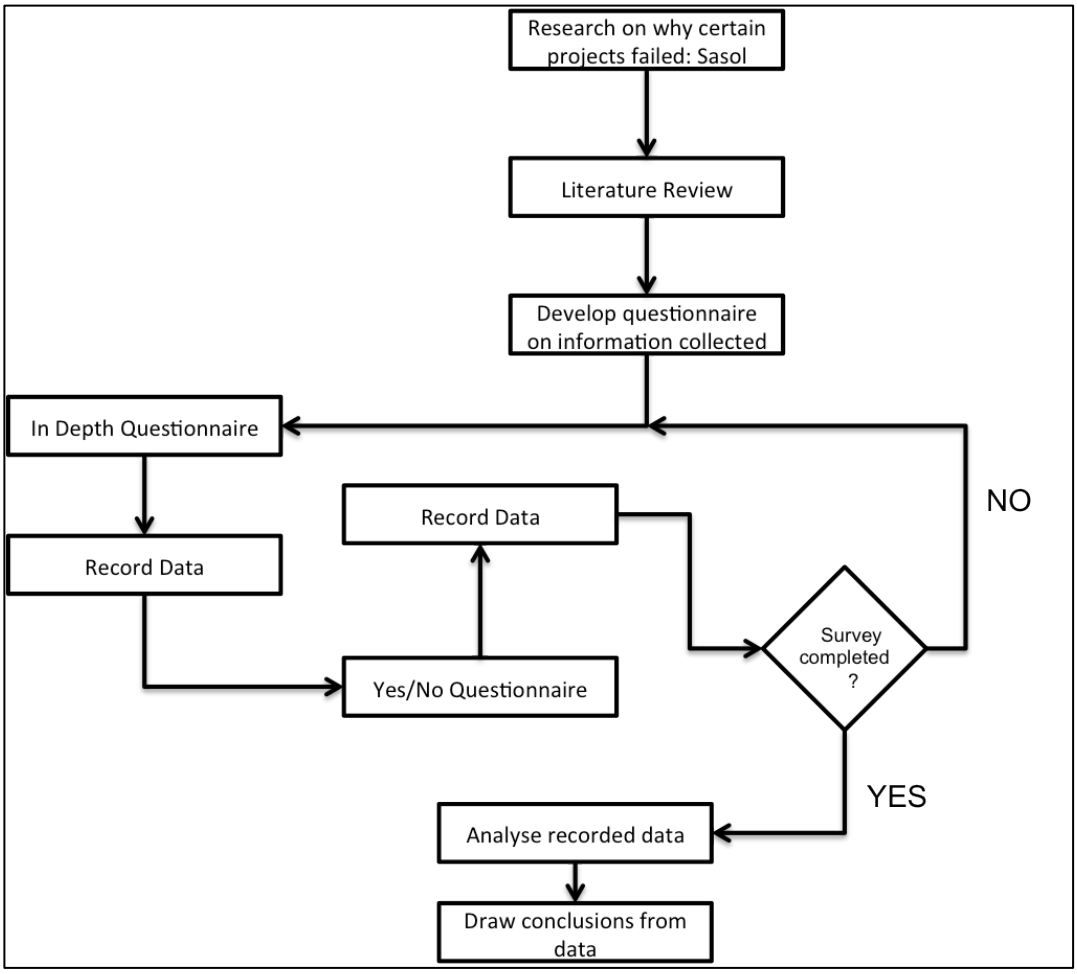


Figure 8: Research Methodology

This research will not be focused on creating new theory but rather doing a new focused analysis on an existing problem and testing assumptions that have already been made. The focused analysis will be done via a set of clearly articulated questions in project critical success areas as derived from the literature review .So, in summary Sasol will be benchmarked against project management best practices as researched in the literature review.

8. Research

Research was conducted on projects that were regarded as failures by Sasol. Since the below list is compiled on a relatively small group of projects they are considered failed projects according to Sasol because they are either unacceptably over budget, under budget, not on schedule, or do not perform according to acceptable operational requirements. Projects that are under budget are also considered failures because they tie up capital that could have been used for other value adding projects. The research conducted will be to pin point the reasons for failures. A preliminary research has been conducted and included in this report with detailed research that will be included in the final report. The detailed research will entail specific questions designed and drafted, to be answered by the project leaders themselves as to the exact reasons why projects failed. In the figure below a sample list of failed Sasol projects is investigated. This is followed by conclusions as to why they failed.

Project Name	Plannned Complete Date	Forcast Complete Date	Expended	Capital Approved	Over Budget	Under Budget	Over Schedule
Project A	Dec-11	Feb-12	923 665 000	908 700 000	14 965 000	NO	2 months
Project B	Dec-11	Feb-12	606 438 000	675 000 000	NO	68 562 000	2 months
Project C	Nov-10	Dec-10	103 817 025	104 000 000	NO	182 975	1 month
Project D	Aug-11	Oct-11	292 000 000	240 000 000	52 000 000	NO	2 months
Project E	Aug-08	Sep-08	17 626 865	15 700 000	1 926 865	NO	1 month
Project F	Aug-11	Sep-11	12 289 867	12 400 000	NO	110 133	1 month
Project G	May-11	Jun-11	1 892 947	2 200 000	NO	307 053	2 months
Project H	Aug-11	Sep-11	6 809 617	5 480 000	1 329 617	NO	1 month
Project I	Aug-11	Sep-11	15 601 265	17 700 000	NO	2 098 735	1 month
Project J	May-11	Jun-11	13 614 322	13 500 000	114 322	NO	1 month
Project K	Nov-11	Dec-11	200 000 000	221 000 000	NO	21 000 000	1 month
Project L	Jul-11	Aug-11	15 402 413	18 000 000	NO	2 597 587	1 month
Project M	Jun-11	Jul-11	5 981 994	6 000 000	NO	18 006	1 month
Project N	Nov-10	Feb-11	260 000 000	249 000 000	11 000 000	NO	3 months

Figure 9: Sample list of Sasol projects

It is clear that all the above projects have been delivered beyond the agreed promised schedule. Late delivery results in late start up and also late production and hence less

income from sale of product. Six projects have come in over budget and eight projects have come in under budget, thus leading to an overall lack of confidence in the company's ability to predict cost and to also ensure cost effectiveness. Using this data and general feedback from Sasol, this generally positions Sasol below average in terms of project execution as indicated in the picture below:

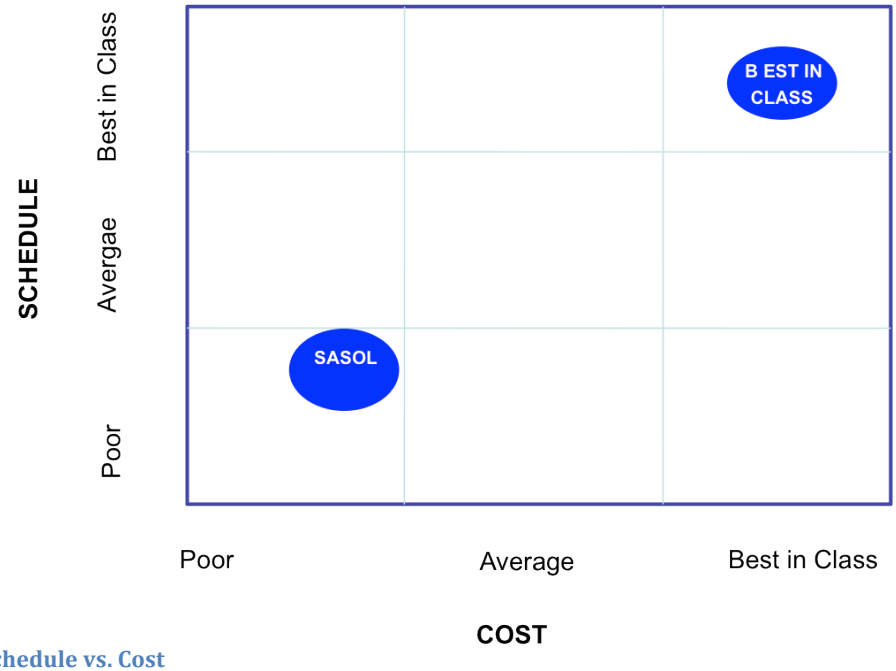


Figure 10: Schedule vs. Cost

It clearly shows that in terms of maintaining a schedule and running a project on budget, Sasol is still below average. This figure points out a need to make changes in the project management process so that unnecessary losses do not occur often.

After a discussion with Sasol project leaders and an examination of the results, a short summary of the reasons why projects failed are recorded below:

- Poor scope definition resulting in poor execution of front end loading, i.e. conceptual design and basic engineering
- Poor governance of the BD&I process
- Poor projects control, i.e. cost and schedule control
- Poor team development, i.e. not all engineering and projects function allocated to the project
- Capability of engineering and construction contractors
- Unrealistic expectation from businesses.

In order to truly understand the exact causes of project, a detailed set of questions have been drafted in order to delve deeper into the reasons of project failure. These questions have been drafted based on project management best practices that have been covered in the literature review.

The questions have been categorized into 6 main areas that are critical for Execution Excellence. These are:

1. Shaping a project
2. Following the Stage Gated Process
3. Appropriate Front End loading
4. Project teams and resources
5. Project Management and Controls
6. Contractors & Consultants

A set of pertinent questions has been designed for each category and based on the outcome of the analysis; any shortcomings in critical areas will be highlighted. The 6 major categories of questions and the associated detailed questions are contained in appendix A.

8.1Survey 1 – Based on basic project management principles

Section 1 – Shaping Questions

1. How detailed were the scope definitions?
2. Did the project lack owner buy in?
3. Were the schedules integrated with the cost estimates?
4. Were the schedules developed by the project team and not by outside contractors?
5. Were trade-offs clearly defined?
6. Were the business objectives clearly defined?
7. Were the project objectives clearly defined?
8. Was each team organized and prepared before the project had begun?
9. Did the project have any impact on existing operations?
10. During what stages did the projects start to fail (FEL1, 2 or 3)?

11. Was the basic data known and collated for all the projects?
12. If there were design changes made how late were they made?

Section 2 – Stage Gated Questions

1. Was the BD&I process strictly enforced by project leaders?
2. Before passing through FEL1 was the project definition clearly defined?
3. Were all the processes and functions needed to pass through each phase completed with the required quality?
4. Were some projects pushed through the gates lacking the necessary quality because of scheduling or cost issues?
5. Were the project deliverables met, for each of the gates in the process?
6. How often were changes made to the scope of the project?
7. Were there changes often made after the detailed design and or scope definition?
8. What is the frequency of change in projects that have failed?
9. Were there late design changes? How many projects changed the design even after it was approved?
10. Did the changes made still mirror the business and project objectives?
11. Were all technical issues resolved during the FEL process?

Section 3 – Project Teams

1. Were the project teams formed in advance?
2. Were the business and project objectives clearly understood? Are late business decisions made because of a lack of understanding of the aforementioned objectives?
3. Were the cost and schedule trade-offs defined well enough?
4. Were the team roles and responsibilities defined and documented?
5. Did the team members understand the project drivers?
6. Did these projects have sufficient team development? Are the teams fully integrated in the project environment?
7. Was the team continuity maintained during the duration of the project?
8. Was there constant turnover in team members?

Section 4 – Project Control

1. Were the practices for best project control being closely followed?
2. Was there constant measuring of physical progress? Not just at major milestones or checkpoints?
3. Did the projects have a cost control specialist and a schedule control specialist?
4. Did the projects make use of 'Value Improving Practices'? (VIPs)
5. Wad there proper understanding between the business and technical aspects of the projects.

Section 5 – Contractors & Consultants

1. How much technical influence is given to the contractors or consultants?
2. How accountable were the contractors and consultants for the work they did?
3. Is there sufficient communication between the owners and the contractors with regards to project objectives?
4. Was the project teams affected by the outsourcing of project tasks?

Section 6 – Front End Loading

1. Front end Loading was guided by business objectives
2. Business and project objectives aligned & approved by the owner
3. Project objectives are quantifiable and measurable
4. Key decisions on technology, site & feedstock made and agreed
5. Contracting strategy made clear and communicated
6. All interfaces clearly defined (business, technical, contractors if any)
7. Project execution plan and risk analysis completed

8.2 Survey 2 (Yes/No) – Based on project management critical success factors

1. Was there support from senior management?
2. Were clear and realistic objectives set?

3. Was a strong and detailed plan kept up to date?
4. Was there good communication and feedback?
5. Was there adequate User/client/owner involvement?
6. Was there a skilled and suitably qualified sufficient team?
7. Was the change management effective?
8. Were the project manager/team members competent?
9. Was there a strong business case/sound basis for project?
10. Was there sufficient and well allocated resources?
11. Was there good leadership within the project?
12. Did the project make use of proven/familiar technology?
13. Was the schedule realistic?
14. Were the risks addressed/assessed/ managed?
15. Was the project sponsor on board and engaged?
16. Was an adequate budget approved?
17. Was the organizational adaptation/culture/induction sufficient?
18. Was the performance by suppliers/contractors/ consultants satisfactory?
19. Was there planned project close down/review/ acceptance of possible failure?
20. Was provision made for training of team members?
21. Correct choice/past experience of project management methodology/tools?
22. Was past learning's/knowledge applied?

9. Deliverables& Validation

In the validation phase, the answers from the questionnaire will be examined. This will provide the necessary information for analysis of results & highlighting key reasons for project failure. Finally key focus areas will be highlighted, in the form of a radar diagram as indicated in the sample figure below. Each project will be evaluated according to the key success factors and the results will be expressed as a % of compliance to a specific project management category as indicated in the sample figure below.

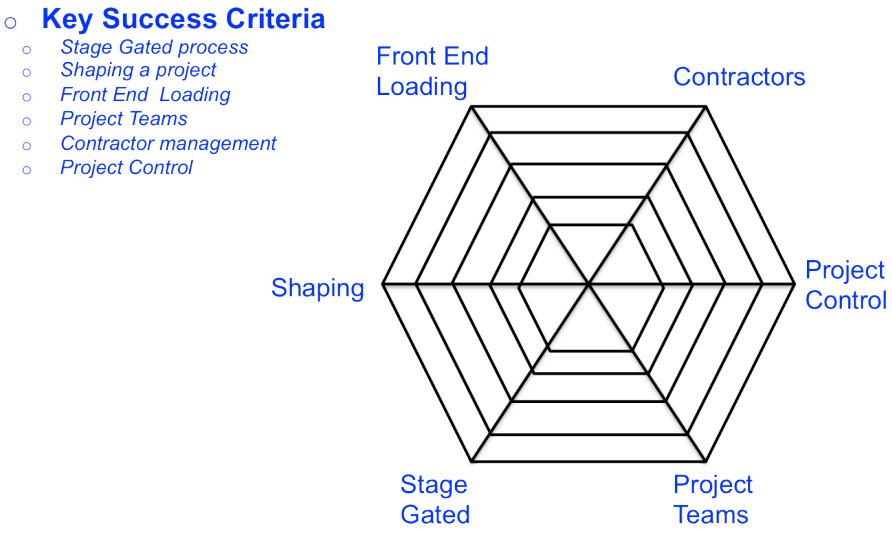


Figure 11: Example of project evaluation card based on survey

Each project will be evaluated according to the survey in Appendix A, and the results will be graphed and presented as indicated in figure 11 above. More specifically, particular attention will be drawn to categories that indicate a lack of compliance in specific areas. These specific focus areas will form the basis for improvement in the current Sasol project management department, system or procedures. Finally as suggested in the project proposal, clear recommendations will be made so that Sasol can improve its project management process.

10. Results

10.1 Introduction

According to the research methodology the results obtained in this section are from a culmination of information from two different surveys conducted within Sasol on a small sample of projects. Two surveys were conducted in conjunction with a group of project managers at Sasol, the first a more detailed questionnaire requesting the project managers to answer questions based on project management best practices and the second a brief yes **or no** survey based on critical success factors within project management. An in depth analysis was done on the outcome of the surveys which ultimately forms the basis for the project conclusion and recommendations.

The research was conducted on a small sample of 14 projects that had failed or were in the process of failing by being over budget or over schedule or under budget. The research was conducted by requesting the project managers to fill in surveys so as to identify were and why projects failed. Since each project is unique, with distinctive requirements, it is expected that the responses would vary. The plan was to find a trend in failing Sasol projects and consequently identify areas where improvements could be made within project management system or process.

10.2 Results obtained from the surveys

A. Survey 1

With regards to the first survey, the questions where split up into six different categories all based on key project management areas as determined in the literature review. The questions under each category were as diverse as possible to give the best overall indication of where during the project development life cycle the projects have gone wrong. The 6 categories are:

1. Project shaping or the planning and development of the project,
2. Stage gated process the phase procedure used in project management to manage each project during its life cycle
3. Front End Loading
4. Project management and control
5. Project teams and resources
6. Contractors and consultants.

These areas cover all the major basics in the project management process and serve as a basis for finding fundamental problems in Sasol projects. These categories were rated on a 1 to 5 scale, where 1 being strongly disagrees and 5 being strongly agree. In terms of weighting, all sections carry a weighting of 15 except for shaping which carries a weighting of 20. Shaping is the highest as it represents the most critical phase of the project management process. It is in this phase that the project is framed, contextualized and set on the correct path for Execution. The remaining 5 categories all carry an equal weighting, as they are all equally important. Failure in any these categories will most certainly result in some aspect of project failure. The

spreadsheets shown in appendix B are the results obtained from the surveys.The weightings are clearly shown and the problem areas are highlighted in red. Further analysis will be done on these areas in the ensuing sections.

B. Survey 2

The second survey conducted as mentioned earlier is a yes or no questionnaire based on a list of critical success factors derived from literature. The results are shown in the appendix C and problem areas are highlighted in red. If the answer was NO for a particular question, this was generally treated as a problem area and noted for further exploration. If an answer came back as not applicable it was because the project had not reached such a stage during development for the project manager to answer accurately. A YES generally indicates an OK project status. The Yes/No questions were categorized into the 6 main project management areas as listed in the previous section.

10.3 Analysis of results

With regards to the **first survey**, if a project manager answered a question positively with either a 4 or 5, these answers were considered to be favorable and therefore not problem areas. If answered with a 3 this generally indicates a need for improvement and if the answer was a 1 or 2 it was regarded as a problem area and in need of specific and immediate attention. With regards to the **second survey**, if a project manager answered no on a particular question it was treated as a problem area and clearly the more no's for a particular question shows that such an area is in need of drastic improvement. The objective of conducting the 2 surveys was to understand whether there was any correlation between the surveys and to highlight common areas of concern or improvement. The survey questions and actual analysis are shown in appendix B. A summary of the first survey is tabulated in the figure below. In the table categories are mentioned with a percentage highlighted in green, which represents a % of focus areas for a particular category in the survey. These areas in need of most attention (>35% in survey) are highlighted in red on the right hand side of the table.

A. Survey 1 – Analysis

Analysis Category	Overall % Concerns	Specific Area Concerns
Shaping	**40%**	1. Project context 2. Schedule, and cost aligned 3. Cost, Quality & Schedule aligned 4. Project cost known 5. Opex known
Stage gated process	**38.5%**	1. Investment in FEL 2. Project definition clear before moving on 3. Gate criteria in place before passing 4. Change management 5. Technical issues resolved
FEL	**43%**	1. Contract strategy clear 2. Interfaces made clear 3. Project exe plan and risk analysis
Project Management & control	**88%**	1. Continuous measurement of progress 2. Cost&schedule reports frequently circulated 3. Cost & schedule Control specialist 4. Cost predictable 5. Projects not implemented faster than benchmark 6. Value Improving Practices
Project teams and resources	**88%**	1. Ensuring teams understand business/project objectives 2. Ensuring team continuity is maintained throughout project 3. Minimal turnover of key project members 4. Important for team members to understand project trade-offs
Contractors & consultants	**75%**	1. Sufficient communication between owners & contractors 2. Contractors have more influence on technical matters 3. Project teams affected by outsourcing

Figure12: Survey 1 Analysis

The analysis clearly highlights the three most critical areas requiring attention as:

1. Project management & controls,
2. Project teams and resources
3. Consultants are contractors.

The remaining three areas comparatively do not indicate a dire problem but still requires attention for general improvement

B. Survey 2 – Analysis

The summary of the results of the yes/no analysis is tabulated below. These questions have been categorized into the 6 sections as mentioned previously .In the analysis of the yes/no survey, the questions highlighted in red had a **no** selected more than 40% of the time, and requires immediate attention.

Analysis Category	Overall % Concerns	Specific Area Concerns
Shaping	**None**	None
Stage Gated Process	**12.5%**	1. Project not stopped/recycled due to not meeting gate critera
FEL	**None**	None
Project management & control	**25%**	1. Inadequate change management 2. Lack of detailed planning
Project teams and resources	**50%**	1. Insufficient & inadequate resources 2. Resource competency 3. Adapting & induction 4. Inadequate training
Contractors and Consultants	**12.5%**	1. Lack of performance by contractors

Figure13: Survey 2 Analysis

In principle there is a noticeable & strong correlation between the 2 surveys where it is clear that most of the problems areas are encountered in the same categories:

1. Project management & controls
2. Project teams and resources

It is also important to mention that although the other areas did not feature prominently with specific problem areas, there are opportunities in these areas for improvement.

11. Conclusion

The goal at the start of the report was to research and investigate a sample of failed projects at Sasol to understand areas and sections in the project management process that could be improved upon or bettered in the future. Since project development is such an integral part in a global engineering company like Sasol, optimising and adapting the project management process to ensure that there multi million dollar projects are eventual success' is a critical process

To begin the project, a research methodology was adopted with the purpose of beginning a small analysis on why projects were failing. This investigation was conducted after research into the field of project management was completed. The research brought to light a basic understanding of the field and many areas that define project critical success factors. After the research was concluded a list of areas within the field of project management were underlined. These areas formed the basis for the questionnaires, which were subsequently designed to understand where and why projects were failing, based on the key areas studied in the literature review.

The questionnaires were then given to project managers who were part of the project management department. The project manager's were also involved or in charge of projects that experienced some sort of failure. With the feedback from the questionnaires, the areas with the most negative reviews were consequently the areas, which were highlighted for further analysis.The results after a general analysis from survey 1 are represented in the radar diagram below. The sections in need of the most attention are the ones closet to the center

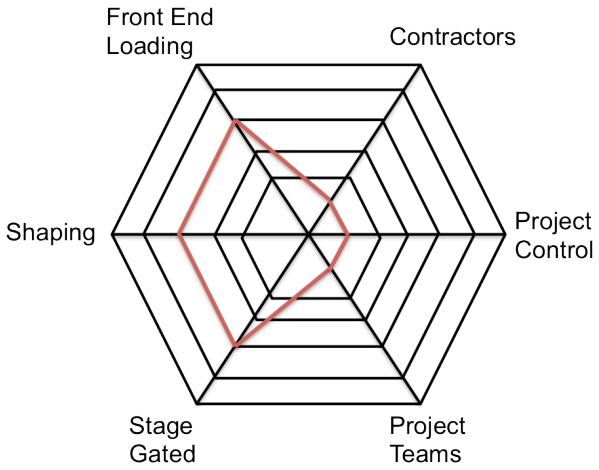


Figure 14: Project Management Radar Diagram

As depicted in the Radar diagram, the areas of main concern are:

- Project management and controls
- Project teams & resources
- Contractors and consultants

The above areas (Category 1) will need immediate and drastic focus and key recommendations will be made to this extent. The 3 remaining areas (Category 2) also need attention but to a lesser extent. In principle, it is clear that `Sasol needs a plan to improve both category 1 and category 2 areas

Looking at the project specific radar screens, it is clear that some projects are doing better than others and from the analysis it is very clear that projects with a shortcoming in any of the critical 6 areas generally fail.

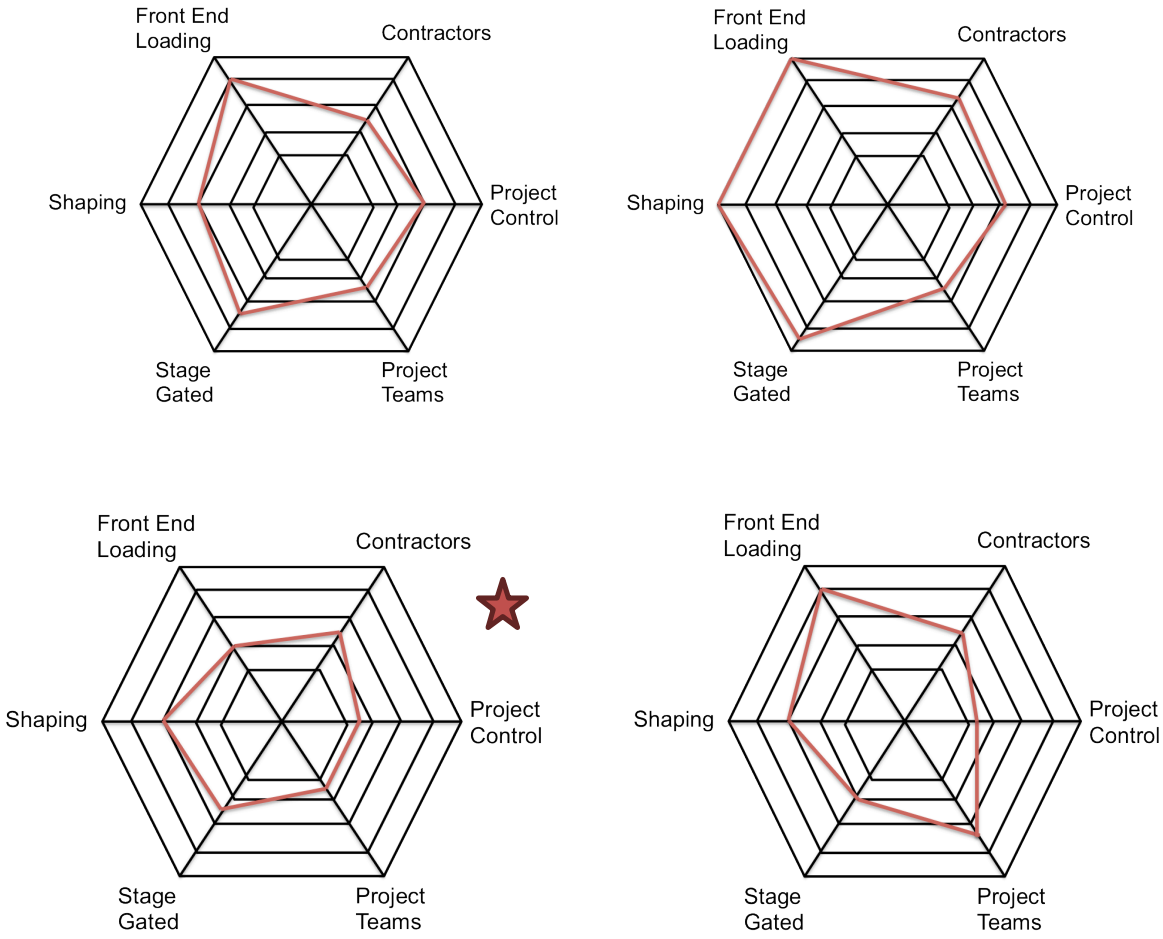
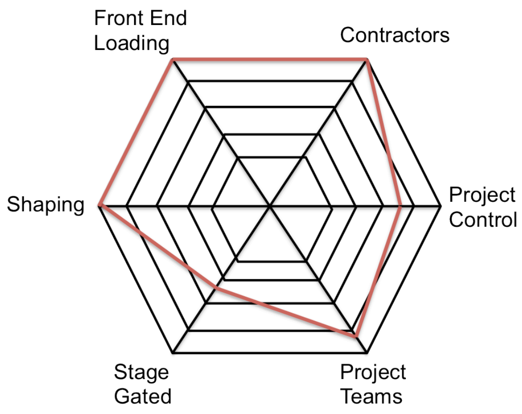
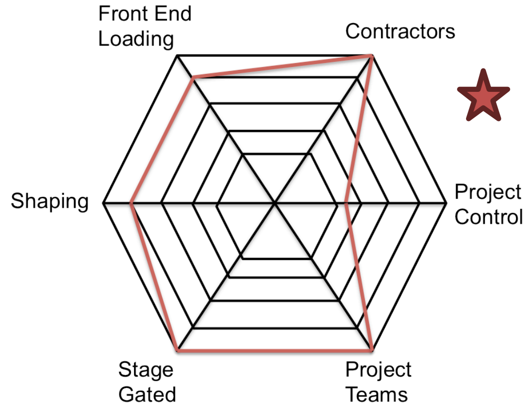
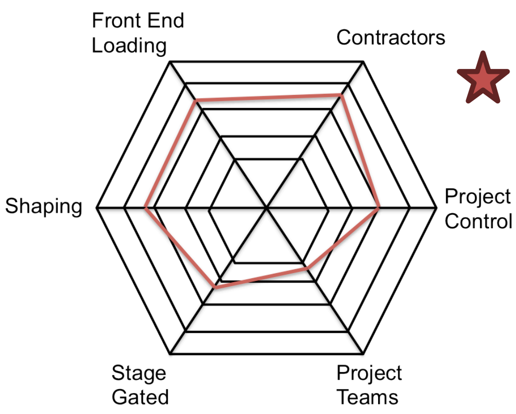


Figure 15: Radar diagrams for individual projects


Front End Loading
Contractors
Shaping
Project Control
Stage Gated
Project Teams


Front End Loading
Contractors
Shaping
Project Control
Stage Gated
Project Teams


Front End Loading
Contractors
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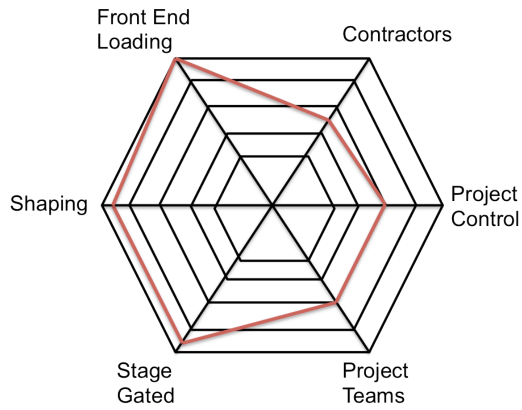
Stage Gated
Project Teams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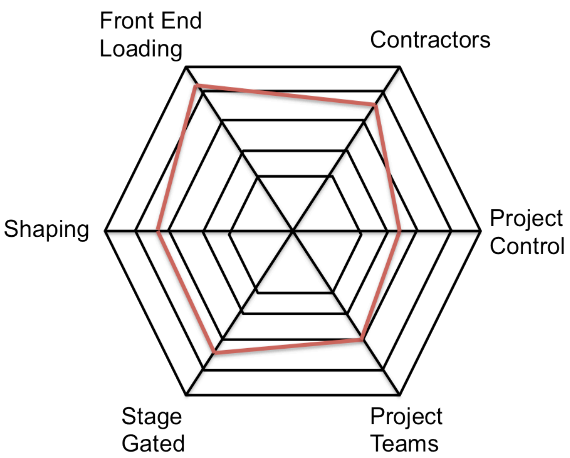
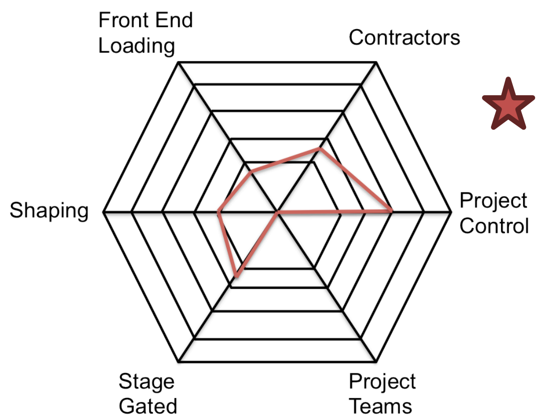
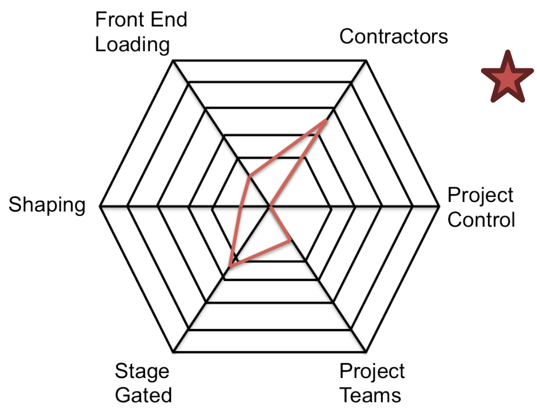

Front End Loading
Contractors
Shaping
Project Control
Stage Gated
Project Teams


Front End Loading
Contractors
Shaping
Project Control
Stage Gated
Project Teams


Front End Loading
Contractors
Shaping
Project Control
Stage Gated
Project Teams

It is very clear from the radar diagrams per project, that the most common areas of failure are:

- Contactors & Consultants
- Project Control
- Project Teams & Resources

The radar diagrams marked with a star are the projects that had problems because of the aforementioned areas. It is clear that these are common problem areas and are therefore areas where improvements must be made.

In conclusion the surveys have highlighted definitive areas of improvement. Sasol's project management team can work on these areas to improve the eventual success rate of projects. Since the sample for this project was small, it is recommended that a larger and more in depth analysis be done on Sasol projects. The larger sample can be looked at and intricate details of project management can be examined to understand the full extent of the problems. For the time being,basic problem areas have been identified and this is a leading indictor that Sasol has problems in project management. Sasol can start to optimise these areas for immediate improvement in their management of projects. Clear recommendations will be made in the section that follows in order for Sasol to progress with their small project implementation. These suggestions made are general in nature and very high-level. As explained earlier, a more in depth analysis will have to be conducted to further understand details.

12. Recommendations

In order for Sasol to move from its current positioning (figure below) to the preferred best in class quadrant, improvement in all 6 project management categories are required.

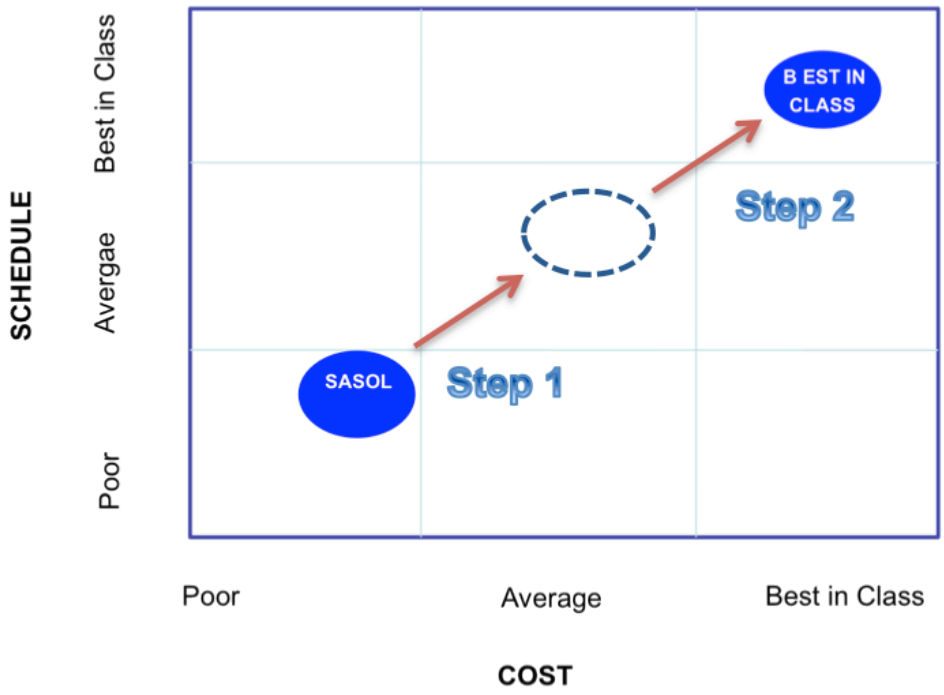


Figure 16: Step process for Sasol to become best in class

It is recommended that Sasol follow a 2-step process to achieve the Best in Class position. The fundamental reason for this is that Sasol is a large organization and achieving the end goal in 2 incremental steps would be easier than trying to achieve this in one large step.

- **Step 1** would entail immediate focus and attention to improving the 3 categories of Project management & controls, project resources and contractors /consultants.
- **Step 2** would entail optimizing and improving the remaining 3 categories, Shaping, Stage gated process and FEL.

The following section briefly addresses areas of improvement at a high level. An already suggested in this investigation, a more in depth study will have to be done to address more detail and core issues.

12.1Areas in need of improvement

Step 1: Improvement Plan

- Project Management & Controls
    - Continuously measuring project progress, not just at milestones or checkpoints
    - Always producing new and updated cost and scheduling reports for team members
    - Making sure Value Improving Practices are made use of in the project environment
- Project Teams & Resources
    - Forming the team before the project planning begins
    - Making sure that the team members are well aware of the trade-offs between cost, quality and schedule
    - Clearly defining team roles and responsibilities early on in the project.
    - Making sure all the team members understand the business as well as the project objectives and drivers
    - Team continuity should be maintained; there should be minimal member turnover once the project has started.
    - Develop clear business objectives to drive project competitiveness
    - Clearly & concisely document business objectives
    - Explain clearly the trade-offs (cost, schedule, operability)
    - Avoid turnover of key project members, team discontinuity is disruptive & can cause substantial cost & schedule losses)
    - Where ever possible team members should not overlap into other projects. Team members that are worked too hard can be ineffective
- Contractors and consultants
    - Make sure that there is sufficient communication between contractors, consultants and the project team with regards to business and project objectives

- Outsourcing of project tasks should be carefully monitored
- Contractors or consultants should not be highly influential in the technical aspects of the projects.

Step 2: Improvement Plan

- Shaping
  - Formalise the shaping process in Sasol
  - All from the start should know project capital and operating costs including sensitivities. The effective management of these costs is key.
  - Making changes to the scope before the completion of the shaping phase not after
  - Clearly understanding the context of said project.
- Stage Gated Process
  - Invest appropriately in the FEL stages of the project
  - Do not allow projects through the phase gates while lacking the appropriate quality. Recycle projects if need be.
  - Making little or no changes after the detailed design is approved
  - Resolving technical issues in the beginning of the stage gated process
  - Defining the scope of the project during the early stages
  - Implement project continuous reviews and plan for the gate review where project is either approved or not.
  - Establish achievable targets for each phase/gate in line with business objectives
  - Align reviews with project management best practices
  - Adhere to the stage gated model, the Sasol BD&I is not just a reference model but a process that must be followed precisely
- Front End Loading
  - Completing a fully defined project execution plan and risk analysis
  - Clearly defining all business interfaces
  - Invest significantly in FEL
  - Key engineering & planning docs are necessary for effective execution
  - Define projects clearly in this phase so that teams don't make engineering changes late on
  - Must be no room for deviations within project scope

- Make sure team members understand the importance of FEL & what is required of them at this stage
- If project is not of the correct quality do not let it pass through the gates (stricter enforcement)

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Appendix A

Survey 1

	Tick the appropriate box				
	strongly disagree				strongly agree
SHAPING THE PROJECT					
	1	2	3	4	5
1. Scope clearly and sufficiently defined	1	2	3	4	5
2. All key Stakeholders identified before the project start?	1	2	3	4	5
3. Project context clearly understood?	1	2	3	4	5
4. Project had owner buy in?	1	2	3	4	5
5. Schedules integrated/aligned with the cost estimates?	1	2	3	4	5
6. Schedules developed by the project team and not by outside contractors?	1	2	3	4	5
7. project cost known before start?	1	2	3	4	5
8. Project operating cost known before start					
9. Were trade-offs clearly defined? Eg cost , schedule , quality	1	2	3	4	5
10. Business objectives clearly defined?	1	2	3	4	5
11. Project objectives clearly defined and aligned with business objectives?	1	2	3	4	5
12. Team organized /aligned and prepared before the project had begun?	1	2	3	4	5
13. Did the project have any impact on existing operations?	1	2	3	4	5
14. Change management in place and managed	1	2	3	4	5
15. most changes occurred during execution phase	1	2	3	4	5

	Tick the appropriate box				
	strongly disagree				strongly agree
STAGE GATED PROCESS					
1. Does Sasol have a world class execution model in the BD&I	1	2	3	4	5
1. BD&I process strictly enforced by project leaders?	1	2	3	4	5
2. Appropriate investment in the FEL1,2,3 stages?	1	2	3	4	5
2. Project definition was clearly defined before passing FEL1?	1	2	3	4	5
3. All the processes, functions needed to pass through each phase completed with the required quality?	1	2	3	4	5
4. Some projects passed BD&I gates although lacking quality, scheduling or cost issues?	1	2	3	4	5
5.Project deliverables met, for each of the gates in the process?	1	2	3	4	5
6. Changes well managed throughout process	1	2	3	4	5
7. Most changes made after scope freeze or detailed design	1	2	3	4	5
8. frequency of change in projects higher than the norm	1	2	3	4	5
9. Project experienced many late changes after approval	1	2	3	4	5
10. All changes approved were in keeping with business and project objectives	1	2	3	4	5
11. All technical issues resolved during the FEL process?	1	2	3	4	5

	Tick the appropriate box				
	strongly disagree				strongly agree
PROJECT TEAMS AND RESOURCES					
1. Project teams formed in advance?	1	2	3	4	5
2. Business and project objectives clearly understood at project onset	1	2	3	4	5
3. Cost ,schedule and quality trade-offs well defined?	1	2	3	4	5
4. Team roles and responsibilities defined and documented?	1	2	3	4	5
5. All team members understood the business and project drivers?	1	2	3	4	5
6. Projects have sufficient team development & teams fully integrated in the project environment?	1	2	3	4	5
7. Team continuity maintained during the duration of the project?	1	2	3	4	5
8. There was turnover in key team members?	1	2	3	4	5

	Tick the appropriate box				
	strongly disagree				strongly agree
PROJECT MANAGEMENT AND CONTROLS					
1. Best practices for project management and control followed	1	2	3	4	5
2. Continuous measurement of physical progress & not only at major milestones or checkpoints?	1	2	3	4	5
3. Cost and schedule reports produced and circulated frequently to all team members	1	2	3	4	5
4. Projects have a cost control specialist and a schedule control specialist in team?	1	2	3	4	5
5. Sasol projects are always cost predictable					
6. Sasol projects cost more than the benchmarked Equivalent project					
7. Projects are implemented faster than the benchmarked equivalent project	1	2	3	4	5
8. Projects made use of 'Value Improving Practices'? (VIPs) during FEL	1	2	3	4	5

	Tick the appropriate box				
	strongly disagree				strongly agree
MANAGING CONTRACTORS/CONSULTANTS					
1. There is sufficient communication between the owners and the contractors with regards to business and project objectives?	1	2	3	4	5
2.Contractors/consultants have excessive influence on technical issues	1	2	3	4	5
3.Contractors /consultants were ultimately held accountable for the work they did?	1	2	3	4	5
4. Project teams were affected by the outsourcing of project tasks?	1	2	3	4	1

	Tick the appropriate box				
	strongly disagree				strongly agree
FEL DEVELOPMENT					
1. Front end Loading was guided by business objectives	1	2	3	4	5
2. Business and project objectives aligned & approved by the owner	1	2	3	4	5
3. project objectives are quantifiable and measurable					
4. Key decisions on technology , site & feedstock made and agreed	1	2	3	4	5
5. Contracting strategy made clear and communicated	1	2	3	4	5
6. All interfaces clearly defined (business , technical, contractors if any)	1	2	3	4	5
7. project execution plan and risk analysis completed	1	2	3	4	5

Survey 2

QUESTIONS (YES/NO)
Was there support from senior management
Clear realistic objectives set
Strong/detailed plan kept up to date
Good communication/ feedback
Was there adequate User/client/owner involvement
Skilled/suitably qualified/ sufficient staff/team
Effective change management
Competent project manager/team members
Strong business case/sound basis for project
Sufficient/well allocated resources
Good leadership Proven/familiar technology Realistic schedule
Risks addressed/assessed/ managed
Project sponsor on board and engaged
Adequate budget approved
Organizational adaptation/ culture/induction
Good performance by suppliers/contractors/ consultants
Planned project close down/review/ acceptance of possible failure
Training provision
Correct choice/past experience of project management methodology/tools
Past Learning's/knowledge applied

Appendix B

Survey 1 – Project Manager Feedback

SHAPING	WEIGHTING 20	PM1	PM2	PM3	PM4	PM5	PM6	PM7	PM8	PM9	PM10	PM11
1. Scope clearly and sufficiently defined	4	4	5	4	5	5	4	4	5	4	3	3
2. All key Stakeholders identified before the project start?	4	5	5	4	5	4	4	3	4	4	3	3
3. Project context clearly understood?	4	4	5	4	4	4	4	3	5	3	2	2
4. Project had owner buy in?	4	5	5	5	5	5	5	5	5	5	3	1
5. Schedules integrated/aligned with the cost estimates?	4	5	4	1	5	4		4	5	3	2	2
6. Schedules developed by the project team and not by outside contractors?	4	5	5	1	4	4	5	5	4	5	3	4
7. project cost known before start?	3	4	5	3	3	5	3	3	4	3	4	1
8. Project operating cost known before start	3	3	5	3	2	4	3	3	4		4	1
9. Were trade-offs clearly defined? Eg cost , schedule , quality	4	4	4	4	3	4	4	4	5	3	2	2
10. Business objectives clearly defined?	4	4	4	4	4	5	4	5	5	4	3	3
11. Project objectives clearly defined and aligned with business objectives?	4	4	5	4	4	5	4	4	5	4	2	1
12. Team organized /aligned and prepared before the project had begun?	4	4	5	2	4	4		4	5	5	2	2
13. Did the project have any impact on existing operations?	4	4		5	1	5		4	5	5	4	
14. Change management in place and managed	4	3	5	4	4	5		2	5	5	2	1
15. most changes occurred during execution phase	3	2		2		4		5	1	4	2	

STAGE GATED PROCESS	WEIGHTING 20	PM1	PM2	PM3	PM4	PM5	PM6	PM7	PM8	PM9	PM10	PM11
1. Does Sasol have a world class execution model in the BD&I	4	4	5	4	4	4		5	4	5	5	4
1. BD&I process strictly enforced by project leaders?	4	3	5	4	3	4		4	4	4	2	3
2. Appropriate investment in the FEL1,2,3 stages?	3	3	5	3	3	3		3	5	4	2	3
2. Project definition was clearly defined before passing FEL1?	4	5	5	3	3	3	4	5	4	3	3	
3. All the processes,functions needed to pass through each phase completed with the required quality?	4	4	5	3	3	4		3	5	4	2	
4. Some projects passed BD&I gates although lacking quality,scheduling or cost issues?	3	3	3	4	4	4		1			4	
5.Project deliverables met, for each of the gates in the process?	4	4	5	3	4	3	4	4	4	4	2	
6. Changes well managed throughout process	4	4	5	4	4	4	4	3	5	4	2	
7. Most changes made after scope freeze or detailed design	3	2		2	3	3		2	1	3	4	
8. frequency of change in projects higher than the norm	2	2	1	1	2	3		3	1	2	3	
9. Project experienced many late changes after approval	2	1	1	2	4	2		3	2	2	4	
10. All changes approved were in keeping with business and project objectives	4	4	5	3	4	4	4	4	4	3	2	
11. All technical issues resolved during the FEL process?	3	4	5	1	4	2		1	4	2	2	

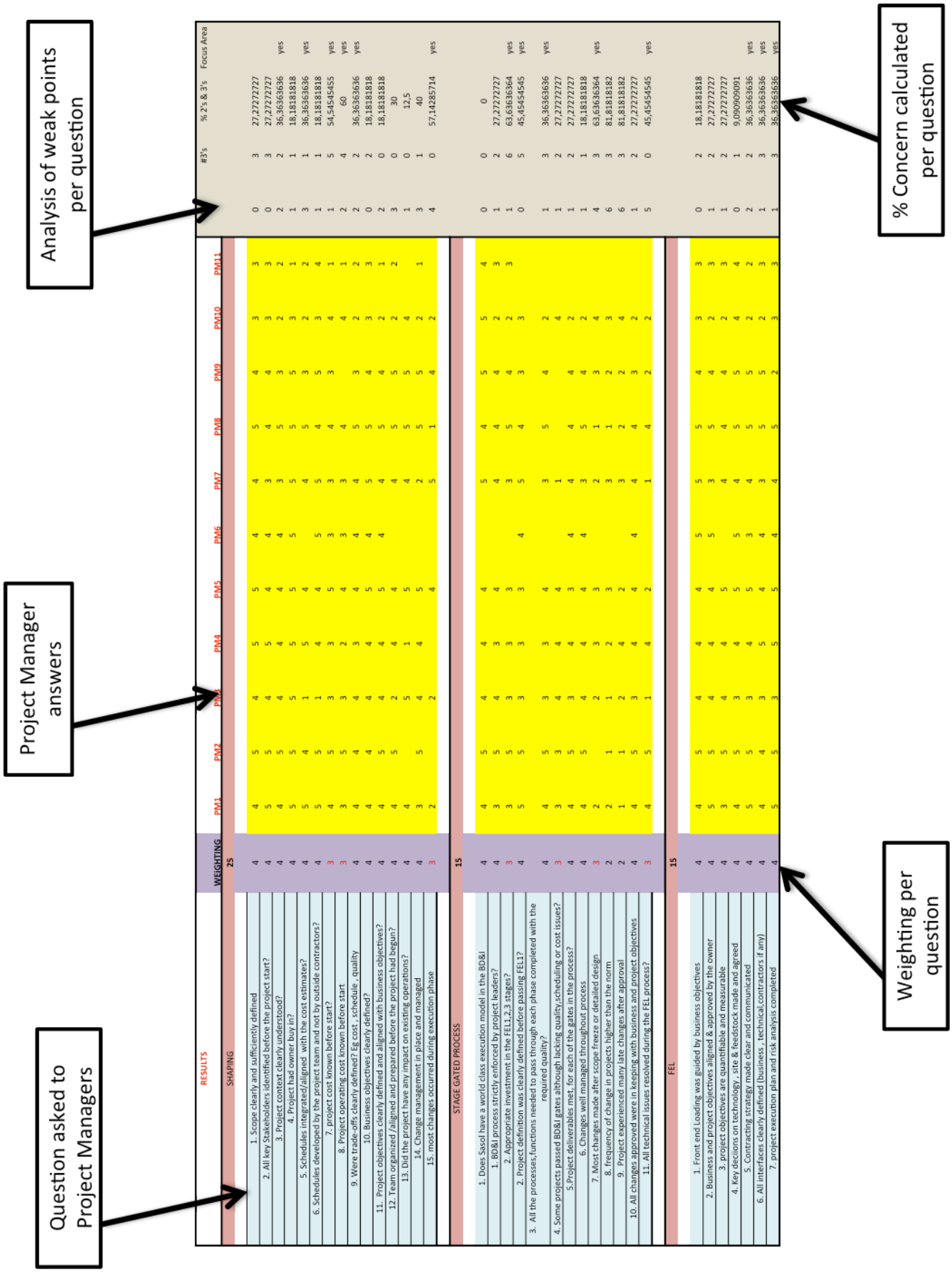
FEL	WEIGHTING 20	PM1	PM2	PM3	PM4	PM5	PM6	PM7	PM8	PM9	PM10	PM11
1. Front end Loading was guided by business objectives	4	4	5	4	4	4	5	5	5	4	3	3
2. Business and project objectives aligned & approved by the owner	4	5	5	4	4	4	5	3	5	4	2	3
3. project objectives are quantifiable and measurable	4	3	5	4	4	5		4	4	4	2	3
4. Key decisions on technology , site & feedstock made and agreed	4	4	5	3	4	5	5	4	5	5	4	4
5. Contracting strategy made clear and communicated	4	5	5	3	4	5	3	4	5	5	2	2
6. All interfaces clearly defined (business , technical,contractors if any)	4	4	4	3	5	4	4	3	5	5	2	3
7. project execution plan and risk analysis completed	4	5	5	3	5	5	4	4	5	2	3	3

	WEIGHTING	PM1	PM2	PM3	PM4	PM5	PM6	PM7	PM8	PM9	PM10	PM11
CONTRACTORS & CONSULTANTS	10											
1. There is sufficient communication between the owners and the contractors with regards to business and project objectives?	4	4	5	4	5	5		1	4	4	3	3
2.Contractors/consultants have excessive influence on technical issues	3	2	3	3	3	4		5	2	2	2	4
3.Contractors /consultants were ultimately held accountable for the work they did?	4	4	5	4	5	5		4	5	4	2	4
4. Project teams were affected by the outsourcing of project tasks?	3	3		3	2	5		5	3	4	4	2

	WEIGHTING	PM1	PM2	PM3	PM4	PM5	PM6	PM7	PM8	PM9	PM10	PM11
PROJECT MANAGEMENT & CONTROLS	15											
1. Best practices for project management and control followed	4	4	5	3		5		4	4	4	4	3
2. Continuous measurment of physical progress & not only at major milestones or checkpoints?	4	3	5	4	2	5		3	5	4	2	3
3. Cost and schedule reports produced and circulated frequently to all team members	4	4	5	3	2	4	3	2	5	4	4	3
4. Projects have a cost control specialist and a schedule control specialist in team?	3	4	5	4	1	5	1	4	5	4	2	3
5. Sasol projects are always cost predictable	3	3	3	1		1	5	2	4	2	4	
6. Sasol projects cost more than the benchmarked Equivalent project	4	4	3	4		3		5	3	3	4	
7. Projects are implemented faster than the benchmarked equivalent project	3	2	3	1		4		5	3	2	2	
8. Projects made use of 'Value Improving Practices'? (VIPs) during FEL	4	4	5	3	5	4		4	3	3	4	

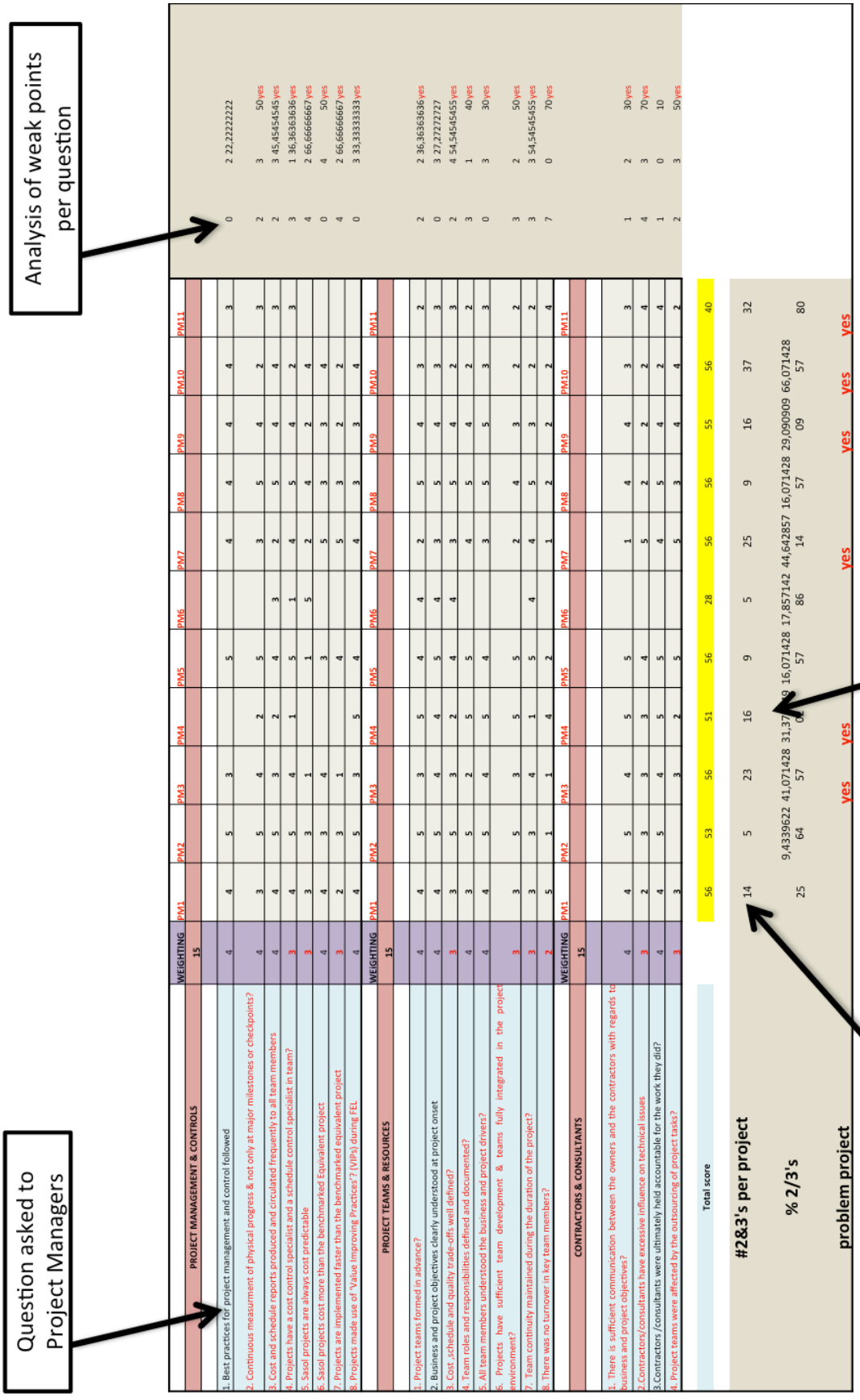
	WEIGHTING	PM1	PM2	PM3	PM4	PM5	PM6	PM7	PM8	PM9	PM10	PM11
PROJECT TEAMS & RESOURCES	15											
1. Project teams formed in advance?	4	4	5	3	5	4	4	2	5	4	3	2
2. Business and project objectives clearly understood at project onset	4	4	5	4	4	5	4	3	5	4	3	3
3. Cost ,schedule and quality trade-offs well defined?	3	3	5	3	2	4	4	3	5	4	2	3
4. Team roles and responsibilities defined and documented?	4	3	5	2	5	5		4	5	4	2	2
5. All team members understood the business and project drivers?	4	4	5	4	5	4		3	5	5	3	3
6. Projects have sufficient team development & teams fully integrated in the project environment?	3	3	5	3	5	5		2	4	3	2	2
7. Team continuity maintained during the duration of the project?	3	3	3	4	1	5	4	4	5	3	2	2
8. There was no turnover in key team members?	2	5	1	1	4	2		1	2	2	2	4

Analysis of Survey 1



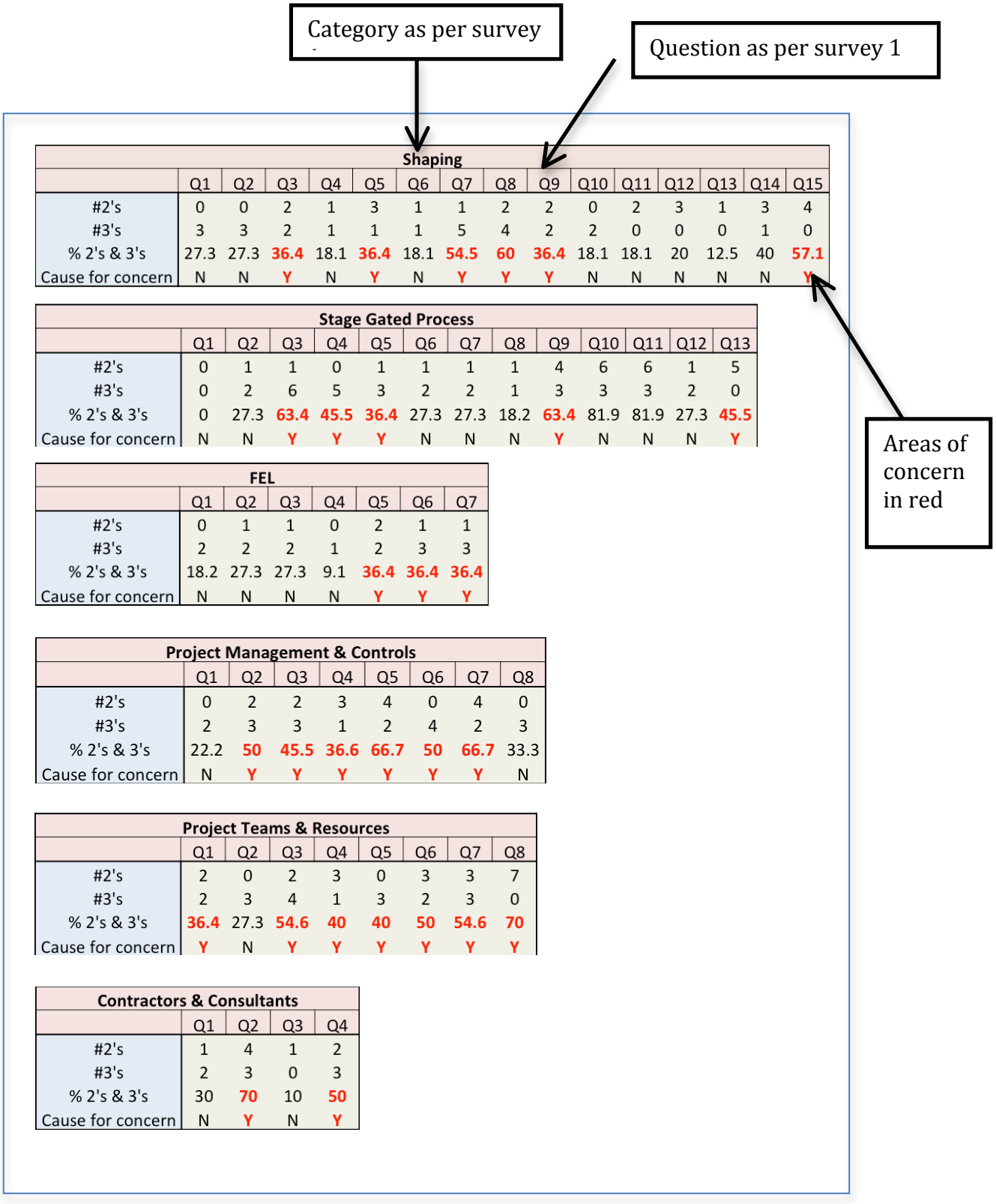
RESULTS	WEIGHTING	PM1	PM2	PM3	PM4	PM5	PM6	PM7	PM8	PM9	PM10	PM11	#3's	% 2's & 3's	Focus Area
SHAPING	25														
1. Scope clearly and sufficiently defined	4	4	5	4	5	5	4	4	5	4	3	3	0	3	27,27272727	
2. All key Stakeholders identified before the project start?	4	5	5	4	5	4	4	3	4	4	3	3	0	3	27,27272727	
3. Project context clearly understood?	4	4	5	4	4	4	4	3	5	3	2	2	2	2	36,36363636	yes
4. Project had owner buy in?	4	5	5	5	5	5	5	5	5	5	3	1	1	1	18,18181818	
5. Schedules integrated/aligned with the cost estimates?	4	5	4	1	5	4		4	5	3	2	2	3	1	36,36363636	yes
6. Schedules developed by the project team and not by outside contractors?	4	5	5	1	4	4	5	5	4	5	3	4	1	1	18,18181818	
7. project cost known before start?	3	4	5	3	3	5	3	3	4	3	4	1	1	5	54,54545455	yes
8. Project operating cost known before start	3	3	5	3	2	4	3	3	4		4	1	2	4	60	yes
9. Were trade-offs clearly defined? Eg cost , schedule , quality	4	4	4	4	3	4	4	4	5	3	2	2	2	2	36,36363636	yes
10. Business objectives clearly defined?	4	4	4	4	4	5	4	5	5	4	3	3	0	2	18,18181818	
11. Project objectives clearly defined and aligned with business objectives?	4	4	5	4	4	5	4	4	5	4	2	1	2	0	18,18181818	
12. Team organized /aligned and prepared before the project had begun?	4	4	5	2	4	4		4	5	5	2	2	3	0	30	
13. Did the project have any impact on existing operations?	4	4		5	1	5		4	5	5	4		1	0	12,5	
14. Change management in place and managed	4	3	5	4	4	5		2	5	5	2	1	3	1	40	
15. most changes occurred during execution phase	3	2		2		4		5	1	4	2		4	0	57,14285714	yes
STAGE GATED PROCESS	15														
1. Does Sasol have a world class execution model in the BD&I	4	4	5	4	4	4		5	4	5	5	4	0	0	0	
1. BD&I process strictly enforced by project leaders?	4	3	5	4	3	4		4	4	4	2	3	1	2	27,27272727	
2. Appropriate investment in the FEL1,2,3 stages?	3	3	5	3	3	3		3	5	4	2	3	1	6	63,63636364	yes
2. Project definition was clearly defined before passing FEL1?	4	5	5	3	3	3	4	5	4	3	3		0	5	45,45454545	yes
3. All the processes,functions needed to pass through each phase completed with the required quality?	4	4	5	3	3	4		3	5	4	2		1	3	36,36363636	yes
4. Some projects passed BD&I gates although lacking quality,scheduling or cost issues?	3	3	3	4	4	4		1			4		1	2	27,27272727	
5.Project deliverables met, for each of the gates in the process?	4	4	5	3	4	3	4	4	4	4	2		1	2	27,27272727	
6. Changes well managed throughout process	4	4	5	4	4	4	4	3	5	4	2		1	1	18,18181818	
7. Most changes made after scope freeze or detailed design	3	2		2	3	3		2	1	3	4		4	3	63,63636364	yes
8. frequency of change in projects higher than the norm	2	2	1	1	2	3		3	1	2	3		6	3	81,81818182	
9. Project experienced many late changes after approval	2	1	1	2	4	2		3	2	2	4		6	3	81,81818182	
10. All changes approved were in keeping with business and project objectives	4	4	5	3	4	4	4	4	4	3	2		1	2	27,27272727	
11. All technical issues resolved during the FEL process?	3	4	5	1	4	2		1	4	2	2		5	0	45,45454545	yes
FEL	15														
1. Front end Loading was guided by business objectives	4	4	5	4	4	4	5	5	5	4	3	3	0	2	18,18181818	
2. Business and project objectives aligned & approved by the owner	4	5	5	4	4	4	5	3	5	4	2	3	1	2	27,27272727	
3. project objectives are quantifiable and measurable	4	3	5	4	4	5		4	4	4	2	3	1	2	27,27272727	
4. Key decisions on technology , site & feedstock made and agreed	4	4	5	3	4	5	5	4	5	5	4	4	0	1	9,090909091	
5. Contracting strategy made clear and communicated	4	5	5	3	4	5	3	4	5	5	2	2	2	2	36,36363636	yes
6. All interfaces clearly defined (business , technical,contractors if any)	4	4	4	3	5	4	4	3	5	5	2	3	1	3	36,36363636	yes
7. project execution plan and risk analysis completed	4	5	5	3	5	5	4	4	5	2	3	3	1	3	36,36363636	yes

Analysis of Survey 1 Cont.



PROJECT MANAGEMENT & CONTROLS	WEIGHTING 15	PM1	PM2	PM3	PM4	PM5	PM6	PM7	PM8	PM9	PM10	PM11			
1. Best practices for project management and control followed	4	4	5	3		5		4	4	4	4	3	0	2	22,22222222
2. Continuous measurment of physical progress & not only at major milestones or checkpoints?	4	3	5	4	2	5		3	5	4	2	3	2	3	50 yes
3. Cost and schedule reports produced and circulated frequently to all team members	4	4	5	3	2	4	3	2	5	4	4	3	2	3	45,45454545 yes
4. Projects have a cost control specialist and a schedule control specialist in team?	3	4	5	4	1	5	1	4	5	4	2	3	3	1	36,36363636 yes
5. Sasol projects are always cost predictable	3	3	3	1		1	5	2	4	2	4		4	2	66,66666667 yes
6. Sasol projects cost more than the benchmarked Equivalent project	4	4	3	4		3		5	3	3	4		0	4	50 yes
7. Projects are implemented faster than the benchmarked equivalent project	3	2	3	1		4		5	3	2	2		4	2	66,66666667 yes
8. Projects made use of 'Value Improving Practices'? (VIPs) during FEL	4	4	5	3	5	4		4	3	3	4		0	3	33,33333333 yes
PROJECT TEAMS & RESOURCES	**WEIGHTING 15**	**PM1**	**PM2**	**PM3**	**PM4**	**PM5**	**PM6**	**PM7**	**PM8**	**PM9**	**PM10**	**PM11**			
1. Project teams formed in advance?	4	4	5	3	5	4	4	2	5	4	3	2	2	2	36,36363636 yes
2. Business and project objectives clearly understood at project onset	4	4	5	4	4	5	4	3	5	4	3	3	0	3	27,27272727
3. Cost ,schedule and quality trade-offs well defined?	3	3	5	3	2	4	4	3	5	4	2	3	2	4	54,54545455 yes
4. Team roles and responsibilities defined and documented?	4	3	5	2	5	5		4	5	4	2	2	3	1	40 yes
5. All team members understood the business and project drivers?	4	4	5	4	5	4		3	5	5	3	3	0	3	30 yes
6. Projects have sufficient team development & teams fully integrated in the project environment?	3	3	5	3	5	5		2	4	3	2	2	3	2	50 yes
7. Team continuity maintained during the duration of the project?	3	3	3	4	1	5	4	4	5	3	2	2	3	3	54,54545455 yes
8. There was no turnover in key team members?	2	5	1	1	4	2		1	2	2	2	4	7	0	70 yes
CONTRACTORS & CONSULTANTS	**WEIGHTING 15**	**PM1**	**PM2**	**PM3**	**PM4**	**PM5**	**PM6**	**PM7**	**PM8**	**PM9**	**PM10**	**PM11**			
1. There is sufficient communication between the owners and the contractors with regards to business and project objectives?	4	4	5	4	5	5		1	4	4	3	3	1	2	30 yes
2.Contractors/consultants have excessive influence on technical issues	3	2	3	3	3	4		5	2	2	2	4	4	3	70 yes
3.Contractors /consultants were ultimately held accountable for the work they did?	4	4	5	4	5	5		4	5	4	2	4	1	0	10
4. Project teams were affected by the outsourcing of project tasks?	3	3		3	2	5		5	3	4	4	2	2	3	50 yes
Total score		56	53	56	51	56	28	56	56	55	56	40			
#2&3's per project	14	5	23	16	9	5	25	9	16	37	32				
% 2/3's	9,4339622	41,071428	31,37	16,071428	17,857142	44,642857	16,071428	29,090909	66,071428						
problem project	25	64	57	57	86	14	57	09	57	80					
		yes	yes			yes		yes	yes	yes					

Summary of Results from Analysis of Survey 1



Shaping															
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15
#2's	0	0	2	1	3	1	1	2	2	0	2	3	1	3	4
#3's	3	3	2	1	1	1	5	4	2	2	0	0	0	1	0
% 2's & 3's	27.3	27.3	36.4	18.1	36.4	18.1	54.5	60	36.4	18.1	18.1	20	12.5	40	57.1
Cause for concern	N	N	Y	N	Y	N	Y	Y	Y	N	N	N	N	N	Y

Stage Gated Process													
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13
#2's	0	1	1	0	1	1	1	1	4	6	6	1	5
#3's	0	2	6	5	3	2	2	1	3	3	3	2	0
% 2's & 3's	0	27.3	63.4	45.5	36.4	27.3	27.3	18.2	63.4	81.9	81.9	27.3	45.5
Cause for concern	N	N	Y	Y	Y	N	N	N	Y	N	N	N	Y

FEL							
	Q1	Q2	Q3	Q4	Q5	Q6	Q7
#2's	0	1	1	0	2	1	1
#3's	2	2	2	1	2	3	3
% 2's & 3's	18.2	27.3	27.3	9.1	36.4	36.4	36.4
Cause for concern	N	N	N	N	Y	Y	Y

Project Management & Controls								
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
#2's	0	2	2	3	4	0	4	0
#3's	2	3	3	1	2	4	2	3
% 2's & 3's	22.2	50	45.5	36.6	66.7	50	66.7	33.3
Cause for concern	N	Y	Y	Y	Y	Y	Y	N

Project Teams & Resources								
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
#2's	2	0	2	3	0	3	3	7
#3's	2	3	4	1	3	2	3	0
% 2's & 3's	36.4	27.3	54.6	40	40	50	54.6	70
Cause for concern	Y	N	Y	Y	Y	Y	Y	Y

Contractors & Consultants				
	Q1	Q2	Q3	Q4
#2's	1	4	1	2
#3's	2	3	0	3
% 2's & 3's	30	70	10	50
Cause for concern	N	Y	N	Y

Appendix C

Survey 2 – Project Manager Feedback

QUESTION	RESULTS (Yes/No) PM1	PM2	PM3	PM4	PM5	PM6	PM7
Was there support from senior management	YES	YES	yes	YES	yes	YES	YES
Clear realistic objectives set	YES	YES	yes	NO	NO	YES	YES
Strong/detailed plan kept up to date	YES	YES	NO	YES	NO	NO	YES
Good communication/ feedback	YES	YES	yes	YES	yes	NO	YES
Was there adequate User/client/owner involvement	NO	YES	yes	YES	yes	YES	YES
Skilled/suitably qualified/ sufficient staff/team	YES	YES	NO	YES	NO	YES	n/a
Effective change management	YES	YES	yes	YES	NO	NO	n/a
Competent project manager/team members	YES	YES	yes	YES	NO	NO	n/a
Strong business case/sound basis for project	YES	YES	yes	YES	yes	YES	YES
Sufficient/well allocated resources	NO	YES	NO	YES	NO	NO	NO
Good leadership Proven/familiar technology Realistic schedule	YES	YES	NO	YES	yes	YES	n/a
Risks addressed/assessed/ managed	YES	YES	yes	YES	yes	YES	YES
Project sponsor on board and engaged	YES	YES	yes	YES	yes	YES	YES
Adequate budget approved	YES	YES	yes	YES	yes	YES	YES
Organizational adaptation/ culture/induction	YES	YES	yes	NO	yes	NO	n/a
Good performance by suppliers/contractors/ consultants	YES	NO	NO	YES	NO	YES	YES
Planned project close down/review/ acceptance of possible failure	NO	YES	NO	YES	NO	n/a	n/a
Training provision	YES	YES	NO	YES	yes	n/a	NO
Correct choice/past experience of project management methodology/tools	YES	YES	NO	YES	NO	YES	YES
Past Learning's/knowledge applied	YES	YES	NO	YES	NO	YES	YES

Summary of Results from Analysis of Survey 2

YES/NO Analysis	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
% No	0	28.6	42.9	14.3	14.3	33.3	33.3	33.3	0	71.4	16.7	0	0	0	33.3	42.9	60	33.3	28.6	28.6
Cause for Concern	N	N	Y	N	N	Y	Y	Y	N	Y	N	N	N	N	Y	Y	Y	Y	N	N