# Validating the core problem of project portfolio management in a multi-project environment

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# Project Report Summary

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The project portfolio management process is characterised by a series of stages and gates where a project needs to pass the set criteria at that given point in order to continue to the next phase of the process. In this research report it is postulated that project portfolio management, in a multi-project environment, suffers from a core problem referred to as the release-problem. The release-problem serves as the catalyst that causes seven undesirable effects to occur within the project portfolio management environment. These undesirable effects lead to delays that hamper the rate of work the system is able to complete, complicates managerial decision-making and jeopardises the four desired outcomes of project portfolio management.  (Viljoen, 2005:1-8)

In order to ascertain whether the release-problem is in fact responsible for the seven operational problems associated with project portfolio management, a single case study was conducted within an electronic equipment design firm who uses a shared pool of resources to complete multiple projects at the same point in time.  The aim of the case study was to collect evidence in support of the validating the postulated release-problem and to ascertain whether the effect-cause-effect patterns derived by Viljoen (2005:6-8)

where in fact present within the organisation. The case study was conducted through the aid of a questionnaire and by developing evaporating cloud diagrams with senior members of the organisation's project portfolio management hierarchy. The evaporating cloud diagrams finalised during the interviews, were later amalgamated into a single entity which represents the organisation's core conflict.

The core conflict found within the organisation is in fact a close representation of the defined release-problem and it is therefore feasible to claim that the release-problem does in fact exist within the organisation.  The effect-cause-effect patterns derived by Viljoen were found to be valid up to a certain point of the stated current reality tree, but not up to the tree's final conclusion.

## *A few words of gratitude*

I hereby wish to express my sincere gratitude to the following persons:

- My esteemed study leader, Mr. P.J. Viljoen; for his Socratic approach to teaching, exceptional leadership, encouragement and patient willingness to help me surmount the numerous obstacles that were presented prior and during the study period.
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# Soli Deo Gloria

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## 1.1 Introduction

Organisations involved with the completion of projects, especially for-profit organisations, whose prime goal should be to "generate more money now as well as in the future" (Goldratt, 1990a:Ch. 3:p. 1), are by necessity having to manage a whole host of projects which have to be implemented using a resource pool that is limited.  There are two fields of study which aim to alleviate this problem. Firstly, rules and techniques are defined for the needed activities of schedule development and schedule control in (Project Management Institute, 2000:73-86) and resource management in (Project Management Institute, 2000:107-116) which traditionally falls under the auspices of project management.

Secondly, in (Cooper, Edgett, Kleinschmidt, 2001b:2) project portfolio management is described to enable:

- Portfolio maximisation – conducting valuable projects
- Balancing the portfolio – having an appropriate mix of projects
- Alignment with strategy – projects support business strategy
- Choosing the right number of projects – with resource capacity in mind

There is however a **fundamental management problem** faced by managers of portfolios of projects, who are using formal project portfolio management methodologies to conduct their projects. This problem is referred to as the **push-problem** by Viljoen (2005:3), which is specific to Critical Chain Multi-Project Management (CCMPM) environments and as the **release-problem** in this study; that can lead to "pipeline gridlock". (Cooper et al, 2001b:4)   The release-problem is merely an alternate statement of the push-problem.

Viljoen (2005:3) describes the push-problem as follows: "The objective of multiple project-based organisations is to continuously deliver many projects that increase the

value of the organisation. Value can be seen as the amount of money generated by the organisation for a given time period (through sales) as well as the return on the investment (ROI) that is required to generate that money. Money generated is equivalent to *Throughput* as defined by Goldratt (1990b:19)."

If project portfolio managers wish to accomplish this objective, there are two necessary conditions that need to be satisfied:

- "The demands of every client must be satisfied because that increases their perception of value."  (Viljoen, 2005:4)
- "System productivity must improve because it is fundamental to the value of an organisation through the value metric of return on investment (ROI)." (Viljoen, 2005:4)

## 1.2 The fundamental management problem

There is a clear conflict inherent in trying to satisfy both of the previously mentioned conditions (or requisites). It is explained by examining the necessary opposing prerequisites:

1. In order to satisfy the demands of every client, more work has to be released into the system regardless of the load placed on resources. This is done because clients (and at times even project managers) demand that their work be given priority and these priorities are set without considering the holistic situation of all the other current projects under construction.
2. To improve system productivity, more work must not be released into the system regardless of the load placed on resources. It is assumed that work-in-progress (WIP) increases if more work is released into the system and that increased WIP slows the system down and causes it to become unproductive as inputs into the system increase but the outputs do not. This is referred to as the release-problem.
(Refer to Chapter 3 for a graphical depiction of the release-problem.)

## *1.3 Problem statement*

The project portfolio management process in companies is usually designed and implemented as a series of stages and gates in a funnel. The rate of work flowing through this funnel is often hampered by queues of decisions waiting to be made at a gate and required re-iterations of previous stages for re-processing or needed additional information. Often when projects are selected and prioritised, changes have to be made to existing project schedules, which in turn lead to longer lead-times. In order to increase the value of an organisation, two necessary conditions or requisites have to be met. The needed prerequisites for each requisite are in conflict with one another and lead to the emergence of the release-problem. The release-problem causes a number of negative side-effects and thereby jeopardises the four desired outcomes of project portfolio management.   (Viljoen, 2005:1)

# Chapter 2 – Literature Review

## 2.1 Introduction

In this chapter, a succinct review will be presented on project portfolio management, project scheduling and management, the seven problems associated with project portfolio management and Dr. Goldratt's thinking processes.

## 2.2 Project portfolio management

For an enterprise involved in the execution of projects, implementing the right projects is more than simply about choosing individual candidates; rather it is about the total mix of projects and new product and technology investments that the business undertakes. Project portfolio management is therefore formally defined as follows:

"Portfolio management is a dynamic decision process, whereby a business's list of active new product (and development) projects is constantly up-dated and revised. In this process, new projects are evaluated, selected and prioritized; existing projects may be accelerated, killed or de-prioritized; and resources are allocated and re-allocated to active projects. The portfolio decision process is characterized by uncertain and changing information, dynamic opportunities, multiple goals and strategic considerations, interdependence among projects, and multiple decision-makers and locations. The portfolio decision process encompasses or overlaps a number of decision-making processes within the business, including periodic reviews of the total portfolio of all projects (looking at all projects holistically, and against each other), making Go/Kill decisions on individual projects on an on-going basis, and developing a new product strategy for the business, complete with strategic resource allocation decisions." (Cooper et al, 2001b:3)

### 2.2.1 The rationale for effective project portfolio management

Project portfolio management is viewed as a critical task by business, according to at least some senior management in a survey by Cooper et al (2001c:6) (An exploratory

study of 30 leading firms was undertaken – in-depth personal interviews. This study helped to identify the issues, goals, concerns, metrics, type of methods used, etc. Next, a detailed survey questionnaire was developed in concert with the IRI's Research on Research Committee).  (Cooper et al, 2001c:3)

The figure below provides the mean importance ratings of project portfolio management, broken down by executive function.  Not surprisingly, senior management in technology (VP's of R&D, etc) are giving project portfolio management the highest importance ratings of all the functions (with score 4.1 out of 5). Additionally, higher performing businesses also tend to rate the importance of project portfolio management much higher than poorer performers. (Cooper et al, 2001c:6)
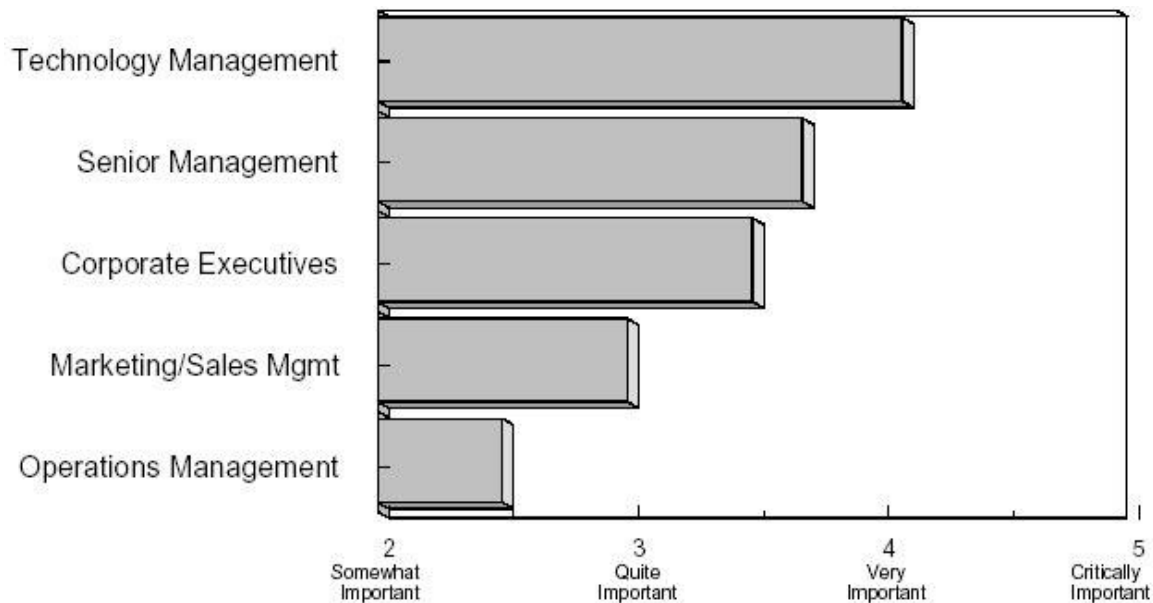


Figure 1: How senior management sees the importance of project portfolio management (Cooper et al, 2001c:5)

Specific reasons for the importance of effective project portfolio management are defined by Cooper et al (2001b:3). These are:

- Financial – to maximise return; to maximise R&D productivity; to achieve financial goals.
- To maintain the competitive position of the business – to increase sales and market share.

- To properly and efficiently allocate scarce resources.

- To forge the link between project selection and business strategy: the portfolio is the expression of strategy; it must support the strategy.

- To achieve focus – not doing too many projects for the limited resources available; and to resource the "great" projects.

- To achieve balance – the right balance between long and short term projects, and high risk and low risk ones, consistent with the business's goals.

- To better communicate priorities within the organisation, both vertically and horizontally to provide better objectivity in project selection – to weed out bad projects.

## 2.2.2 The effects of lacking effective project portfolio management

Cooper et al (1998:4-5) indicates that without effective new project portfolio management and project selection criteria, companies face a slippery road downhill. This is illustrated in the following figure:
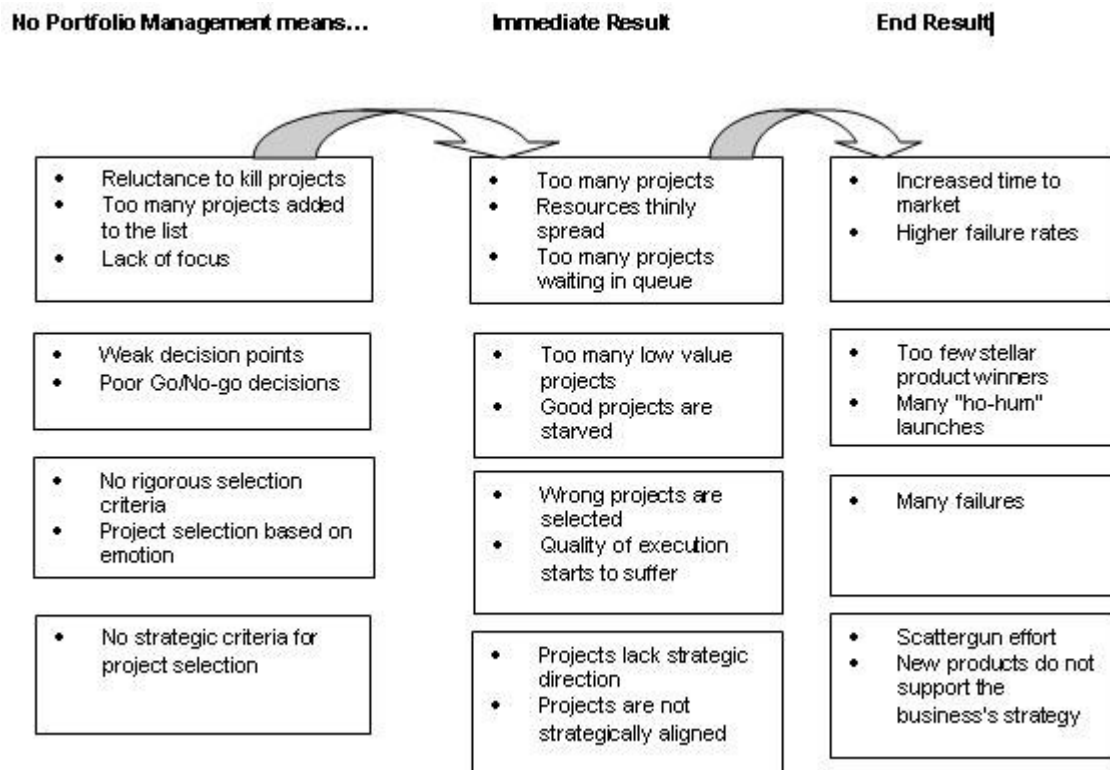


Figure 2: What happens when you have no portfolio management method (Cooper et al, 1998:4-5)

Indeed, many of the problems that beset product development initiatives in businesses can be directly traced to a lack of effective project portfolio management. First, weak project portfolio management translates into a strong reluctance to kill new product projects. There are no effective Go/Kill criteria and no consistent mechanism for evaluating and, if necessary, culling weak projects. Projects seem to take a life of their own, running like express trains past review points. Further, new projects simply get added to the "active list" with little appreciation for their resources needs or impact on other projects. Clark and Wheelwright in (Engwall and Jerbrant, 2003:408) refer to this as the "canary cage approach". New canaries (projects) are thrown into the cage without any analysis of the effects of the other canaries already in the cage. The result is a total lack of focus: *far too many projects for the available resources*.

The problems do not stop there. A lack of focus and too many active projects mean that resources and people are too thinly spread. As a result, projects end up in a queue – "pipeline gridlock" as stated in (Cooper et al, 2001b:4) – and cycle time starts to increase. Suddenly there are complaints about projects taking too long to get to market. But worse: with resources and people thinly spread, everyone starts to scramble – too many balls in the air. The result is clearly predictable: the quality of execution starts to suffer. For example, the essential upfront homework isn't done and needed market studies designed to build in the voice of the customer are left out due to lack of time and people. Poor-quality execution of these tasks and others such as required steps and stages in the new product process means an increase in failure rates.  Not only are projects then late to market, but their success rates drop!

Additionally, lacking effective project portfolio management, there are no rigorous and tough decision points, which in turn leads to poor project selection decisions. One common result is too many mediocre projects in the pipeline: too many extensions, minor modifications and defensive products, which only yield marginal value to the company.  Thereby many of the launches warrant low and disappointing results and there is a noticeable lack of stellar new product winners.  By far the most damaging result of the above is that the few really good projects are starved for resources so that

they are either late to market or never achieve their full potential. Such wasted opportunities are not reflected in the company's financial statements.

Without a rigorous portfolio selection method, the wrong projects often get selected and for all the wrong reasons. Instead of decisions based on facts and objective criteria, decisions are based on politics and emotion. A great number of these ill-selected projects simply fail.

The final consequence that needs mention is the result on strategy. Without a project portfolio management method, strategic criteria for project selection is missing and so there is no strategic direction to the projects selected. After all, new products are the leading edge of business strategy. They define tomorrow's vision of your company! But without a portfolio method, projects are not strategically aligned with the business's strategy and many strategically unimportant projects find themselves in the pipeline. The end result is a scattergun effort that does not support the business's strategic direction. (Cooper et al, 1998:4-5)

The price for not having an effective project portfolio management and selection method for new products is very high. If a business faces any of the above mentioned problems, perhaps one of the root causes can be postulated to be ineffective project portfolio management.

(**Caveat**: The above-mentioned negative consequences of having no effective project portfolio management model will be offset by indicating what the core problem of these negative consequences are; using the current reality tree as designed by Viljoen (2005:6); with suitable modifications for the present study.  This current reality tree was built with the major operational difficulties as defined by Engwall and Jerbrant (2003:403-408) in mind; and not with the above mentioned negative consequences. )
The follow table demonstrates a plausible relationship between the seven operational problems of project portfolio management as interpreted by Viljoen (2005:5) from Engwall and Jerbrant (2003:403-408) and those as identified by Cooper et al (1998:4-5).

## 2.2.3 The four goals of project portfolio management

According to Cooper et al (2001b:5-22) and Cooper et al (2001a:3-5), there are four common denominators across businesses when it comes to project portfolio management: four macro or high level goals. The goal you wish to emphasize most will in turn influence your choice of portfolio methods. These four goals are:

1. ***Maximising the value of your portfolio.*** Here the goal is to select new product projects so as to maximise the sum of the values or commercial-worth's of all active projects in your pipeline in terms of some business objective. Some of the methods that can be employed to achieve this goal include:

    a. ***NPV***: Calculate the NPV (Net present value) of each project and then rank all projects against their NPV. The "Go" projects are on the top of the list and projects are rank-ordered according to this index until out of resources, thus seemingly maximising the value of the portfolio (the sum of the NPV value for each project) for a given or limited resource expenditure.

    b. ***ECV:*** The calculation of the ECV (expected commercial value) is based on a decision tree analysis and considers the future stream of earnings from the project, the probabilities of commercial success and technical success; as well as development costs and commercialisation costs. The ECV of each project is calculated and then a ratio is determined through dividing the ECV with a constraining resource (say R&D costs per project). Projects are then rank ordered according to the ECV/R&D cost ratio until the total budget limit is reached. The projects on the top of the list are considered "Go" while the rest (beyond the total budget limits) are put on hold. This methodology ensures that the ECV is maximised for a given budget.

    c. ***Productivity Index:*** It is similar to the ECV method illustrated above, although a probability adjusted NPV value is employed as the ECV value. This ECV value is multiplied by the probability of technical success and divided by remaining constraint costs.

    d. ***Scoring models:*** Traditionally, scoring models are used for making Go/Kill decisions at gates, but they are also employed in project prioritisation and

project portfolio management decisions. Projects are scored on each of a number of criteria by management. These include:

    i.  Strategic alignment.

   ii.  Product advantage.

  iii.  Market attractiveness.

  iv.  Ability to leverage core competencies

   v.  Technical feasibility.

  vi.  Reward vs. risk.

The project attractiveness score is the weighted addition of the item ratings, and becomes the basis for developing a rank ordered list of projects. (Cooper et al, 2001b:5-7)

2. **A balanced portfolio.**  Here the goal is to achieve a balanced set of development projects in terms of a number of key parameters. These include long term versus short term projects; high versus lower risk projects; and across various markets, technologies, product categories and project types (e.g. new products, improvements, cost reductions, maintenance and fixes, and fundamental research). Pictures portray balance with greater ease than lists and numbers, and so the techniques are used here are largely graphical in nature. They include:

  a.  **Bubble diagrams:** Display your projects on a two-dimensional grid as bubbles (the size of the bubbles denotes the spending on each endeavour). The axes vary but the most popular chart is the risk-reward bubble diagram, where NPV is plotted versus probability of technical success. Then seek an appropriate balance in numbers of projects (and spending) across the four quadrants.

  b.  **Pie charts:** Displays your spending breakdowns as slices of pies in a pie chart. Popular pie charts include a breakdown by project types, by market or segment, and by product line or product category.

Both bubble diagrams and pie charts, unlike the maximisation models of the first goal, are not decision-models, but rather aids in the display of information: they

depict the current portfolio and where the resources are going – the "what is". These charts provide a viable beginning for the discussion of "what should be" – how the resources should be allocated. (Cooper et al, 2001b:9-15)

3.  ***Building strategy into the portfolio.*** Here the goal is to make sure that all projects are "on strategy "; and that the breakdown of spending across all projects, areas, markets and the like, must reflect the strategic priorities (the areas of focus and their respective priorities). Some of the portfolio methods that were designed to achieve strategic alignment include:

   a.  ***Top-down, strategic buckets:*** "Begin at the top with your business's strategy and from that, the *product innovation strategy* for your business – its goals, and where and how to focus your new product efforts. Next, make splits in resources: "given your strategy, where should you spend your money?" These splits can be by project types, product lines, markets or industry sectors, and so on. Thus, you establish *strategic buckets* or envelopes of resources. Then, within each bucket or envelope, list all the projects – active, on-hold and new – and rank these until you run out of resources in that bucket. The result is multiple portfolios, one portfolio per bucket. Another result is that your spending at year-end will truly reflect the strategic priorities of your business." (Cooper et al, 2001a:4)

   b.  ***Top-down, product roadmap:*** "Once again, begin at the top, namely with your business and product innovation strategy. But here the question is: "given that you have selected several areas of strategic focus – markets, technologies or product types – what major initiatives must you undertake in order to be successful here?" It's analogous to the military general asking: given that I wish to succeed in this strategic arena, what major initiatives and assaults must I undertake in order to win here? The end result is a mapping of these major initiatives along a timeline – the product roadmap. The selected projects are 100% strategically driven." (Cooper et al, 2001a:4)

c. **Bottom-up:** "Make good decisions on individual projects, and the portfolio will take care of itself" is a commonly accepted philosophy. That is, make sure that your project gating system is working well – that gates are accepting good projects, and killing the poor ones – and the resulting portfolio will be a solid one. Even better, to ensure strategic alignment, use a scoring model at your project reviews and gates, and include a number of strategic questions in this model. Strategic alignment is all but assured: your portfolio will indeed consist of all "on strategy" projects (although spending splits may not coincide with strategic priorities). "(Cooper et al, 2001a:4)

Note that regardless of the strategic approach that is used by the person(s) responsible, all of the above-mentioned approaches assume that you have a "product innovation strategy", something that is unfortunately missing in some businesses. (Cooper et al, 2001a:4)

4. **Pick the right number of projects.** (This study is particularly concerned with the number of projects that is present in the portfolio funnel.) It is hypothesized that companies have too many projects underway for the limited resources available. The result is pipeline gridlock – projects end up in a queue; they take too long to complete or to reach the target audience; and key activities – such as pre-project feasibility studies and pre-project design – are omitted because of a lack of people and time. The ways to combat this include:

   a. **Resource limits:** The value maximisation methods (as described in Goal #1) build in resource limitation – then you rank your projects until you are out of resources. The balancing methods (as described in Goal #2), such as bubble diagrams, also builds in resource limitation. The sum of the areas of the bubbles – the resources that are required to work on each project – should be a constant number and by adding an additional project to the diagram would explicitly require that another project would have to be deleted. (Cooper et al, 2001a:4)

b. ***Resource capacity analysis:*** "Determine your resource demand: prioritise your projects (best to worst) and add up the resources required by department for all active projects (usually expressed in person-days per month). Project management software, such as MS-Project ®        , enables this roll-up of resource requirements. Then determine the available resources (the supply) per department – how much time people will have to work on these projects. A department-by-department and month-by-month assessment usually reveals that there are too many projects; it suggests a project limit (the point beyond which projects in the prioritised list should be put on hold); and it identifies which departments are the bottlenecks. "(Cooper et al, 2001a:4-5)

There is an inherent danger that the four goals of project portfolio management, as outlined above, can become in conflict with one another. The value maximisation goal (where the project with the highest NPV or IRR takes precedence) may be in conflict with the balancing goal (having the right mix of short and long term projects; high and low risk projects, etc). On the other hand, choosing a portfolio that is 100% aligned with strategy may lack the ability to generate profits in the short to medium term.

The next sections will outline the traditional project portfolio management approaches, inclusive of their strengths and weaknesses.

## 2.2.4 Project portfolio management approaches

There are two fundamentally different approaches to integrating project portfolio management into your new product process, the stage-gate and portfolio review approaches. (Cooper, 2000:1 – 11) and (Cooper et al, 2001b:25-31)

### A) Stage-gate approach:

"A stage-gate process is a conceptual and operational road map for moving a new-product project from idea to launch – a blueprint for managing the new-product process to improve effectiveness and efficiency. Stage-gate approaches break the innovation process into a predetermined set of stages, with each one consisting of a

set of prescribed, cross-functional and parallel activities. At the entrance to each stage is a gate, which serves as the quality control and go/kill check point in the process." (Cooper, 2000:5).
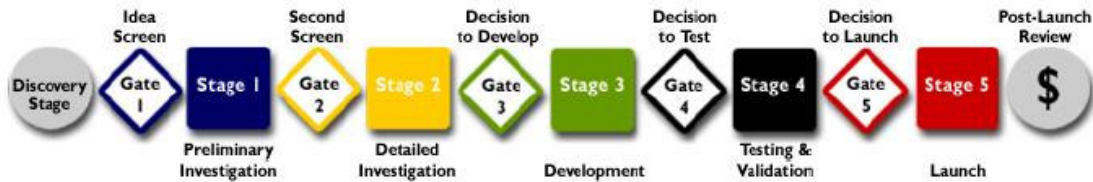


Figure 3: Simple map of a Stage-Gate Process. (Cooper, 2000:5)

These five stages are where the action occurs. Each stage consists of a set of parallel activities undertaken by people from different functional areas of the enterprise. The five stages (post the idea generation phase) are summarised as follows:

1. **Stage 1**   Scoping: a quick investigation and sculpting of the project.
2. **Stage 2**   Build the business case: the detailed homework and up-front investigative work leading to a business case; defined product, a business justification and a detailed plan of action for the next stages.
3. **Stage 3**   Development: the actual design and development of the new product. Additionally, the manufacturing (or operations) process is mapped out, the marketing launch and operating plans are developed, and the test plans for the next stage are defined.
4. **Stage 4**   Testing and validation: the verification and validation of the proposed new product, its marketing and production.
5. **Stage 5**   Launch: full commercialisation of the product – the beginning of full production and commercial launch and selling.  (Cooper, 2000:6)

Preceding each stage is an entry gate or a go/kill decision point. Effective gates are central to the success of a fast-paced, new-product process:

- Gates serve as quality-control checkpoints: Is this project being executed in a quality fashion?
- Gates also serve as go/kill and prioritisation decision points: Gates provide the funnels where mediocre projects are successfully culled out.
- Finally, gates are where the path forward for the next stage is decided, along with resource commitments. Gate meetings are usually staffed by senior managers from different functions, who "own" the resources the project team leader and team require for the next stage. These decision-makers are called "gatekeepers". (Cooper, 2000:6)

It is also important to note that gates have a common format:
- **Deliverables**: These are the inputs into the gate review – what the project leader and team deliver to the meeting. They are the results of the actions of the previous stage, and are based on a standard menu of deliverables for each gate.
- **Criteria**: These are questions or metrics on which the project is judged in order to make the go/kill and prioritisation decision.
- **Outputs**: These are the results of the gate-review – a decision (go/kill/hold/recycle). An action plan is approved, and the date and deliverables for the next gate are agreed upon. (Cooper, 2000:6)

The "gates dominate approach": "is best suited for larger firms in mature businesses where the portfolio of projects is fairly static. A solid gating process, where resource allocation methods are integrated into the gates, is likely best here: there is simply no great need to reprioritise the entire set of projects every few months; rather the focus is more on in-depth reviews on individual projects and making sound go/kill decisions on each. Portfolio management is simply added to the process by modifying the gates somewhat, and holding several portfolio reviews annually, but more as course corrections. "(Cooper et al, 2001b:25)
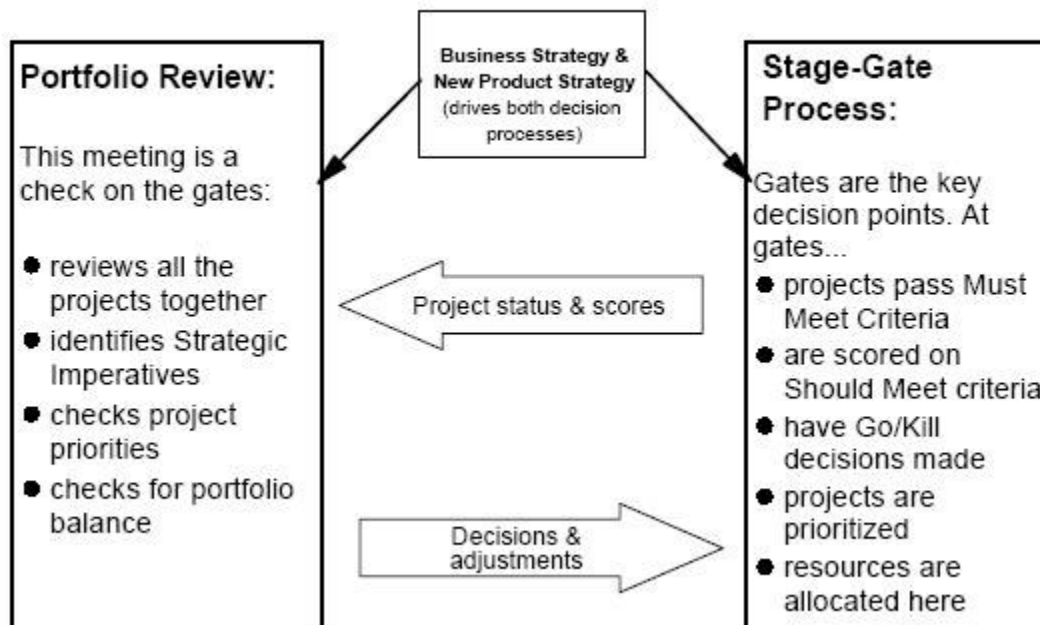
Figure 4: Method 1 – An integrated project portfolio management process (stage-gate with portfolio reviews) (Cooper et al, 2001:28)

## B) Portfolio review approach:

The "portfolio reviews dominate": "is best suited to fast-paced companies in fluid markets, whose portfolios are likely to be more dynamic: here a constant reprioritisation of the portfolio of projects is essential, simply because things change so fast in the marketplace. What was a great project several months ago suddenly is not so good anymore – the whole market has changed! In this method, all projects are up for auction about 4 times per year. Portfolio reviews are the key decision meetings and amount to an all-project, mass gate meeting, where all projects and resources are on the table." (Cooper et al, 2001b:25)
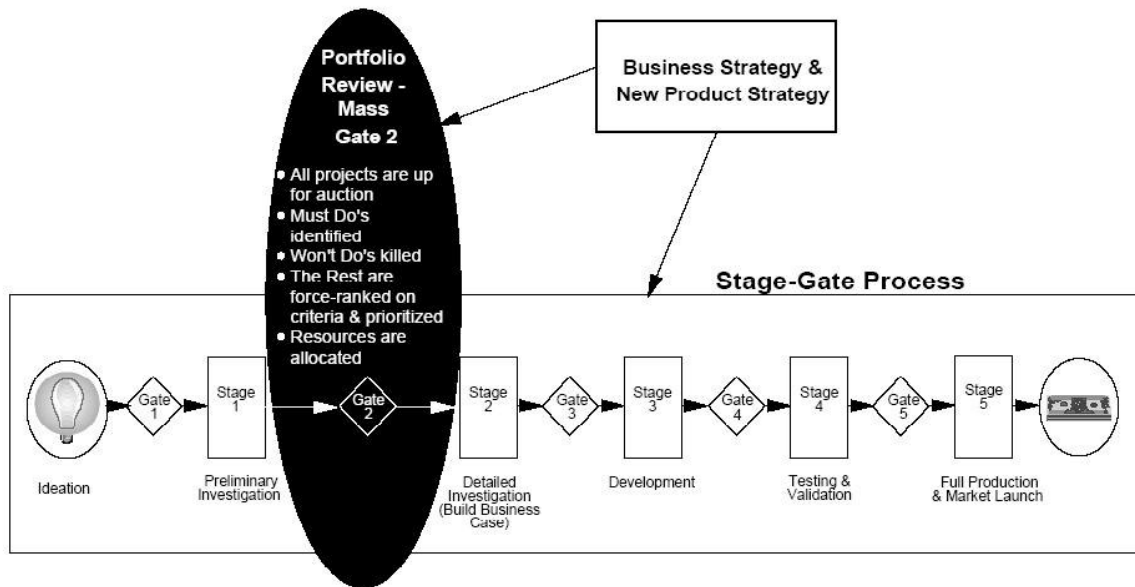
Figure 5: Method 2 – Project portfolio management intersecting with the new product process. (Cooper et al, 2001b:31)

## 2.2.5 Comparing the approaches

"Approach 2 has some advantages (and disadvantages) versus approach 1. Management indicates that it is easier to prioritise projects when looking at all projects on the table together (rather than one at a time at real-time gates). Additionally, some people have difficulty with the two-part gate approach in approach 1, for example, how does one find the resources for a good project when that is the only project being considered at the meeting? Finally, some managers like the notion that prioritisation of all projects is done regularly – no project is sacred!" (Cooper et al, 2001b:31)

"There are also disadvantages to approach 2, and areas in which approach 1 is superior. Many managers believe that if projects are to be killed, then the project team should be there to defend the project (or at least to provide updated information), such as happens in an in-depth gate meeting. Another criticism is that approach 2 requires a major time commitment from senior management; often taking several days every quarter to conduct this portfolio/gate 2 decision meeting!

A final advantage of approach 1 is that gate reviews provide much more in-depth assessment than is ever possible when all the projects are considered at a single meeting." (Cooper et al, 2001b:31)

## 2.2.6 Popularity and effectiveness of portfolio methods

According to Cooper et al (2001c:10), the popularity of portfolio methods used by industry provides insights and guides to others. A word of caution: just because a method is popular, don't assume that it delivers the best results. Research into these methods conveys the following information: (Note: Many businesses use multiple methods, so that the percentages of methods used in the following figure add up to well over 100 percent.)

Respondents were queried about which method is the dominant one – the method that dominates the decision process.
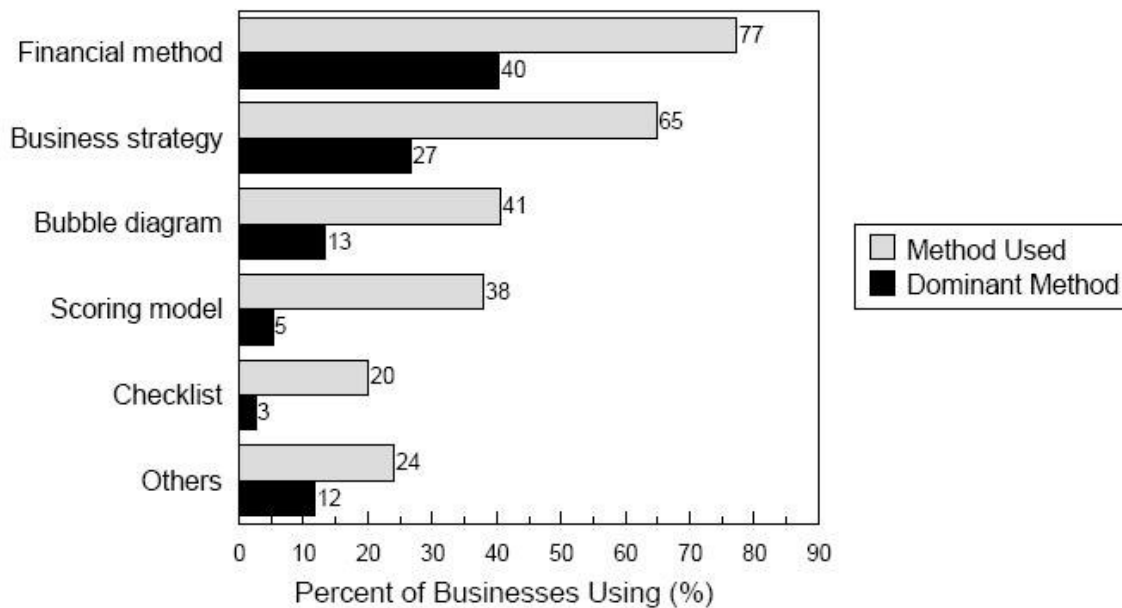


Figure 6: Popularity of portfolio methods employed (Cooper et al, 2001c:10)

- "*Financial methods* dominate portfolio management and project selection approaches. Financial methods include profitability and return metrics, such as NPV, RONA, ROI and payback period. A total of 77.3 percent of businesses use

a financial approach in portfolio management and project selection, while 40.4 percent of businesses rely on financial approaches as the dominant portfolio method. That is, project selection and the composition of the portfolio of projects boil down to a financial calculation, and the rating and ranking of projects are based on this financial number or index!" (Cooper et al, 2001c:10)

- "The *business's strategy* as the basis for allocating money across different types of projects is the second most popular portfolio approach. For instance, having decided the business's strategy, money is allocated across different types of projects and into different envelopes or buckets. Projects are then ranked or rated within buckets. A total of 64.8 percent of businesses use a strategic approach to select their portfolio of projects; for 26.6 percent of businesses, this is the dominant method. "(Cooper et al, 2001c:10)

- *Bubble diagrams or portfolio maps*. Here, projects are plotted on an X-Y plot or map, much like bubbles or balloons. Projects are categorised according to the zone or quadrant they are in (e.g., pearls, oysters, white elephants, and bread-and-butter projects.) A total of 40.6 percent of businesses use portfolio maps: only 5.3 percent of businesses use this as their dominant method however. (Cooper et al, 2001c:10)

- *Scoring models*. Here, projects are rated or scored on a number of questions or criteria (for example, low-medium-high; or 1-5 or 0-10 scales). The ratings on each scale are added to yield a Total or Project Score, which becomes the criterion used to make project selection and/or ranking decisions. A total of 37.9 percent of businesses use scoring models, in 13.3 percent, this is the dominant decision method.  "(Cooper et al, 2001c:11)

- *Check lists*. Projects are evaluated on a set of yes/no questions. Each project must achieve either all Yes answers, or a certain number of Yes answers to proceed. The number of Yes's is used to make Go/Kill and/or prioritisation (ranking) decisions. Only 20.9 percent of businesses use check lists; and in only 2.7 percent of businesses is check lists the dominant method. (Cooper et al, 2001c:11)

- *Others.*  Twenty-four percent of businesses indicate that they use some "other method" – other than the ones described above. A closer scrutiny of these "other" methods reveals that most are variants or hybrids of the above models and methods, for example: Many businesses that responded "other method" describe a strategically driven process, much like the strategic method above. That is, they let their business's strategy drive the spending splits (e.g., across buckets such as markets, product types, project types) and even let their strategy drive the choice of individual projects. A number of businesses use multiple criteria – profitability, strategic, customer appeal – but not necessarily in a formal scoring model format. Some businesses are probabilities of commercial and technical success, either multiplied together, or multiplied by various financial numbers (NPV, EBIT) – a variant of the financial method. One business simply confessed to relying on "intuition and experience".   (Cooper et al, 2001c:11)

Popularity does not necessarily equate to effectiveness however, when the performance of the firms' portfolios were rated on six metrics in a study by Cooper et al (2001b:23-24). Companies that relied heavily on financial tools as the dominant portfolio selection model fared the worst. Financial tools yield an unbalanced portfolio of lower value projects; and projects that lack strategic alignment. By contrast, strategic methods produce a strategically aligned and balanced portfolio. Scoring models appear best for selecting high value projects, which also yields a balanced portfolio. Finally, firms using bubble diagrams obtain a balanced and strategic aligned portfolio. (Cooper et al, 2001b:23-24)

## Performance Ratings for Each Portfolio Method (1-5 Scores)

| Performance Metric | Financial Methods | Strategic Methods | Scoring Model | Bubble Diagrams |
|---|---|---|---|---|
| Projects are aligned with business's objectives | 3.76 ✘ | 4.08 | 3.95 | 4.11 ★ |
| Portfolio contains very high value projects | 3.37 ✘ | 3.77 | 3.82 ★ | 3.70 |
| Spending reflects the business's strategy | 3.50 | 3.72 ★ | 3.59 | 3.00 ✘ |
| Projects are done on time – no gridlock | 2.79 ✘ | 3.22 ★ | 3.13 | 2.90 |
| Portfolio has good balance of projects | 2.80 ✘ | 3.08 | 3.20 ★ | 3.20 ★ |
| Portfolio has right number of projects | 2.50 | 2.93 ★ | 2.70 | 2.25 |

★ = Best method on each performance criterion

✘ = Worst method on each criterion

Ratings are 1-5 mean scores for each method, when used as dominant portfolio method.
Here 1=Poor and 5=Excellent

Source: *R-T Mgmt* [8].

Figure 7: Strengths/Weaknesses for each portfolio method (Cooper et al, 2001b:24)

"It is ironic that the most rigorous techniques – the various financial tools – yield the worst results, not so much because the methods are flawed, but simply because reliable financial data are often missing at the very point in a project where the key project selection decisions are made." (Cooper et al, 2001b:24)

## *2.3 Project scheduling and management*

### 2.3.1 Schedule development

"Schedule development means determining start and finish dates for project activities. If the start and finish dates are not realistic, then the project is unlikely to be finished as scheduled. The schedule development process must often be iterated (along with the processes that provide inputs, especially duration estimating and cost estimating) prior to determination of the project schedule." (Project Management Institute, 2000:73)

The two most prominent mathematical analysis techniques used to determine when activities could be scheduled, namely the Critical Path Method (CPM) and Review Technique (PERT), will briefly be covered in the following sections:

## 2.3.2 Critical path method

"The chemical company DuPont, Inc. developed the Critical Path Method in the 1950s and this approach was researched well in the 1960s and 1970s. CPM trades duration compression off against additional cost and provides alternative plans: plans of shorter duration although at higher cost and ones with lower cost but of longer duration." (Steyn, 2)

"The principle is as follows: opportunities to reduce the duration of activities on the critical path, which is defined as "...the series of activities which determines the earliest completion of the project..."  (Project Management Institute, 2000:200), often exist, and such opportunities often incur additional expense. Where opportunities exist to expedite (or "crash") activities on the critical path by spending more money, two alternatives are presented, namely a normal duration at normal cost and a "crash" duration at a "crash" (higher) cost. The cost slope of an activity is defined as (crash cost - normal cost) / (crash time - normal time). If a number of such opportunities exist for activities on the critical path, it makes sense to crash the ones with the least steep cost slope first. This method enables executives to trade the increase in cost off against the benefits of completing the project earlier, and to choose from two or more alternative project schedules with corresponding budgets." (Steyn, 2-3)

"By crashing activities on the critical path, this path becomes shorter relative to the non-critical paths. This means that non-critical paths now have less slack (float) and some of them might also become critical. An increase in the number of critical paths increases the risk of a delay. Reduction of the amount of slack on paths that do not become critical also increases the risk of a delay. The only way to overcome this would be to spend even more money to reduce the duration of non-critical activities as well. This is normally not done and textbooks seem to ignore the increase in risk instead.

Furthermore, there are obvious limits to resources that might be utilised on a project."
(Steyn, 3)

"Crashing does not always produce a viable alternative." (Project Management Institute,
2000:75) "Although crashing implies higher risks, more demands on skilled people and
significantly higher costs, CPM is, in certain cases, useful to provide executives with
alternative project plans." (Steyn, 3)

### 2.3.3 Program evaluation and review technique

"The estimated duration of an activity is by no means fixed: potential for completing the
activity either faster or slower than the most likely duration exists. The PERT technique
accepts that scheduling is a stochastic problem and takes this variability in the duration
of activities into account. Normally the upside potential for early completion is smaller
than the downside potential for delay. Consider, for example, the activity of driving to
work: it might normally take twenty minutes (realistic estimate) to drive to work but
sometimes, due to unforeseen circumstances, it might take much longer. Although the
probability of a serious delay, such as might be caused by an accident, is low, it is non-
zero. The potential of the activity taking much less than the estimated 20 minutes is
rather limited. Thus the downside potential of a possible delay is much greater than the
upside potential of finishing the activity faster than in the most likely duration."  (Steyn, 4)
This implies that the distribution is lognormal as is illustrated below:
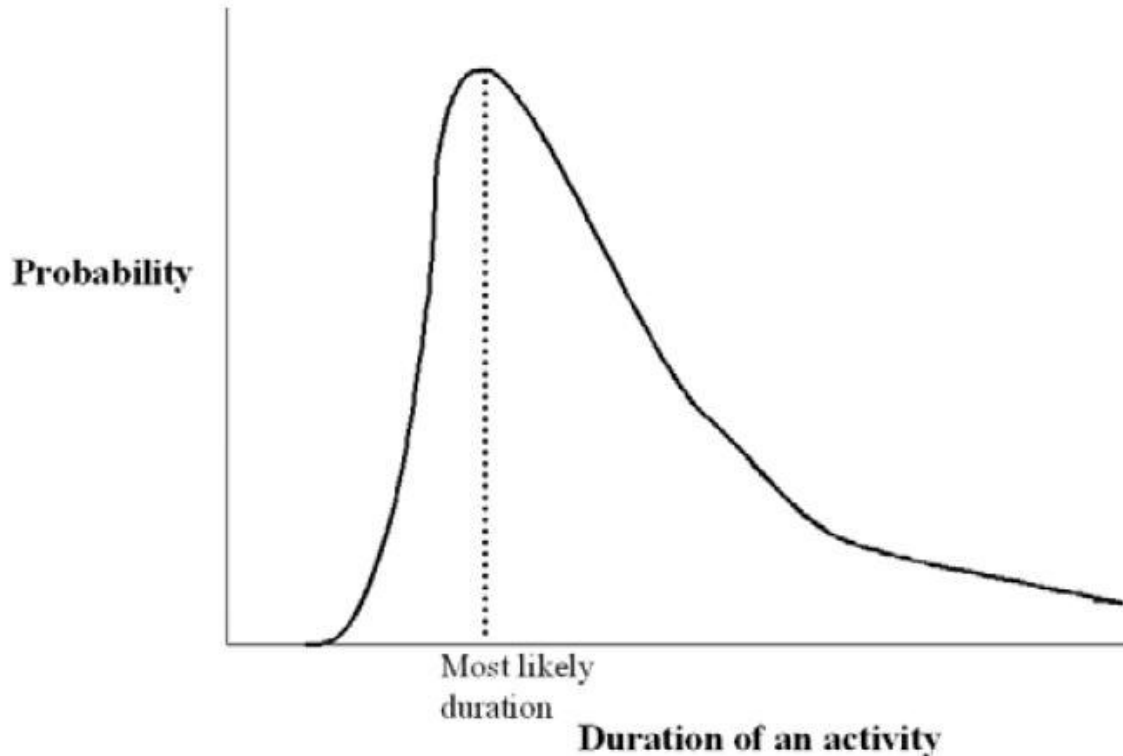
Figure 8: Lognormal distribution of activity duration (Steyn, 4)

"To simplify calculations, a beta distribution is often assumed. In order to work with three estimated values (minimum, most likely and maximum) and to simplify the problem even further, triangular distribution is quite often assumed. This is a gross over simplification and results in an underestimate of the effect of risk on project turnout, leading to inappropriate risk management decisions. The three estimated values for activity duration and the Central Limit Theorem are used to estimate probability figures for the duration of the whole project. According to this theorem, if the distribution curves of a relatively large number of independent activities (in this case the activities on the critical path) are summarised, the resulting distribution is normal." (Steyn, 4-5)

Furthermore, for n activities on the critical path, the mean of the distribution of project completion, E, will be given by:

$$E = t_{e1} + t_{e2} + t_{e3} + \ldots + t_{en}$$

In this instance $t_{ei}$ is the mean duration of activity i. In addition, according to this theorem, the variance of the distribution for project completion, $V_T$, could be calculated as:

$$VT = V_{t1} + V_{t2} + V_{t3} + \ldots + V_{tn}$$

In this instance $V_{ti}$ is the variance associated with activity i. "With these formulas, given a specific future date, the project manager is in a position to provide a probability figure for completion on or before the specified date. Conversely, given a desired level of confidence, the project manager could calculate a completion date (e.g. for a 90% level of confidence, the project completion date would be December 2003, but for a 95% confidence, the project completion date would be February 2004)." (Steyn, 5)

**Shortcomings associated with PERT:**

"A first shortcoming is that most applications of PERT do not take into account the so-called "merge point bias". Merge point bias could be explained as follows: If two paths, each with a 50% chance of being completed on time, have to be finished before a third activity could start, the probability that the third activity would be able to start on time, is only 25%. If five activities merge (this is typical at the closure stage of many projects) and each activity has a 50% chance of being completed on time, the probability of the project ending on time is only $(0.5)^5$ or approximately 3%." (Steyn, 5)

"The second shortcoming is that the critical path changes from time to time as activities are completed early or fall behind schedule and that PERT does not take into account that non-critical paths might become critical. The implication is that, during project execution, the project manager does not know what activities are critical and can, therefore, not focus his or her attention on the right activities. The only solution would be to re-plan frequently - something that few project managers would do."  (Steyn, 5)

## 2.3.4 Schedule control

"Schedule control is concerned with a) influencing the factors that create schedule changes to ensure that changes are agreed upon, b) determining that the schedule has changed and c) managing actual changes when and as they occur. Schedule control must be thoroughly integrated with the other control processes." (Project Management Institute, 2000:79)

**Inputs to schedule control**

1. **Project schedule:** "The approved project schedule, called the schedule baseline (which must be feasible technically and in terms of resources), is a component of the project plan. It provides the basis for measuring and reporting schedule performance." (Project Management Institute, 2000:79)
2. **Performance reports:** "Performance reports provide information on schedule performance, such as which planned dates have been met and which have not. Performance reports may also alert the project team to issues that may cause problems in the future." (Project Management Institute, 2000:80)
3. **Change requests:** "Change requests may occur in many forms – oral or written, direct or indirect, externally or internally initiated, and legally mandated or optional. Changes may require extending the schedule or may allow accelerating it." (Project Management Institute, 2000:80)

**Tools and techniques for schedule control**

1. **Schedule change control system:** "A schedule change control system defines the procedures by which the project schedule may be changed. It includes the paperwork, tracking systems and approval levels necessary for authorising changes. Schedule change control should be integrated with the integrated change control system. "(Project Management Institute, 2000:80)

2. **Performance measurement:** "Performance measurement techniques help to assess the magnitude of any variations that do occur. An important part of schedule control is to decide if the schedule variation requires corrective action. For example, a major delay on a non-critical activity may have little effect on the overall project, while a much shorter delay on a critical or near-critical activity may require immediate action." (Project Management Institute, 2000:80)

3. **Additional planning:** "Few projects run exactly according to plan. Prospective changes may require new or revised activity duration estimates, modified activity sequences, or analysis of alternative schedules." (Project Management Institute, 2000:80)

4. **Project management software:** "The ability of project management software to track planned dates versus actual dates and to forecast the effects of schedule changes, real or potential, makes it a useful tool for schedule control." (Project Management Institute, 2000:80)

5. **Variance analysis:** "Performance of the variance analysis during the schedule-monitoring process is a key element for control. Comparing target dates with the actual/forecast start and finish dates provides useful information for the detection of deviations and for the implementation of corrective solutions in case of delays. The float variance is also an essential planning component to evaluate project time-performance. Particular attention has to be given to critical and sub-critical activities (i.e., analysing the sub-critical paths, in order of ascending float)." (Project Management Institute, 2000:80)

**Outputs from schedule control**

1. **Schedule updates:** "A schedule update is any modification to the schedule information that is used to manage the project. Appropriate stakeholders must be notified as needed. Schedule updates may or may not require adjustments to other aspects of the project plan.  Revisions are a special category of schedule updates. Revisions are changes to schedule start and finish dates in the approved project schedule. These changes are generally incorporated in

response to scope changes or changes to estimates. In some cases, schedule delays may be so severe that re-base lining is needed to provide realistic data to measure performance. However, care must be taken before re-base lining, as historical data will be lost for the project schedule. Re-base lining should only be used as a last resort in controlling the schedule; new target schedules should be the normal mode of schedule revision." (Project Management Institute, 2000:81)

2. **Corrective action:** "Corrective action is anything done to bring expected future schedule performance in line with the project plan. Corrective action in the area of time management often involves expediting: special actions taken to ensure of an activity on time or with the least possible delay. Corrective action frequently requires root-cause analysis to identify the cause of the variation, and schedule recovery can be planned and for activities delineated later in the schedule and need not only address the activity causing the deviation." (Project Management Institute, 2000:81)

3. **Lessons learned:** "The causes of variances, the reasoning behind the corrective action chosen, and other types of lessons learned from schedule control should be documented, so that they become part of the historical database for both this project and other projects of the performing organisation." (Project Management Institute, 2000:81)

## 2.3.5 Resource management

"Project human resource management includes the processes required to make the most effective use of the people involved with the project. It includes all the project stakeholders – sponsors, customers, partners, individual contributors, and others." (Project Management Institute, 2000:107)

### Organisational planning

"Organisational planning involves identifying, documenting, and assigning project roles, responsibilities, and reporting relationships. Roles, responsibilities, and reporting

relationships may be assigned to individuals or groups. The individuals and groups may be part of the organisation performing the project, or they may be external to it. Internal groups are often associated with a specific functional department such as engineering, marketing or accounting." (Project Management Institute, 2000:108-109)

**Inputs to organisational planning**

1. **Project interfaces:** Project interfaces generally fall into one of three categories:
   a. **Organisational interfaces:** "Formal and informal reporting relationships among different organisational units. Organisational interfaces may be highly complex or very simple." (Project Management Institute, 2000:109)
   b. **Technical interfaces:** "Formal and informal reporting relationships among different technical disciplines. Technical interfaces occur both within project phases and between project phases." (Project Management Institute, 2000:109)
   c. **Interpersonal interfaces:** "Formal and informal reporting relationships among different individuals working on the project. These interfaces often occur simultaneously." (Project Management Institute, 2000:109)
2. **Staffing requirements:** "Staffing requirements define what kinds of competencies are required from what kinds of individuals or groups and in what time frames. Staffing requirements are a subset of the overall resource requirements identified during resource planning." (Project Management Institute, 2000:109)
3. **Constraints:** "Constraints are factors that limit the project team's options. A project's organisational options may be constrained in many ways. Common factors that may constrain how the team is organised include, but are not limited to:" (Project Management Institute, 2000:110)
   a. Organisational structure of the performing organisation.
   b. Collective bargaining agreements.
   c. Preferences of the project management team.
   d. Expected staff assignments.

**Tools and techniques for organisational planning**

1. **Templates:** "Although each project is unique, most projects will resemble another project to some extent. Using the role and responsibility definitions or reporting relationships of a similar project can help expedite the process of organisational planning." (Project Management Institute, 2000:110)
2. **Human resource practices:** "Many organisations have a variety of policies, guidelines, and procedures that can help the project management team with various aspects of organisational planning." (Project Management Institute, 2000:110)
3. **Stakeholder analysis:** "The identification of stakeholders and the needs of various stakeholders should be analysed to ensure that their needs will be met." (Project Management Institute, 2000:110)

**Outputs from organisational planning**

1. **Role and responsibility assignments.** "Project roles (who do what) and responsibilities (who decide what) must be assigned to the appropriate project stakeholders. Roles and responsibilities may vary over time. Most roles and responsibilities will be assigned to stakeholders who are actively involved in the work of the project, such as the project manager, other members of the project management team, and the individual contributors. The roles and responsibilities of the project manager are generally critical on most projects, but vary significantly by application area. Project roles and responsibilities should be closely linked to the project scope definition. A Responsibility Assignment Matrix (RAM) is often used for this purpose." (Project Management Institute, 2000:110-111)
2. **Staffing management plan.** "The staffing management plan describes when and how human resources will be brought onto and taken off of the project team. The staffing plan may be formal or informal, highly detailed or broadly framed, based

on the needs of the project. It is a subsidiary element of the overall management plan." (Project Management Institute, 2000:111)

3. **Organisation chart.** "An organisation chart is any graphic display of project reporting relationships. It may be formal or informal, highly detailed or broadly framed, based on the needs of the project. An Organisational Breakdown Structure (OBS) is a specific type of organisation chart that shows which organisational units are responsible for which work packages. "(Project Management Institute, 2000:111)

4. **Supporting detail:** "Supporting detail for organisational planning varies by application area and project size. Information frequently supplied as supporting detail include, but is not limited to:" (Project Management Institute, 2000:112-113)

    a. Organisational impact.

    b. Job descriptions.

    c. Training needs.

### 2.3.6 Staff acquisition

"Staff acquisition involves getting the needed human resources (individuals or groups) assigned to and working on the project. In most environments, the "best" resources may not be available, and the project management team must take care to ensure that the resources that are available will meet project requirements. "(Project Management Institute, 2000:113)

**Inputs to staff acquisition**

1. **Staffing management plan.** See above.

2. **Staffing pool description.** "When the project management team is able to influence or direct staff assignments, it must consider the characteristics of the potentially available staff. Considerations include, but are not limited to: "(Project Management Institute, 2000:113)

    a. Previous experience.

      b.  Personal interests.

      c.  Personal characteristics.

      d.  Availability.

      e.  Competencies and proficiency.

3. **Recruitment practices.** "One or more of the organisations involved in the project may have policies, guidelines, or procedures governing staff assignments. When they exist such practices act as a constraint on the staff acquisition process." (Project Management Institute, 2000:113)

**Tools and techniques for staff acquisition**

1. **Negotiations.** "Staff assignments must be negotiated on most projects. For example, the project management team may need to negotiate with:

      a.  Responsible functional managers to ensure that the project receives appropriately competent staff in the necessary time frame.

      b.  Other project management teams within the performing organisation to assign scarce or specialised resources appropriately. "(Project Management Institute, 2000:113)

2. **Pre-assignment.** "In some cases, staff may be pre-assigned to the project. This is often the case when a) the project is the result of a competitive proposal, and specific staff was promised as part of the proposal, or b) the project is an internal service project, and staff assignments were defined within the project charter." (Project Management Institute, 2000:114)

3. **Procurement.** "Project procurement management can be used to obtain the services of specific individuals or groups of individuals to perform project activities. Procurement is required when the performing organisation lacks the in-house staff needed to complete the project." (Project Management Institute, 2000:114)

**Outputs from staff acquisition**

1. **Project staff assigned.** "The project is staffed when appropriate people have been reliably assigned to work on it. Staff may be assigned full time, part time, or variably, based on the needs of the project." (Project Management Institute, 2000:114)

2. **Project team directory.** "A project team directory lists all the project team members and other stakeholders. The directory may be formal or informal, highly detailed or broadly framed, based on the need of the project." (Project Management Institute, 2000:114)


## 2.4 Operational problems in multi-project environments

The operational problems outlined in the next section, was taken from the publication of Engwall and Jerbrant (2003:403-409). The following excerpts describe the method upon which their empirical research was based:

### 2.4.1 Research background

"The empirical basis is two, qualitative case studies. The first case study was executed from April 1998 to June 1999 at a contract division of a major supplier of signalling systems for railways. The purpose was to generate concepts, theoretical models, and empirical issues, which would guide further studies on multi-project settings as an empirical phenomenon. In order to acquire an in-depth understanding of the practices an ethnographic approach was chosen. During 14 months, one researcher spent approximately 3 days a week at the company. As in most ethnographic research, several sources of data were used, e.g. observations, interviews, and studies of written material, such as project documentation, technical documents, minutes, company instructions, and memos." (Engwall, Jerbrant, 2003:404)

"The second study was initiated in order to test the validity of the findings from the first case. It was carried out during the fall of 1999 at an R&D division of a middle-sized, private telecom operator. This multi-project organisation was chosen in order to contrast

the organization in the first case. Consequently, the study had a similar research design, but it was executed over a third of the time period." (Engwall, Jerbrant, 2003:404)

## 2.4.2 Seven undesired effects

The seven operational problems (or undesired effects) identified by Engwall and Jerbrant (2003:403-409), of project portfolio management is summarised succinctly below:

1. ***The portfolio management hierarchical level is overloaded***. This is attributed to unclear project priorities and conflicting interests between different projects and different departments. These unsettled issues were frequently boosted up through the organisational hierarchy to be resolved by the persons responsible for project portfolio management.

2. ***Portfolio management does priority setting and resource re-allocation on a daily basis***. Project portfolio managers are overwhelmed with issues concerning prioritisation of projects and the distribution of personnel from low-prioritised, or smoothly running projects to high-priority projects or projects in urgent crises. Often there are no free or slack resources available and when resources were redistributed it often produced negative effects at unanticipated places in the project portfolio.

3. ***An ongoing game of negotiation is played for key resources.*** Negotiations for resources on projects occur frequently and the allocation of "key" resources to certain projects caused a constant stream of friction.

4. ***Management is primarily engaged in short term problem solving.*** Owing to troubles in many projects, steering committees and middle-management are occupied with ad hoc problem solving.

5. ***Priorities change often.*** Refer to the above points for an understanding of the cause-effect relationships at play that warrants this.

6. ***One project has negative effects on other projects.*** If one project comes into trouble, it directly affects the other projects. It may cause delays on activity starts and even missed deadlines on the other projects, owing to the fact that a shared

pool of resources are being utilised by all the projects.

7. ***Project managers keep resources working on their projects (unnecessarily)
   in order not to lose them.***  Project managers felt that if they released resources
   to go and work on other projects, they might not be able to return when the
   situation required it. Thus, from the project manager's perspective, it was
   imperative to "protect" resources from other projects for as long as possible by
   keeping them busy (unnecessarily) on menial work.

These seven undesired effects severely inhibit the performance of project portfolio
delivery systems and may ultimately jeopardise the four goals of project portfolio
management as previously described.

## 2.5 Goldratt's thinking processes

Dr. Eliyahu M. Goldratt, inventor and chief instigator of the Theory of Constraints (TOC),
developed the TOC thinking processes that enables the identification of core problems
in personal, organisational, or any other situation; determining and testing a win-win
solution prior to implementation; and determining the obstacles to implementation and
how to address them.

Goldratt frequently states that the role of a manager is to determine:
- What to change?
- What to change to?
- How to successfully cause the change?

Correct identification of core problem(s) must therefore be a primary responsibility of a
manager.  The TOC recommended method of identifying a core problem is by
constructing a current reality tree (CRT) and the TOC tool for precisely defining the
problem is the evaporating cloud technique.

In light of these revelations:

- The CRT thinking process is used in this study to identify the core problem of project portfolio management in multi-project environments.
- The identified problem (the release-problem) is then illustrated and defined clearly; showing all the underlying assumptions by constructing an evaporating cloud diagram.

The following discussions will briefly explain the generic steps necessary to embark upon both the previously mentioned thinking processes.

## 2.5.1 Current reality trees

The list of steps was taken from (Cox, Spencer, 1998:285-286):

1. List between five and ten problems (called undesirable effects, UDEs) related to the situation.
2.  Test each UDE for clarity. Is the UDE a clear and concise statement? This test is called the clarity reservation.
3. Search for a causal relationship between any two of the UDEs.
4. Determine which UDE is the cause and which is the effect. Read as "If cause, then effect." This test is called the causality reservation. Occasionally the cause and effect may be reversed. Check by using the following statement: "Effect because cause…"
5. Continue the process of connecting the UDEs using the "If-then" logic until all the UDEs are connected.
6. Often, the causality is strong to the person feeling the problem but does not seem to exist to others. In these instances, "clarity" is the problem. Use the clarity reservation to eliminate the problem. Generally, entities between the cause and the effect are missing.
7. Sometimes the cause by itself may not seem to be enough to create the effect. These cases are tested with the cause insufficiency reservation and are improved by reading: "If cause and _____ then effect." What is the missing dependent statement that completes the logical relationship? The AND in this relationship is

called a conceptual and, which means that both entities connected with the "and" connector have to be present for the effect to exist.

8. Sometimes the effect is caused by many independent causes. The causal relationships are strengthened by the additional cause reservation. The problem to be addressed is: "How many of the causes are important enough to address?" One, two, or sometimes three causes frequently result in creating about 80% percent of the effect. Generally, eliminating these few causes is enough of a reduction so that the remaining effect becomes minor.

9. Sometimes an If-then relationship seems logical but the causality is not appropriate in its wording. In these instances, words like "some", "few", "many", "frequently", "sometimes", and other modifiers can make the causality stronger.

If the core problem (which will be connected to at least 70% of the UDEs), can be addressed; then almost all of the UDEs will disappear.

## 2.5.2 Evaporating cloud diagrams

The general format of an evaporating cloud is provided below. This was taken from (Cox, Spencer, 1998:296-297).
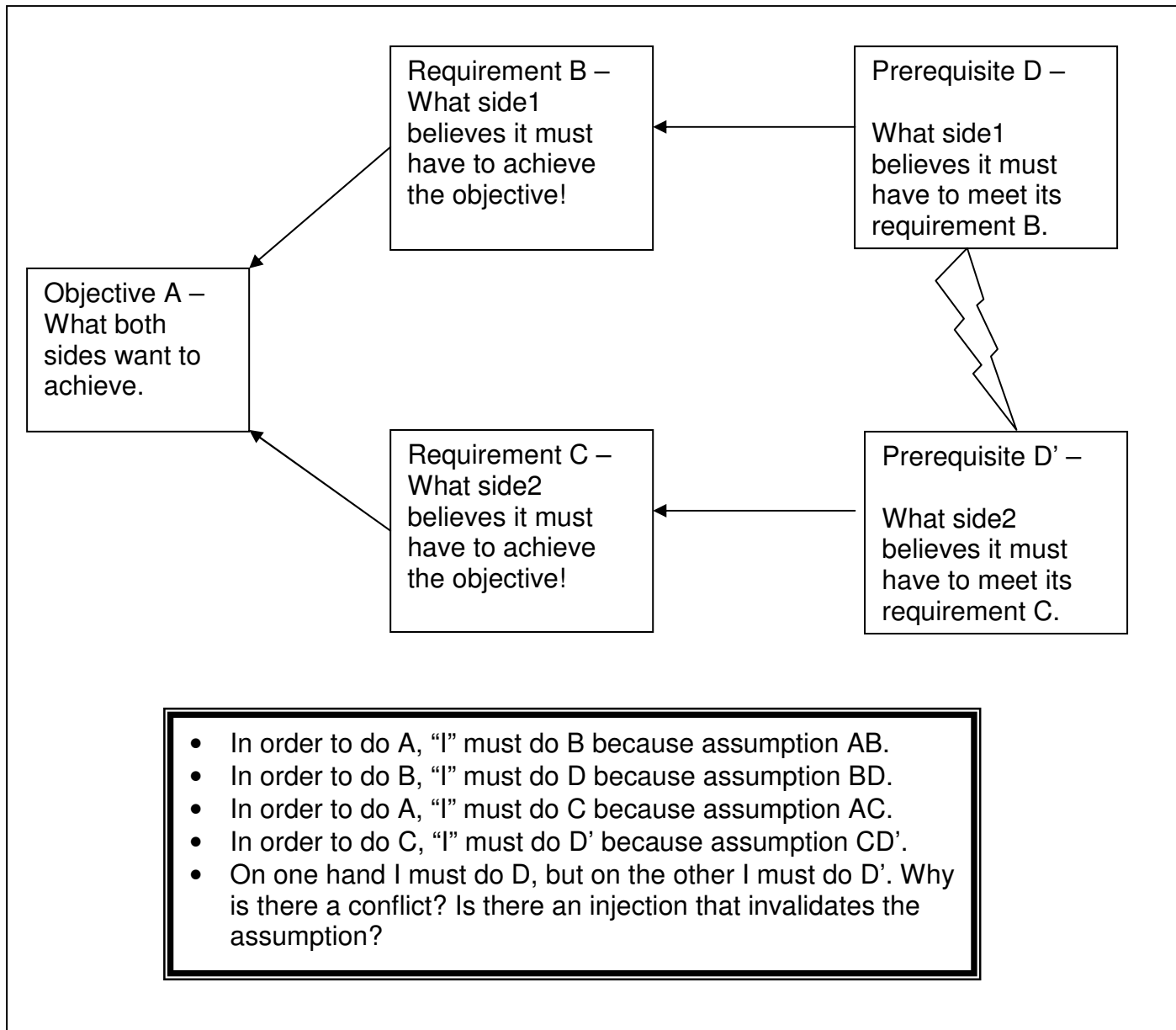


Figure 9: Surfacing the assumptions. (Cox, Spencer, 1998:296)

Objective A is the common goal that is to be achieved by both sides. The goal is the reversal or elimination of the core problem from the CRT. The requirements, B and C,

are what each side, respectively, or the problem solver believes are the underlying foundations that are required to achieve the objective. Prerequisite D is believed necessary to achieve requirement B and prerequisite D' is believed to be necessary to achieve requirement C.  The conflict is that both D and D' cannot exist simultaneously – more of one means less of the other, having one may mean not having the other, etc. In order to have (the tip of the arrow) we must have (the tail of the arrow) because assumption (tip-tail of the arrow). This framework is useful in surfacing assumptions for AB, BD, AC and CD'. To surface the assumption for D-D', the following statement is useful: On one hand, we must have D, but on the other hand, we must also have D'. What assumption(s) prevents us from having both D and D'?

***The stage has now been set to start formulating the core problem of project portfolio management in a multi-project environment, using the TOC thinking processes.***

# Chapter 3 – Theoretical Framework

## 3.1 Introduction

In this chapter, the theoretical framework upon which the research rests will be formulated and expressed using the TOC thinking processes.  This includes the release-problem evaporating cloud diagram and the current reality tree logically linking the aforementioned problem with the seven operational problems associated with project portfolio management in a multi-project environment.

## 3.2 The release-problem evaporating cloud diagram
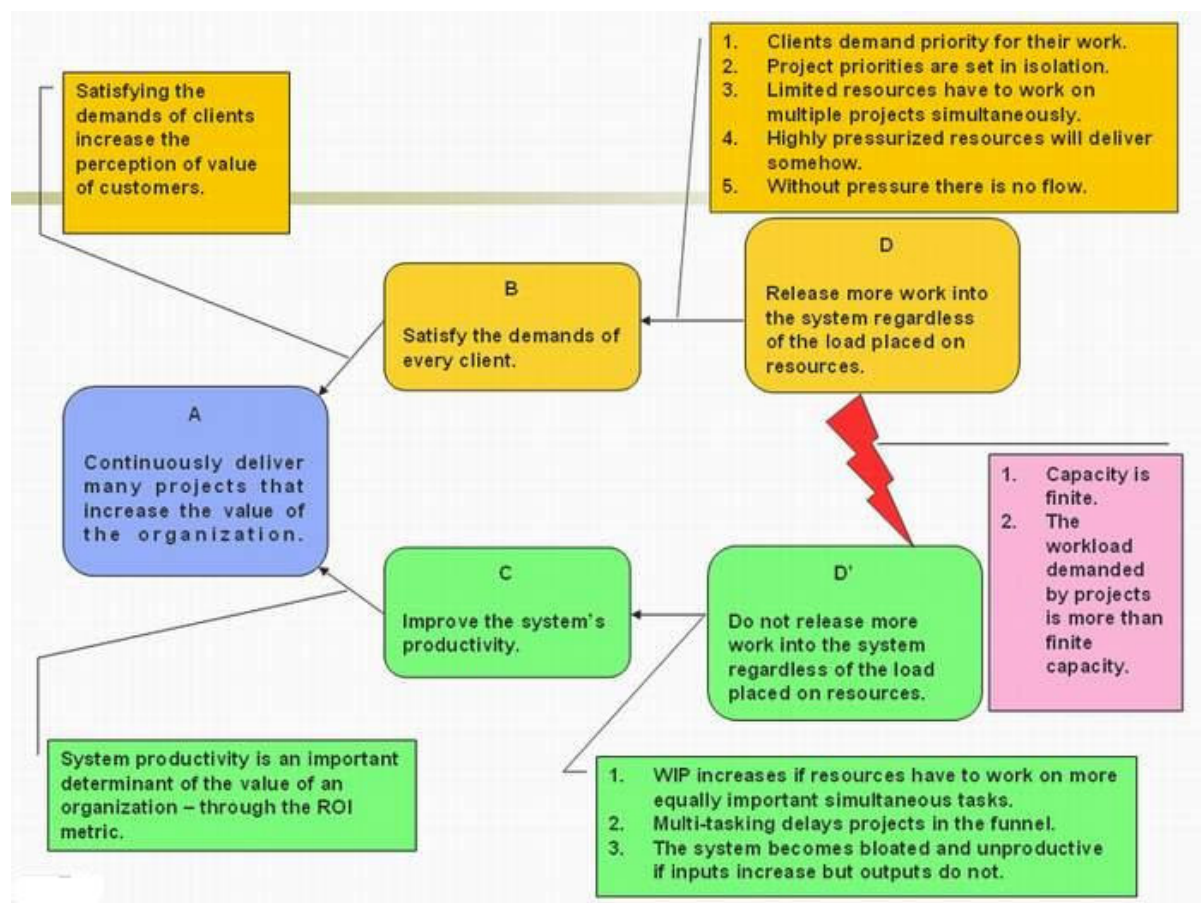


Figure 10: The release-problem evaporating cloud diagram (adjusted from Viljoen (2005:3))

The logic captured within the evaporating cloud illustrated above, is discussed below:

The goal which project portfolio managers must strive to accomplish is to "Continuously deliver many projects that increase the value of the organisation." This is referred to as Objective A.

One of the requirements or needs associated with achieving Objective A, is to "Satisfy the demands of every client", referred to as Requirement B. Requirement B is a necessary condition for achieving Objective A, because "Satisfying the demands of every client increases their perception of value". In order to accomplish Requirement B, we must take the action advocated by Prerequisite D, namely "Release more work into the system regardless of the load placed on resources". Taking this action is necessary because of the following assumptions:

1. Clients demand priority for their work.
2. Project priorities are set in isolation.
3. Limited resources have to work on multiple projects simultaneously.
4. Highly pressurised resources will deliver somehow.
5. Without pressure there is no flow.

The other requirement or need associated with achieving Objective A is to "Improve the system's productivity", referred to as Requirement C. Requirement C is a necessary condition for achieving Objective A, because "System productivity is an important determinant of the value of an organisation, through the ROI metric."  In order to accomplish Requirement C, we must take the non-action advocated by Prerequisite D', namely "Do not release more work into the system, regardless of the load placed on resources." Embarking upon this non-action is necessary because of the following assumptions:

1. WIP (work in process) increases if resources have to work on more equally important simultaneous tasks.
2. Multi-tasking delays projects in the funnel.
3. The system becomes bloated and unproductive if inputs increase but outputs do not.

Now we are in the grips of the conflict (the **release-problem**) between taking the differing actions recommended by Prerequisite D and Prerequisite D'. Which one should we embark upon? It should be noted however that this conflict is only in effect if the associated assumptions are valid, namely:

1. Capacity is finite.
2. The workload demanded by projects is more than finite capacity.

In reality, most companies will compromise between the different actions recommended by the associated Prerequisites. This compromise unfortunately directly jeopardises Objective A, by not fully meeting the needed requirements. As time progresses, the chosen compromise may become unviable and lead to dramatic problems in the working situation.

The following theoretical current reality tree, illustrates what negative side-effects the release-problem may trigger and to what extent it compromises the four desired goals of project portfolio management.

**_7_**
Project managers keep resources working on their projects unnecessarily in order not to loose them.

**_5_**
Task priorities change often.

**_3_**
An ongoing game of negotiation is played for key resources.

170
Original project and key resource schedules are no longer valid.

180
Key resources have a high status in the organisation.

150
Some critical tasks on projects take a long time to complete.

160
Projects are scheduled in isolation.

140
Multitasking ads significant waiting time that increases the elapsed time to complete a task.

130
Some key resources multitask (more) to try to satisfy everybody.

110
Some key resources have long queues of work waiting for them from different projects.

120
Project priorities are set in isolation to satisfy different clients' demands.

**_1_**

**The release-problem**:
More work is released into the system, regardless of the load placed on resources.

100
More projects are released than key resources can handle.

search

49

---

**220**

Early gate decisions are delayed and clouded with short term considerations.

---

**4**

Senior management is primarily engaged in short term problem solving.

---

**1**

The portfolio management hierarchical level is overloaded.

---

**210**

Senior managers with wide responsibilities are portfolio managers.

---

**2**

Portfolio management does priority setting and resource re-allocation on a daily basis across projects.

---

**6**

One project has negative effects on other projects – such as delays that cause missed deadlines.

---

**200**

Portfolio managers are responsible for delivery on many projects.

---

**7**

Project managers keep resources working on their projects unnecessarily in order not to loose them.

---

**5**

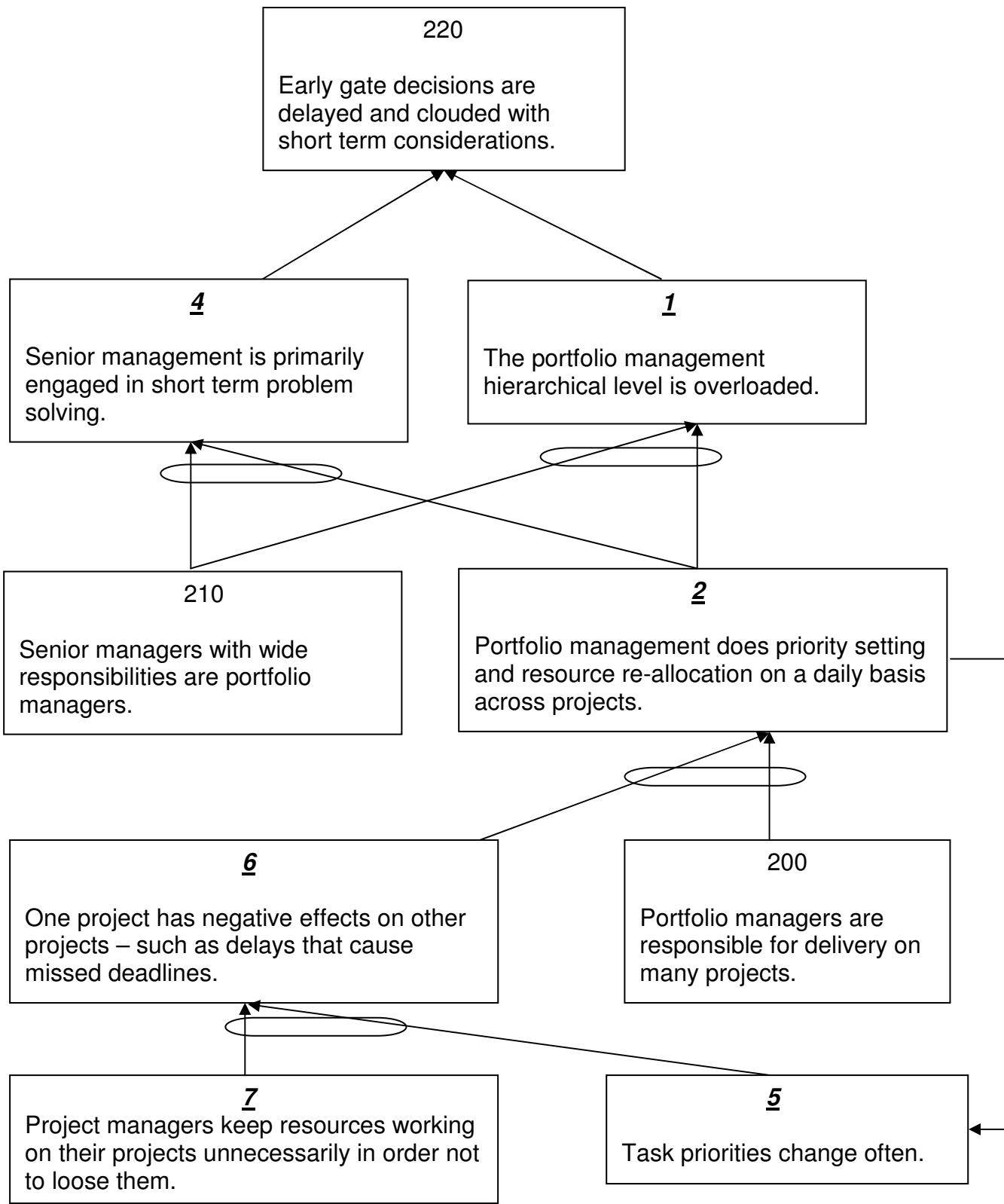Task priorities change often.

---

Figure 11: The logically derived effects of the release-problem (adjusted from Viljoen (2005:6))

## 3.3 Validating the fundamental management problem

The current reality tree given above (slightly altered from Viljoen (2005:6)) provides the logic that links the proposed problem to the seven operational problems in multi-project environments. The figures should be read from the bottom to the top. The arrows and the ellipse are read as "if…and…then" statements.

This logic validates the proposition that the release-problem is fundamental to multi-project environments. The following discourse depicts the logic:

If more project work is released into the system, regardless of the load placed upon resources (release-problem) (1) and the work is more than the finite capacity of key resources (100), then some key resources have long queues of work waiting for them from different projects (110).  The work in these queues is ranked-ordered based on project priorities that are set in isolation to satisfy different clients' demands (120). The inevitable follows and some key resources have to multitask to try and satisfy everybody (130). Multitasking unfortunately add significant waiting time that increases the elapsed time to complete a task (140). This causes that some critical tasks on projects take a long time to complete (150). This means that original project and key resource schedules become unviable (170) because it was compiled from project schedules that were set in isolation (160). Owing to the fact that key resources have a high status in the organisation (180), an ongoing game of negotiations is now played as a result of the invalid resources schedules (3).  This causes task priorities to be changed often (5). It also forces project managers to often keep resources working on their projects (unnecessarily) in order not to forsake them to another project (7). The changed priorities cause more multitasking (130) and a counter- productive circular pattern is fostered. If task priorities change (5) and project managers do not release resources from their projects when they become free (7) then one project has negative effects on other projects – such as delays that caused missed deadlines (6). The problem is then elevated to the project portfolio managers who are responsible for delivery on many projects (200) forcing them to do priority setting and resource re-allocation across the

projects in the funnel on a daily basis (2). This fact again causes task priorities to change (5) which lead inevitably to more multitasking (130) and the counter-productive circular pattern is reinforced. The project portfolio management (senior management (210)) hierarchical level is overloaded (1) and they are thus now primarily engaged in short term problem solving (4) or fire-fighting. Their decisions regarding new opportunities on the early gates in the process is delayed and clouded by short-term problems (220). Viljoen (2005:8) states that the last effect follows logically although it was not explicitly recognised by Engwall and Jerbrant (2003:403-409).

This logic serves as a first validation that the release-problem is a fundamental management problem and suggests that it is worthwhile to continue on the current endeavour to gather empirical evidence to validate the release-problem.

# Chapter 4 – Research Design and Methodology

## 4.1 Introduction

A research strategy is the logic that links the data to be collected and conclusions to be drawn to the questions of the study. This section explains the processes and methods that will be followed to gather the relevant data in this research study. This section will also elaborate on the rationale for the study and instruments that is to be used.

## 4.2 Research objective

The objective of the research is to find empirical evidence in support of validating the proposed fundamental management problem entitled the release-problem.

## 4.3 Rationale for the study

The previously defined release-problem leads to dramatic problems in actual working situations for practicing managers. In reality, work is often released into the system, regardless of the load placed on resources, owing to the fear of losing business; keeping customers satisfied and the belief that the work can be accomplished in some way or another.

Validating the existence of the release-problem is imperative if one wants to gain a deeper understanding of the negative effects that are caused by this problem.  It will also serve as a solid starting point for developing solutions for this fundamental management problem.  The negative effects that stem from the release-problem (described in the literature review section) jeopardises the four desired outcomes of project portfolio management as described by (Cooper et al, 2001b:2).

## *4.4 Research questions*

1.      Are the negative effects (operational problems) associated with project portfolio management apparent in the company under consideration?

2.      How does the management of the company under consideration deal with the release-problem?

3.      Are the effect-cause-effect patterns derived by Viljoen (2005:6-8) present in the multi-project environment of the company under consideration?

## *4.5 Approach and strategy*

To accomplish the research objective, by empirically answering the research questions, a single case study is to be conducted. This case study is to be conducted in an organisation which completes multiple simultaneous projects, drawn from a pool of shared resources.

## *4.6 Unit of analysis*

- The prime unit of analysis will be the project portfolio environment of the South African company that conducts multiple projects simultaneously, using a shared pool of resources to conduct their projects.
  - o   In order to successfully accomplish this task, the boundaries of the system to be studied will be drawn explicitly.
- The embedded unit of analysis will be a project conducted within the multi-project environment of the company under consideration.
- The project will be chronologically followed throughout its entire lifecycle. This approach will provide graphical insight into, amongst others, what occurrences hampered the completion of the project under consideration.

## *4.7 Time period of this study*

This study will be conducted over a one year period. All the data gathered in this process will only be valid for this study period.

## 4.8 Entities to consider

The research will follow a systemic approach throughout the interview and data collection process. This implies that the system boundaries, inputs, outputs and feedback mechanisms for each of the following entities must be considered:

- The project portfolio environment – the prime unit of analysis.
- The project within the multi-project portfolio environment – the embedded unit of analysis.
- The following persons actively engaged in both the units of analysis:
  - o Top management
  - o Business analysts / sales managers
  - o Project portfolio managers
  - o Project managers
  - o Resource managers
  - o Resources

## 4.9 Research instrument

The prime research instrument to be used in the execution of the case study is a questionnaire. The questionnaire will be made up out of a number of different sections (each consisting of a number of different questions) aimed at each individual's (that is to be interviewed) specific role within the project portfolio management environment.

## 4.10 Analysis of data

The main way of validating the gathered data against the theoretical current reality trees and the release-problem evaporating cloud diagram, would be via mapping the current reality cause-and-effect evidence of the units of analysis and then by pattern matching them against the theoretical system cause-and-effect maps. It would also however include:

- Checking performance trends.
- Classifying and categorising the gathered data.

### 4.11 Sources of evidence

The research is to be conducted with the aid of the following sources of information:
(Yin, 2003:86)

- Documentation: The organisation's archived records, minutes, financial and other reports, presentations and documentation could aid in determining the possible existence and consequences of the release-problem.
- Questioning: Surveys/interviews will be conducted with the appropriate personnel in the organisation.

### 4.12 Research maximisation

These sources of evidence to be used (mentioned above) will be maximised by adhering to the following three principles (Yin, 2003:67):

- The use of multiple sources of evidence.
- Creation of a case study database.
- Maintaining a chain of the collected evidence.

### 4.13 Summary

This chapter focused on the research study design, methodology and approach to gather the relevant data in order to analyse and answer the research problem. It further mentioned the research questions and the instruments to be used in the case study.

# Chapter 5 – Data Collection and Analysis

## 5.1 Introduction

In this chapter, an overview will be given regarding the organisation in which the case study was conducted, the interview methodology adhered to as well as a discussion and analysis of the results obtained during the interview process.

## 5.2 Background on the organisation

The organisation, in which the study was undertaken, is an electronic equipment design and manufacturing operation, headquartered in Randburg, South Africa. They have two other regional offices in South Africa, one in Centurion and the other in Cape Town.  The company has recently become part of a multi-national electronics design concern registered in Singapore.

In the eighteen months preceding the research investigation, the South African leg of the company had undergone major structural and strategic changes. They had evolved from being a purely software development concern into a deliverer of a combination of hardware equipment components, with integrated software functionality for external clients.  Previously, not being part of the multi-national company, they were not responsible for industrialising combined products and solely focused on software design. The head office in Randburg, along with their international partners, is now primarily engaged in hardware equipment design and the other offices focus primarily on software design.  The manufacturing and associated logistics parts of the business are outsourced to foreign concerns internal to the multi-national company.

The South African leg of the company also underwent structural changes that amounted to the re-allocation of all resources into one global pool (instead of working within different facets or silo's internal to the organisation) and the separation of business and operational issues via allocating dedicated operations, strategic and marketing personnel.

The project that was looked at during the research investigation is a wireless telephony project, which is intended to create a product whereby cellular telephones could be used in a rural environment; instead of normal fixed-line telephones, to connect to a network infrastructure using the EDGE protocol. The product was ordered and is to be sold by another well-known multi-national electronics firm.  The product will use a combination of internally designed hardware and software components as well as proprietary technology developed by external electronic component manufacturing and design concerns.

## 5.3 Interview procedure

The interviews with the people concerned within the project portfolio management environment of the South African electronic equipment designer; were structured around a hypothesized conflict which could occur within the confines of their organisational role, if the release-problem had in fact played a part in the organisation.  These hypothesized conflicts were expressed in the format of an evaporating cloud diagram. During the interview process, the interviewees were encouraged to alter the hypothesized conflicts to represent a factual and accurate representation of their working environments. The questions which were asked of the interviewees related directly to the hypothesized conflict (specific to their environment) and were actually trying to ascertain whether some of the previously mentioned undesirable effects were in fact present within the microcosm of their daily surroundings.  This methodology resulted in the following benefits:

- It greatly eased communication between the participating parties.
- The interviewee played an active role during the process.
- The interviewee knew exactly what the questions were driving towards.
- The interviewees were able to relate the hypothesized conflict to the project under discussion as well as to previous experiences within the organisation.
- The interviewees provided additional information which was not directly asked of them.

The analysis of the interviews will be presented via illustrating the evaporating cloud diagram (which were finalised and agreed upon during the interview) and by indicating what conclusions could be drawn from it.

## 5.4 Project Manager

The interview conducted with the project manager responsible for the delivery of the software components required on the project is described below:
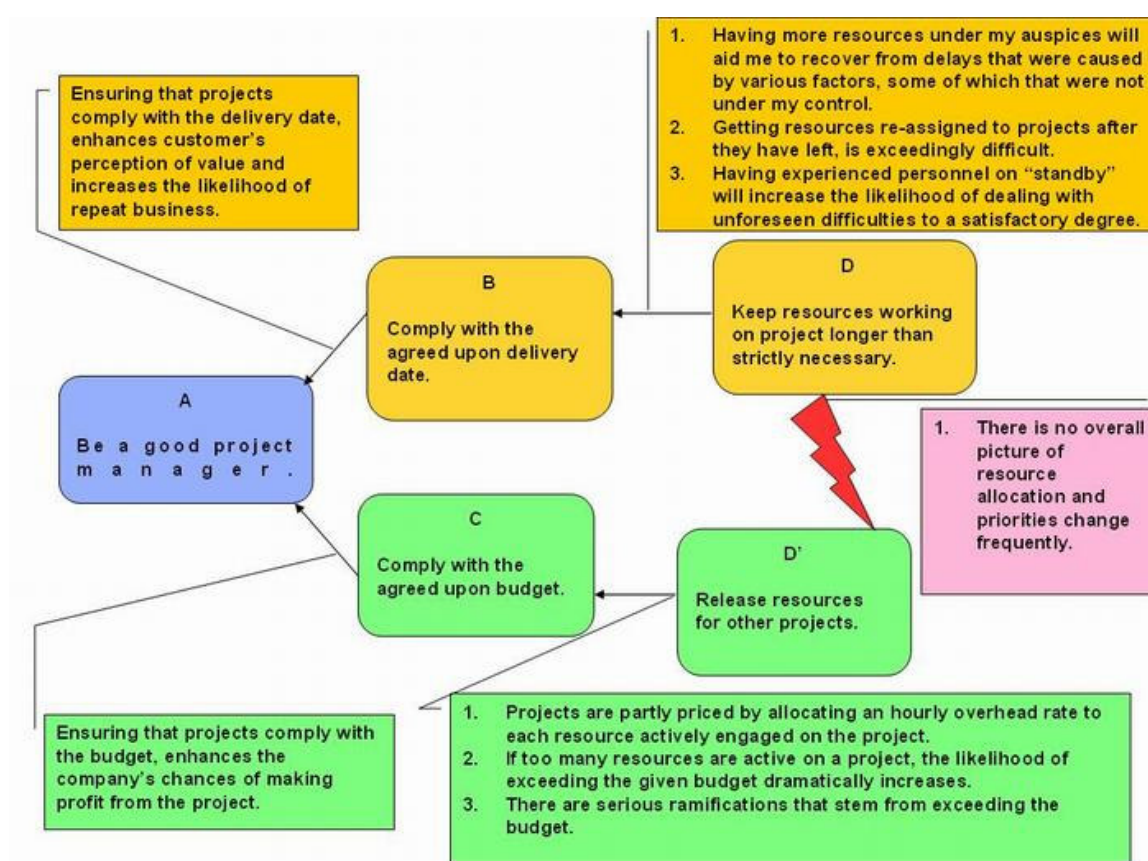


Figure 12: Conflict faced by the project manager during the project

The logic captured within the evaporating cloud illustrated above, is discussed below:

The goal which the project manager strived to accomplish is simply to "Be a good project manager." This is stated as Objective A.

One of the requirements or needs associated with achieving Objective A, is to "comply with the agreed upon delivery date", referred to as Requirement B. Requirement B is a necessary condition for achieving Objective A, because "ensuring that projects comply

with the delivery date, enhances a customer's perception of value and increases the likelihood of repeat business". In order to accomplish Requirement B, he must take the action advocated by Prerequisite D, namely "keep resources working on project longer than strictly necessary". Taking this action is necessary because of the following assumptions:

1. Having more resources under his auspices will aid him to recover from delays that were caused by various factors, some of which that were not under his control. (The project manager stated that this is especially relevant to guard against the effects of normal project variance.)
2. Getting resources re-assigned to projects after they have left is exceedingly difficult. (The project manager stated that once a resource had left a project, there would be a difficult negation process involved in getting them re-assigned to the project.)
3. Having experienced people on "standby" dramatically increases the likelihood of dealing with unforeseen difficulties to a satisfactory degree.

The following should be noted regarding the above statements:
- The project manager accomplished keeping resources on his project longer than strictly necessary, by assigning persons to the project throughout its entire lifecycle. This was done by allocating them a single macro task which stretched throughout the project's duration.
- This would enable the project manager to recover from delays that were caused by task priorities that had changed in order to accommodate key resources being unavailable to work on the project.

The other requirement or need associated with achieving Objective A, is to "comply with the agreed upon budget", referred to as Requirement C. Requirement C is a necessary condition for achieving Objective A, because "ensuring that projects comply with the budget, enhances the company's chance of making a profit from the project."  In order to accomplish Requirement C, he must take the action advocated by Prerequisite D',

namely "release resources for other projects." Embarking upon this action is necessary because of the following assumptions:

1. Projects are partly priced by allocating an hourly overhead rate to each resource actively engaged on the project. (The project manager stated that cost accounting procedures were used to calculate project costs.)
2. If too many resources are active on a project, the likelihood of exceeding the given budget dramatically increases.
3. There are serious ramifications that stem from exceeding the budget. (The project manager stated that if budgets were exceeded that they (the project managers) were berated and were in danger of losing their bonuses, as these are determined by budget adherence.)

The conflict between Prerequisite D and Prerequisite D' was considered valid owing to:
1. There not being an overall picture of resource allocation and priorities changed frequently.

The project under discussion had additional safety built into the budget, as the client company purchasing the project had requested a timeline which was considered unreasonable from the start and as such; two budgets and estimations were given to the client company.  The electronic equipment design firm was aiming to complete the project within the shorter time estimation, but was paid according to the more realistic budget associated with the longer project estimation. This created some leeway for the project manager to accommodate resources on his project longer than they were strictly necessary, as the budget did not play such a crucial role in his decision making criteria during the project planning process.

The following facts were also ascertained during the interview session:

- It frequently occurred that some critical tasks on the project took a long time to complete and were thus late.

- Task priorities on the project changed frequently, as there were difficulties with one of the key component suppliers and as such the matter had to be referred to the electronic equipment design firm's parent company's legal department, which took a long time to resolve the issue.
- Even though additional safety was built into the project budget, there were going to be overruns for certain facets.

### *Conclusions drawn:*

The following relevant details were ascertained during the interview:

- The project manager did in fact keep resources working on the project longer than strictly necessary.  *(UDE number 7 confirmed)*
- There was a difficult negotiation process involved in getting key resources re-assigned to the project after they had officially left.  *(UDE number 3 confirmed)*
- Project priorities were relatively stable during the period, as all projects were considered to be equally important.
- Task priorities were unfortunately forced to change frequently, owing to difficulties experienced with one of the key component suppliers. *(UDE number 5 confirmed)*

## 5.5 Resource Manager

The interview conducted with the resource manager responsible for the delivery of all required resources on projects conducted within the organisation, including the project under consideration, is described below:
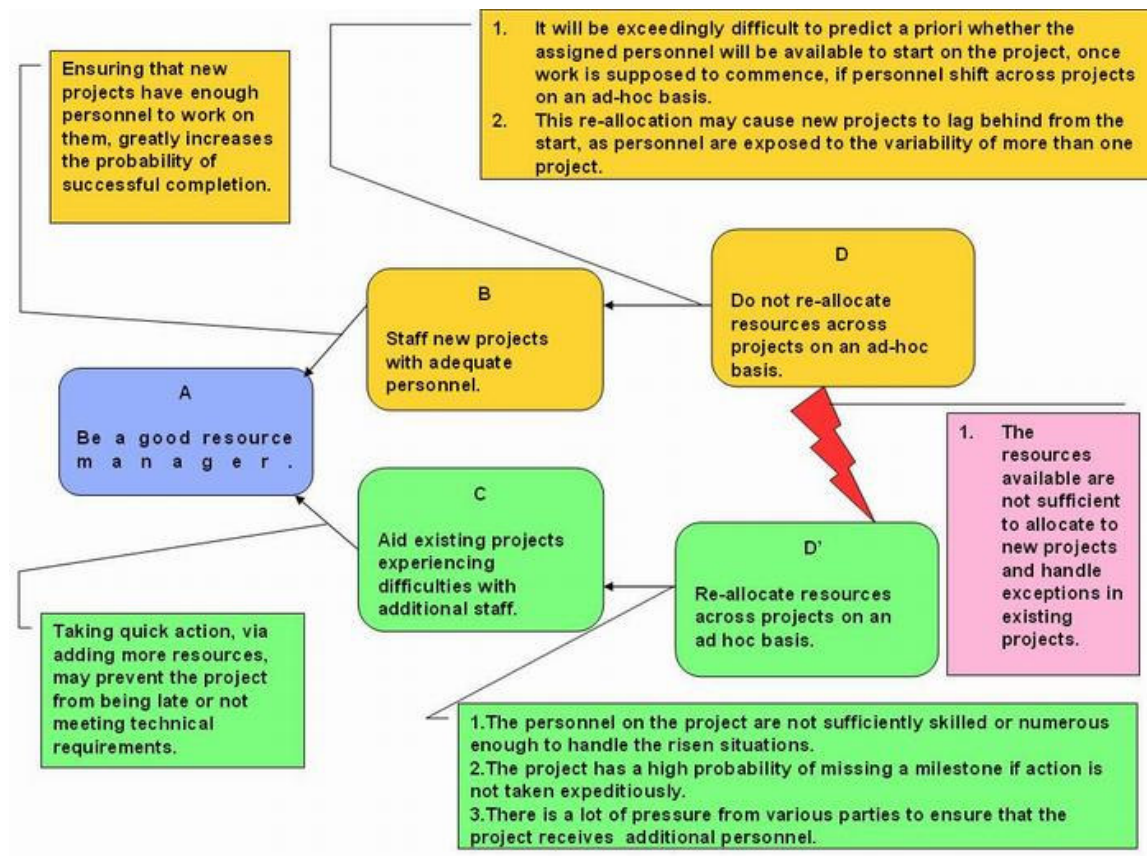


Figure 13: Conflict faced by the resource manager during the project

The logic captured within the evaporating cloud illustrated above, is discussed below:

The goal which the resource manager strived to accomplish is simply to "be a good resource manager." This is stated as Objective A.

One of the requirements or needs associated with achieving Objective A, is to "staff new projects with adequate personnel", referred to as Requirement B.

Requirement B is a necessary condition for achieving Objective A, because "ensuring that new projects have enough personnel to work on them, greatly increases the probability of successful completion". In order to accomplish Requirement B, he must take the non-action advocated by Prerequisite D, namely "do not re-allocate resources across projects on an ad-hoc basis". Taking this non-action is necessary because of the following assumptions:

1. It will be exceedingly difficult to predict a priori whether the assigned personnel will be available to start on the project, once work is supposed to commence, if personnel shift across projects on an ad-hoc basis.
2. This re-allocation may cause new projects to lag behind from the start, as personnel are exposed to the variability of more than one project.

The other requirement or need associated with achieving Objective A, is to "aid existing projects experiencing difficulties with additional staff", referred to as Requirement C. Requirement C is a necessary condition for achieving Objective A, because "taking quick action, via adding more resources, may prevent the project from being late or not meeting the technical requirements."  In order to accomplish Requirement C, he must take the action advocated by Prerequisite D', namely "re-allocate resources across projects on an ad-hoc basis." Embarking upon this action is necessary because of the following assumptions:

1. The personnel on the project are not sufficiently skilled or numerous enough to handle the risen situations.
2. The project has a high probability of missing a milestone if action is not taken expeditiously.
3. There is a lot of pressure from various parties to ensure that the project receives additional personnel.

The following should be noted regarding the above statements:

- The resource manager stated that it would rarely be necessary to re-allocate resources across projects, as the project teams were kept relatively stable. He stated that in less than 10% of all projects it was necessary to re-allocate resources to aid existing projects experiencing difficulties.

- The project under consideration was aided with additional personnel in the early stages, seeing that the project was not adequately staffed from the beginning, as the amount of work to be conducted was dramatically underestimated.

The conflict between Prerequisite D and Prerequisite D' was considered valid owing to:

1. The resources available were not sufficient to allocate to new projects and to handle exceptions in existing projects.

The resource manager added the following notion:

- It is a difficult proposition to determine the exact ending dates for existing projects (thus when resources will become available) and therefore it is hard to staff new projects (which have to start on a certain date imposed by the client) with the required people; especially if they have to aid projects experiencing difficulties.

**Conclusions drawn:**

The following relevant details were ascertained during the interview:

- Although the project under consideration was aided with additional personnel during the early phases of the project, resource re-allocation within the organisation was in fact a rare occurrence and at best took place on an ad-hoc basis.  **(UDE number 2 NOT confirmed)**

- The resource manager felt that difficulties arose owing to project managers drawing up project plans in an ideal environment. (Implicating that the project plans were drawn up in isolation.)

- Resources are at times unable to commence on a task assigned to them on a project, owing to still being busy on an allocated task on another project. *(UDE number 6 confirmed)*

- It did not occur frequently that negotiation was necessary for the services of certain key resources on the project. (Once the project under consideration got going, things went relatively well…)

- The previous statement is in direct contradiction from what was determined through the software project manager (refer above).

## 5.6 Program Manager

The interview conducted with the program manager, under whose auspices the project under consideration falls is described below:
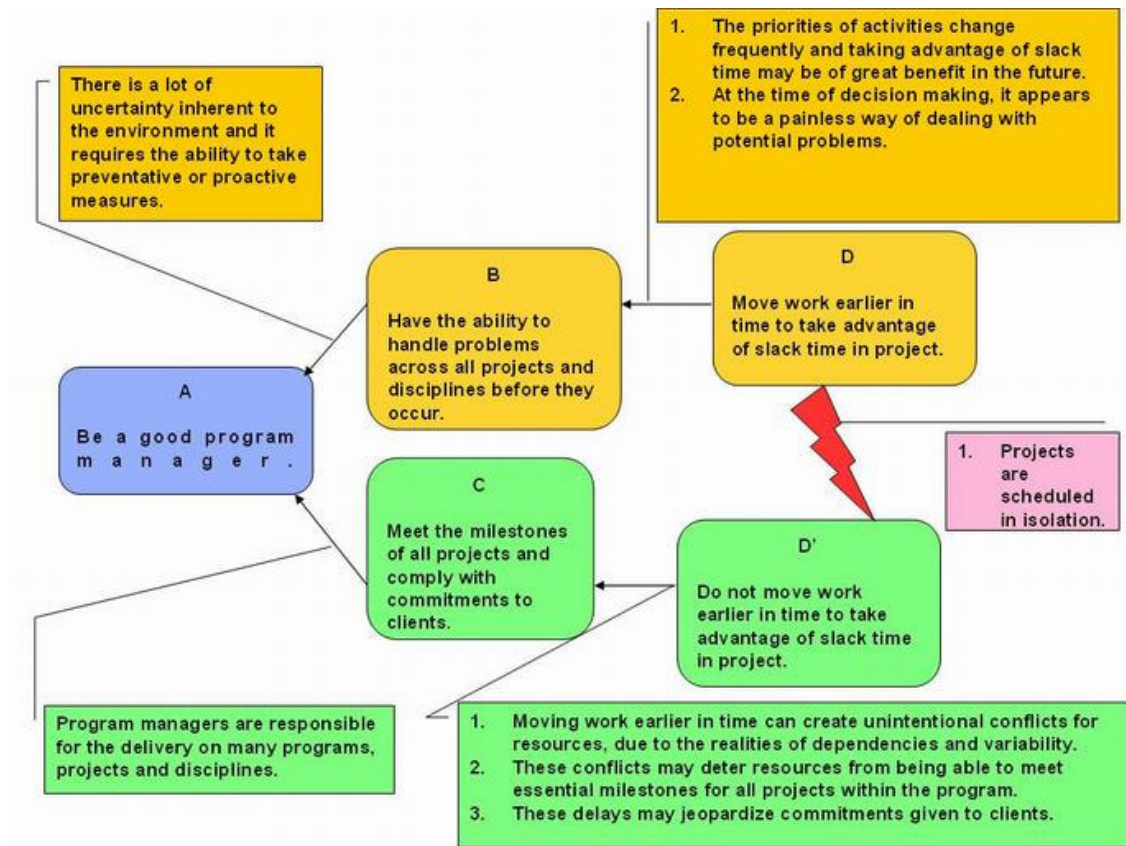


Figure 14: Conflict faced by the program manager during the project

The logic captured within the evaporating cloud illustrated above, is discussed below:

The goal which the program manager strived to accomplish is simply to "be a good program manager." This is stated as Objective A.

One of the requirements or needs associated with achieving Objective A, is to "have the ability to handle problems across all projects and disciplines before they occur", referred to as Requirement B.

Requirement B is a necessary condition for achieving Objective A, because "there is a lot of uncertainty inherent to the environment and it requires the ability to take preventative or proactive measures". In order to accomplish Requirement B, he must take the action advocated by Prerequisite D, namely "move work earlier in time to take advantage of slack time in project". Taking this action is necessary because of the following assumptions:

1. The priorities of activities change frequently and taking advantage of slack time may be of great benefit in the future.
2. At the time of decision making, it appears to be a painless way of dealing with potential problems.

The resource manager stated the following regarding the above notions:

1. He would in fact consider moving work earlier or later in time as only one of his options when the need arises.
2. On the project under consideration, when work was moved earlier in time, it did not cause any unintentional conflicts.

The other requirement or need associated with achieving Objective A is to "meet the milestones of all projects and comply with commitments to clients", referred to as Requirement C. Requirement C is a necessary condition for achieving Objective A, because "program managers are responsible for the delivery on many programs, projects and disciplines."  In order to accomplish Requirement C, he must take the non-action advocated by Prerequisite D', namely "do not move work earlier in time to take advantage of slack time in project." Embarking upon this non-action is necessary because of the following assumptions:
1. Moving work earlier in time can create unintentional conflicts for resources, due to the realities of dependencies and variability.
2. These conflicts may deter resources from being able to meet essential milestones for all projects within the program.

3.  These delays may jeopardize commitments given to clients.

The conflict between Prerequisite D and Prerequisite D' was considered valid owing to:

1.  Projects being scheduled in isolation.

***Conclusions drawn:***

The following relevant details were ascertained during the interview:

- On the project under consideration, work was moved earlier in time, owing to needed components not arriving from a key supplier.
- Work was also delayed, as resources were not available to commence work when needed.
- Individual projects are scheduled in isolation, but the two focal disciplines, hardware design and software engineering, were not scheduled in isolation.
  - The project under consideration was scheduled in isolation, owing to certain key people already having been identified at the planning stage.
  - These resources were in fact scheduled, but nobody was sure regarding as to when they would in fact become available.
- One project does have negative effects on other projects.
  - This is especially relevant when project A is required to finish before project B can start. ***(UDE number 6 confirmed)***

## 5.7 Managing Director

The interview conducted with the managing director of the organisation is described below:
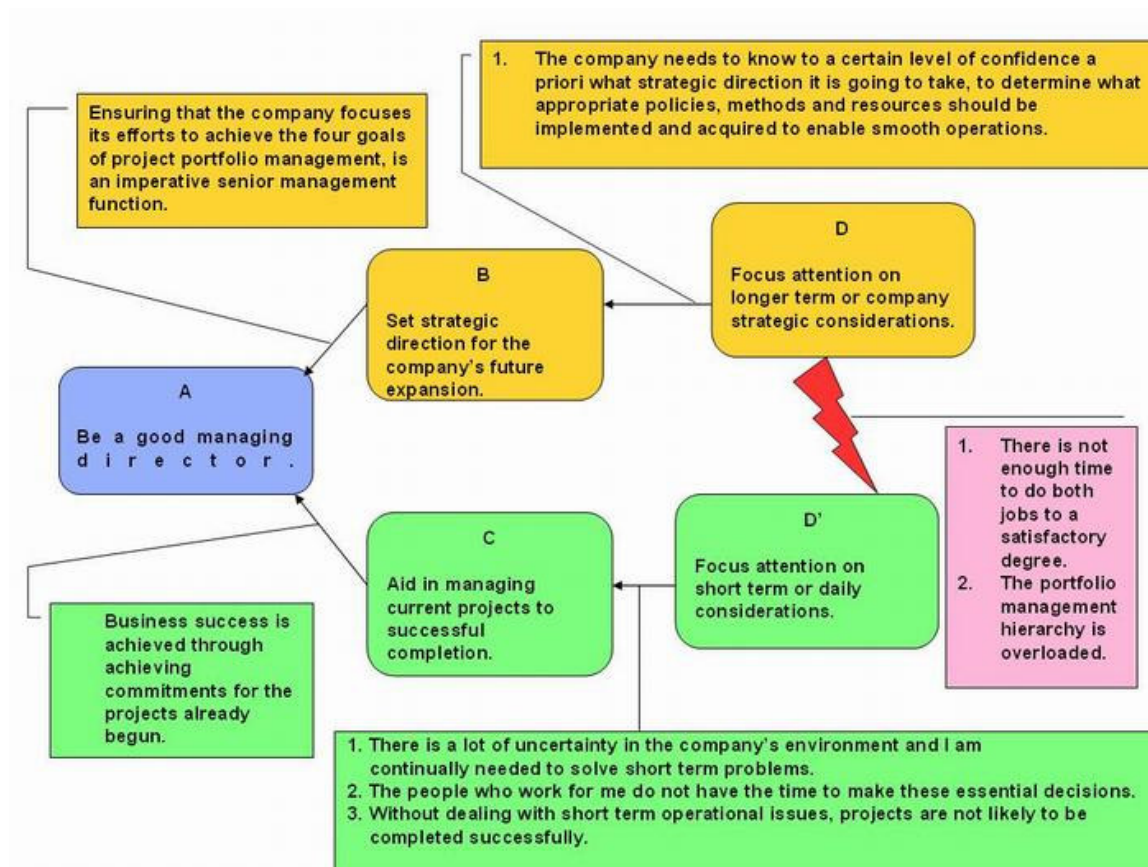


Figure 15: Conflict faced by the managing director during the project

The goal which the managing director strived to accomplish is simply to "be a good managing director." This is stated as Objective A.

One of the requirements or needs associated with achieving Objective A, is to "set the strategic direction for the company's future expansion", referred to as Requirement B.

Requirement B is a necessary condition for achieving Objective A, because "ensuring that the company focuses its efforts to achieve the four goals of project portfolio

management, is an imperative senior management function". In order to accomplish
Requirement B, he must take the action advocated by Prerequisite D, namely "focus
attention on longer term or company strategic considerations". Taking this action is
necessary because of the following assumption:

1. The company needs to know to a certain level of confidence a priori what
   strategic direction it is going to take, to determine what appropriate policies,
   methods and resources should be implemented and acquired to enable smooth
   operations.

The other requirement or need associated with achieving Objective A is to "aid in
managing current projects to successful completion", referred to as Requirement C.
Requirement C is a necessary condition for achieving Objective A, because "business
success is achieved through achieving commitments for the projects already begun."  In
order to accomplish Requirement C, he must take the action advocated by Prerequisite
D', namely "focus attention on short term or daily considerations." Embarking upon this
action is necessary because of the following assumptions:

1. There is a lot of uncertainty in the company's environment and I am continually
   needed to solve short term problems.
2. The people who work for me do not have the time to make these essential
   decisions.
3. Without dealing with short term operational issues, projects are not likely to be
   completed successfully.

The following should be stated regarding the above notions:
- The managing director is of the opinion that since their structural changes had
  taken place, the action of Prerequisite D' has become less relevant to him.
- During the project under consideration, he has had to become involved with
  operational issues on only two occasions. One of which was dealing with the

problem regarding the supplier who had not delivered their needed hardware components.

The conflict between Prerequisite D and Prerequisite D' was considered valid owing to:

1. There not being enough time to do both jobs to a satisfactory degree.
2. The project portfolio management hierarchy is overloaded.

**Conclusions drawn:**

The following relevant details were ascertained during the interview:

- Since the organisation's structural changes which occurred 12 months prior to the interview, improvements were made regarding the workload placed on senior managers.
    - In the new structure, the business and process functions were separated from one another and different people had to resolve different issues.
- Despite the above, the managing director was of the opinion that the project portfolio management hierarchy might in fact still be overloaded. *(UDE number 1 is probable although not fully confirmed)*
- There is still room for improvement regarding the amount of times that the managing director had to intervene on operational issues. (He was not satisfied with the current existing balance.)
- The managing director stated that their project portfolio gate decisions were not delayed and that their project portfolio meetings took place every Monday morning, in order to determine project progress.
- The managing director stated that these meetings were not clouded with short term considerations. *(UDE number 4 NOT confirmed)*

## 5.8 Sales Manager

The interview conducted with the sales manager of the organisation, who was responsible for bidding for the project under consideration, is described below:
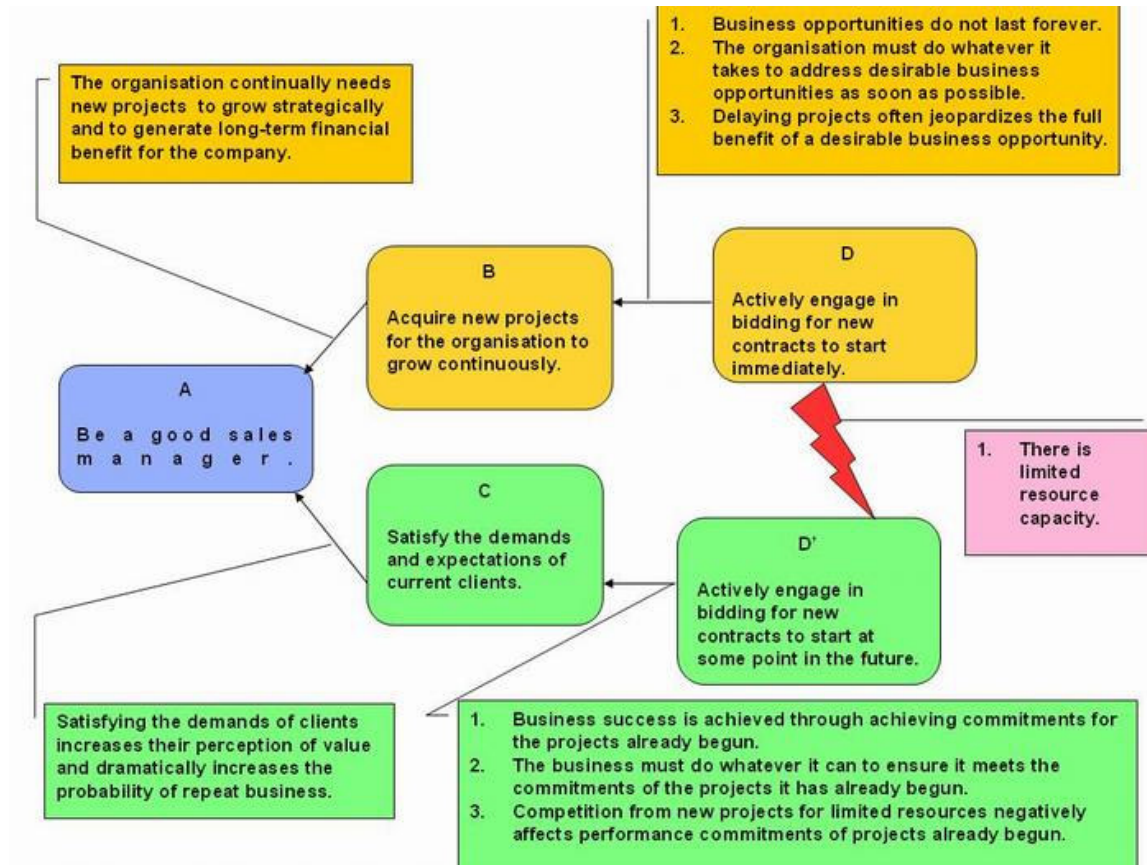


Figure 16: Conflict faced by the sales manager during the project

The goal which the sales manager strived to accomplish is simply to "be a good sales manager." This is stated as Objective A.

One of the requirements or needs associated with achieving Objective A, is to "acquire new projects for the organisation to grow continuously", referred to as Requirement B.

Requirement B is a necessary condition for achieving Objective A, because "the organisation continually needs new projects to grow strategically and to generate long-term financial benefit for the company". In order to accomplish Requirement B, he must take the action advocated by Prerequisite D, namely "actively engage in bidding for new

contracts to start immediately". Taking this action is necessary because of the following assumptions:

1. Business opportunities do not last forever.
2. The organisation must do whatever it takes to address desirable business opportunities as soon as possible.
3. Delaying projects often jeopardizes the full benefit of a desirable business opportunity.

The other requirement or need associated with achieving Objective A is to "satisfy the demands and expectations of current clients", referred to as Requirement C. Requirement C is a necessary condition for achieving Objective A, because "satisfying the demands of clients increases their perception of value and dramatically increases the probability of repeat business."  In order to accomplish Requirement C, he must take the action advocated by Prerequisite D', namely "actively engage in bidding for new contracts to start at some future point in time." Embarking upon this action is necessary because of the following assumptions:

1. Business success is achieved through achieving commitments for projects already begun.
2. The business must do whatever it can to ensure it meets the commitments of the projects it has already begun.
3. Competition from new projects for limited resources negatively affects the performance commitments of projects already begun.

The conflict between Prerequisite D and Prerequisite D' was considered valid owing to:
1. There being limited resource capacity.

**Conclusions drawn:**

The following relevant details were ascertained during the interview:

- The sales manager always actively bids for new contracts, but when the need arises (depending on resource availability) he delays the starting time of the project.

- The amount of contracts that the organisation is able to bid for is currently limited by the available capacity of their system's engineers. It is the function of these system's engineers (who are senior technical specialists) to ascertain the needed resources, skills and components to complete the project. The project pricing is then calculated according to the input from the system's engineers.

- If it is difficult to determine when existing projects will end and there is a continual bidding process underway, then it is foreseeable that some projects (whose start had been postponed in any event during the bidding process), may be started later than planned, owing to resources being unavailable.

## 5.9 Software Architect

The interview conducted with the chief software architect on the project under consideration, is described below:
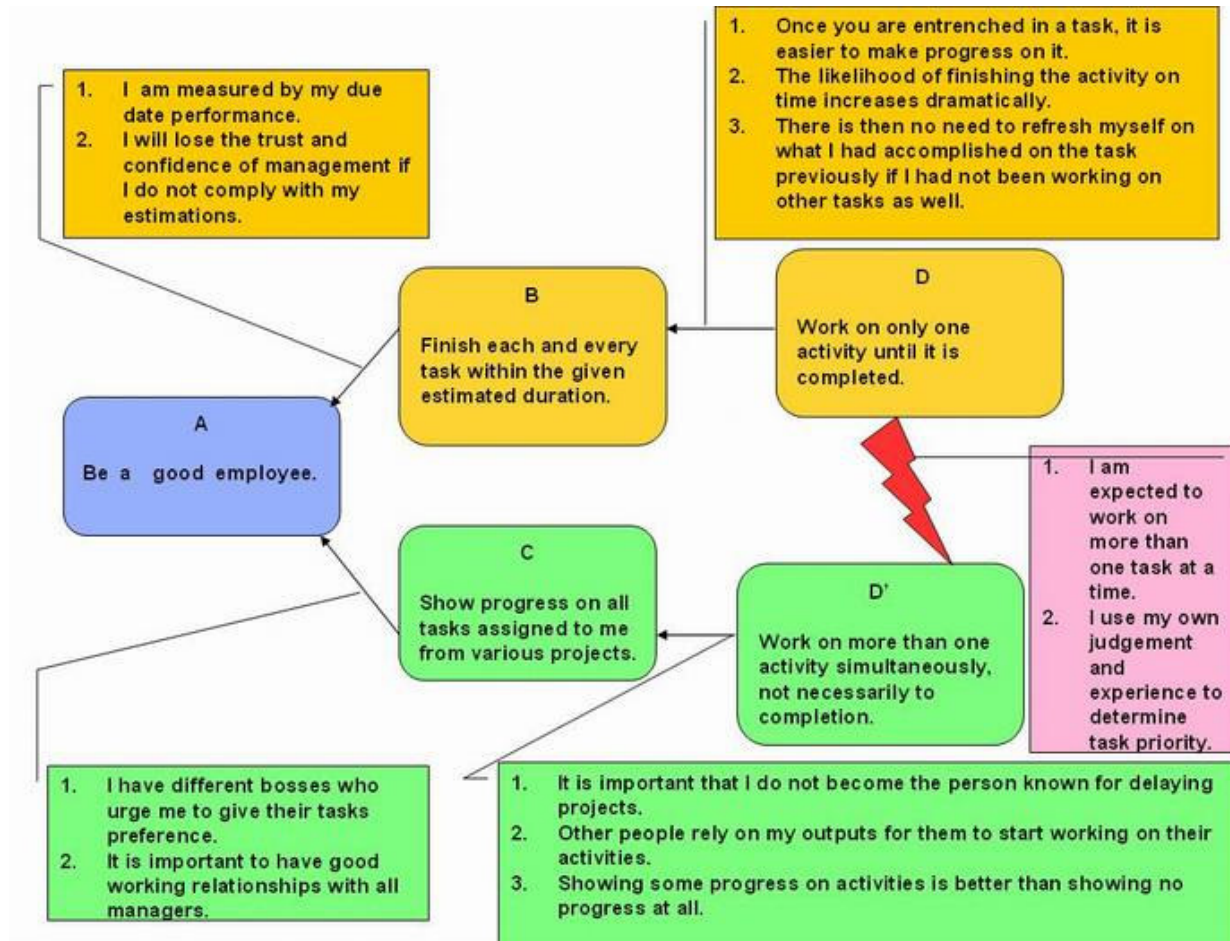


Figure 17: Conflict faced by the software architect during the project

The goal which the software architect strived to accomplish is simply to "be a good employee." This is stated as Objective A.

One of the requirements or needs associated with achieving Objective A, is to "finish each and every task within the given estimated duration", referred to as Requirement B.

Requirement B is a necessary condition for achieving Objective A, because "I am measured by my due date performance and I will lose the trust and confidence of

management if I do not comply with my estimations". In order to accomplish Requirement B, he must take the action advocated by Prerequisite D, namely "work on only one activity until it is completed". Taking this action is necessary because of the following assumptions:

1. Once you are entrenched in a task, it is easier to make progress on it.
2. The likelihood of finishing the activity on time increases dramatically.
3. There is then no need to refresh myself on what I had accomplished on the task previously if I had not been working on other tasks as well.

The other requirement or need associated with achieving Objective A is to "show progress on all tasks assigned to me from various projects", referred to as Requirement C. Requirement C is a necessary condition for achieving Objective A, because "I have different bosses who urge me to give their tasks preference and it is important to have good working relationships with all managers."  In order to accomplish Requirement C, he must take the action advocated by Prerequisite D', namely "work on more than one activity simultaneously, not necessarily to completion." Embarking upon this action is necessary because of the following assumptions:

1. It is important that I do not become the person known for delaying projects.
2. Other people rely on my outputs for them to start working on their activities.
3. Showing some progress on activities is better than showing no progress at all.

The conflict between Prerequisite D and Prerequisite D' was considered valid owing to:
1. He is expected to work on more than one task at a time.
2. He uses his own judgement and experience to determine task priority.

**_Conclusions drawn:_**

The following relevant details were ascertained during the interview:

- During the early phases of the project under consideration (the concept phase) the software architect had to multitask in order to complete all the necessary activities and in this period there was an amount of setup or reorientation time needed when switching between activities.
- This implies that he had long queues of work waiting for him during that phase of the project under consideration.
- The software architect stated that project plans were never reliable.

## 5.10 Summary

This chapter dealt with the data collected during the interview process, expressed in the format of evaporating cloud diagrams. These diagrams were used as tools to ascertain whether the seven operational problems of project portfolio management in fact occurred within the organisation. Five of the seven operational problems could be verified independently during the interview process and serves as a strong indicator that the release-problem does in fact exist within the organisation.

# Chapter 6 – Conclusions and Recommendations

## 6.1 Introduction

In this chapter, the electronic equipment design firm's core problem will be found by amalgamating all six previously mentioned clouds into a single entity. It will be shown that there exists a strong probability that the release-problem is in fact the core problem or root cause from which all of the conflicts ascertained during the research interviews stem.  In addition, the research questions will be answered and further avenues of research will be highlighted.

## 6.2 The core conflict

If all six previous conflict clouds are combined into a single evaporating cloud diagram, it will be possible to ascertain whether the release-problem is in fact the core problem responsible for all of the conflicts found during the research interviews.

**Objective A:**

All six stated goals were:

- Be a good project manager.
- Be a good program manager.
- Be a good resource manager.
- Be a good sales manager.
- Be a good managing director.
- Be a good employee.

The goals strived toward by the individuals present within the organisation, indicates a strong intrinsic drive to do as well as they possibly can within the confines of their organisational role. It can therefore be argued that the common thread running through all these goals can be expressed as:

- Add value to the organisation.

**Requirement B:**

All six stated requirements were:

- Comply with the agreed upon delivery date.
- Have the ability to handle problems across all projects and disciplines before they occur.
- Finish each and every task within the given estimated duration.
- Set strategic direction for the company's future expansion.
- Staff new projects with adequate personnel.
- Acquire new projects for the organisation to grow continuously.

The above needs or requirements relates to the specific individual's need to comply with the intrinsic organisational demands placed upon him by his position. These demands or needs must be met in order to ensure that the organisation performs internally to the best of its ability. It can therefore be argued that the common thread running through all these requirements can be expressed as:

- Be productive.

**Prerequisite or Action D:**

The six stated actions or prerequisites were:

- Keep resources working on project longer than strictly necessary
- Move work earlier in time to take advantage of slack time in project.
- Do not re-allocate resources across projects on an ad-hoc basis.
- Actively engage in bidding for new contracts to start immediately.
- Focus attention on longer term or company strategic considerations.

- Work on only one activity until it is completed.

The above actions are taken in order to ensure meeting the individual's need or requirement to satisfy the organisation's internal expectations. It can therefore be argued that the common thread running through all these actions or prerequisites can be expressed as:

- Focus on internal demands.

**Requirement C:**

All six stated requirements were:

- Comply with the agreed upon budget.
- Meet the milestones of all projects and comply with commitments to clients.
- Satisfy the demands and expectations of current clients.
- Show progress on all tasks assigned to me from various projects.
- Aid in managing current projects to successful completion.
- Aid existing projects experiencing difficulties with additional staff.

The above needs or requirements relates to the specific individual's need to comply with the extrinsic organisational and market demands placed upon him by his position. These demands or needs must be met in order to ensure that the person and the organisation perform to external pressures and expectations to the best of its ability. It can therefore be argued that the common thread running through all these requirements can be expressed as:

- Deliver successfully.

**Prerequisite or Action D':**

The six stated actions or prerequisites were:

- Release resources for other projects.

- Do not move work earlier in time to take advantage of slack time in project.

- Re-allocate resources across projects on an ad-hoc basis.

- Work on more than one activity simultaneously, not necessarily to completion.

- Actively engage in bidding for new contracts to start at some point in the future.

- Focus attention on short term or daily considerations.


The above actions are taken in order to ensure meeting the individual's need or requirement to satisfy external expectations. These external expectations are related to other projects and limitations within the organisation and pressures placed upon them by the market.  It can therefore be argued that the common thread running through all these actions or prerequisites can be expressed as:


- Focus on external demands.


If these amalgamated requirements, prerequisites or actions and goal are combined into an evaporating cloud diagram, the following is obtained:
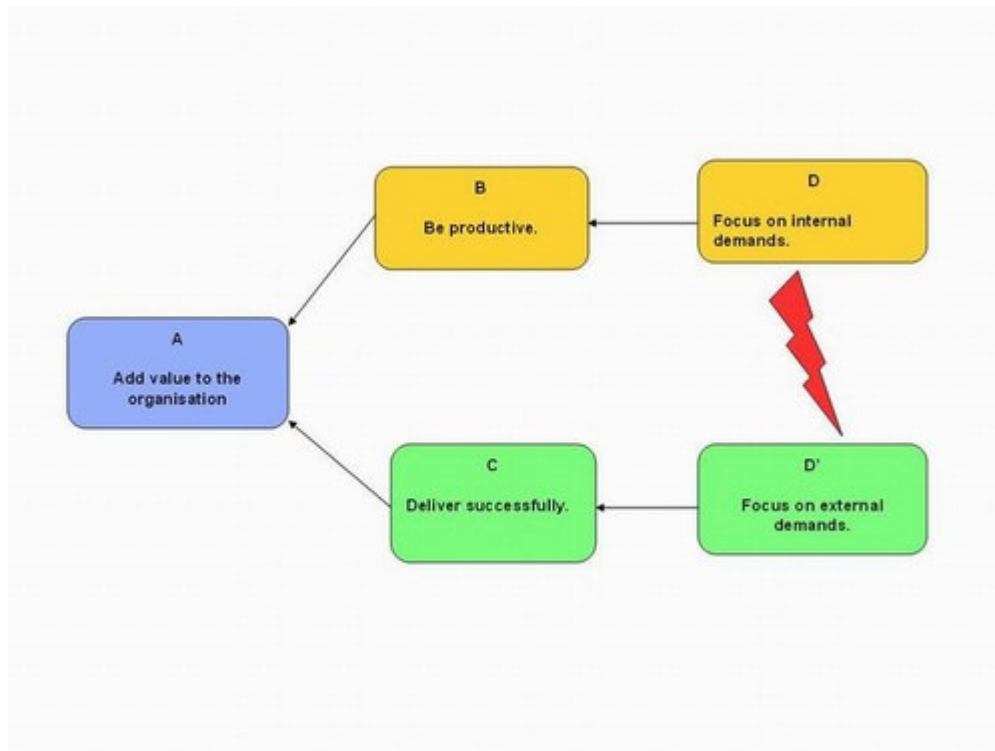
Figure 18: Core conflict faced by the project portfolio management hierarchy

The conflict between Prerequisites D and D' is only valid if there is not enough time to ensure that both internal and external demands receive the appropriate amount of effort and attention.  This implies that there is too much work to do and that people within the organisation would have to oscillate between taking the actions advocated by the two prerequisites (depending on the current circumstance) and thus thereby jeopardise one of the system requirements and eventually the goal.

The amalgamated core conflict illustrated above is a very close representation of the previously described release-problem (although Requirement B and C is inverted from the way it is stated within the release-problem evaporating cloud diagram)

- It is thereby safe to state that there exists a strong probability that the release-problem does in fact exist within the organisation.

## 6.3 Research questions

*1.      Are the negative effects (operational problems) associated with project portfolio management apparent in the company under consideration?*

Only five of the seven operational problems could be independently ascertained during the research investigation within the electronic equipment design firm.

These were:

**UDE 1:** The project portfolio management hierarchical level is overloaded (Only a probability)

**UDE 3:** An ongoing game of negotiation is played for key resources.

**UDE 5:** Priorities change often.

**UDE 6:**  One project has negative effects on other projects.

**UDE 7:** Project managers keep resources working on a project longer than necessary in order not to loose them.

The following operational problems could not be detected:

**UDE 2**:  Project portfolio management does priority setting and resource re-allocation on a daily basis.

**UDE 4**: Management is primarily engaged in short term problem solving.

*2.      How does the management of the company under consideration deal with the release-problem?*

- The company is in the fortunate position that it is able to outsource work to international and local partners if the workload on the South African employees becomes too overbearing.

- This ability is the probable cause as to the rationale behind why not all the operational problems exist within the South African component of the multi-national electronic equipment design organisation.

*3.      Are the effect-cause-effect patterns derived by Viljoen (2005:6-8) present in the multi-project environment of the company under consideration?*

- As not all of the operational problems could be independently identified, it is not feasible to claim that the effect-cause-effect patterns derived by Viljoen are wholly present within the organisation.
- There is enough evidence to suggest that part of the current reality tree developed by Viljoen is valid, but not up to the final conclusion of the current reality tree.
- The current reality tree is valid from the beginning onwards up to the point prior to reaching UDE number 2, namely:  *Portfolio management does priority setting and resource re-allocation on a daily basis across projects.*
- The current reality tree stops being valid at that point, owing to:
    - Resource re-allocation being a rare occurrence within the organisation. (Project teams are kept relatively stable throughout the lifecycle of a project.)
    - Delays caused by one project on another were considered minimal and possible to recover from within the available time.
    - There is always the possibility of outsourcing work to relieve some pressure on the South African leg of the organisation.

## *6.4 Avenues of future research*

In conclusion, the following possibilities regarding future research should be investigated:

- The electronic equipment design firm is able to outsource work to outside partners if the load on resources within the South African context becomes problematic.
  - o Would all the operational problems have existed if this option had not been viable?
  - o Is the current reality tree derived by Viljoen (2005:6-8) more feasible within an organisation that does not have outsourcing capabilities?
- In the eighteen months prior to the research investigation the South African leg of the multi-national organisation had undergone major structural changes. They had moved away from having fixed independent divisions or silo's with their own business and operational infrastructure to having a global pool of resources sharing business and operational management infrastructure.
  - o What effect did this structural change have on the research outcome?
  - o Should the organisational structure have been looked at more closely during the research investigation?
  - o Are certain organisational structures more prevalent to facilitating the presence of the release-problem and the associated operational problems?

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