SUCCESSFUL PROJECT TEAMS (IN AN R&D ENVIRONMENT)

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ABSTRACT

This report is a literature study that focuses on the characteristics of successful project teams in the research and development environment. Project teams are becoming an increasingly important factor in business. Traditional quantitative project management tools no longer give project teams a competitive edge - additional qualitative tools are required, following a systems approach. A paradigm shift away from the traditional triangle of budget, brief and time towards a stronger focus on people issues is proposed. As people do not behave in a linear way, as required for quantitative tools, new methods and tools are required for project team success.

1 INTRODUCTION AND STATEMENT OF PROBLEM

1.1 Introduction

Successful project teams are becoming an increasingly important factor in businesses. Virtually all organisations, from computer manufacturers to retailing and medical suppliers, pay attention to teamwork [39]. A team can be defined as a small group of individuals with complementary skills that are applied to achieve a common goal, for which everyone is held responsible [19]. Complementary implies that a team consists of people with different skills. The common goal lets the people share a path and destination and responsibility brings in the accountability aspect.

Success can be defined as the derivative of a predetermined set of measurement criteria. There are many options of measurement criteria for a successful project team. First, the subject to which the measurement applies, has to be defined. The success of a project team could be based on the project, the project management, or the team. These are not mutually exclusive, as there are overlaps and interdependencies.

As the focus of this study is on the team, measurement will therefore be based on project team success. Secondly, the specific measurement criteria against which a team's success is measured, have to be identified. Typically, an assessment of how well a team is functioning is based solely upon external quantitative measures such as the number of customers served, the number of defective units produced, and other cost, schedule and performance numbers [35]. While these traditional measurements (based on tangible outputs that are easy to define and measure) are still important and valid criteria in assessing a team's performance, they do not give a complete picture of a team's overall long-term performance. It could be argued that less tangible outputs, that are more difficult to define and measure, are more important criteria for measuring successful project teams. Some project managers might focus mainly on quantitative outcomes, based on the assumption that only that which can be measured matters. This could lead to short sightedness: the numbers are only a gauge, or a means to an end. For example, a good cost performance index may indicate good efficiency, but not necessarily effectiveness.

Thirdly, the middle word of successful project teams is project. The Six Sigma Group in Europe [37] defines a project team as follows: *"A team managing the work and activities of a project, the work typically involves balancing competing demands for project scope, time, cost, risk and quality, satisfying stakeholders with differing needs and expectations and meeting identified requirements."*

This definition mentions the stakeholders with their sometimes opposing requirements and expectations, and the challenge posed to project teams to juggle the various and often conflicting demands of the stakeholders [30]. For example, focusing on meeting the expectations of the client or end-user that amounts to more than budgeted for, could lead to overspending. This makes the measurement of successful project teams also more complex: to some stakeholders the budget could be most important, while to others the time schedule, and to others the quality.

The following definition for a project team proposed by the Memorial University of Newfoundland [28] focuses on the knowledge management side of project teams: *"A diverse group of knowledge workers who may join, leave or remain as part of the core team. The project is usually functional or cross functional in nature with a set of goals or objectives."*

Kliem [24] objects to the traditional definitions of projects for not integrating the human aspect adequately. He defines a project as:

- a human endeavour, because in its purest sense it is the result of people using their energies to produce something;
- integrated, in that all decisions and activities are interdependent; and
- achieving a specific purpose. All energies and efforts of a project are oriented towards achieving something that is shared among all stakeholders.

1.2 Team View Approach

A project team operates in the context of its environment, mostly an organisation with a structure and organisational culture. The impact of this environment plays a significant role in the success of a project team [38].The numerous project management articles that focus on the environment conducive to a successful project team substantiate this. Some of the topics external to a project team that have been researched extensively are, for example, the matrix structure [10], organisational systems [17] and corporate culture [21]. Research on project teams can either look at projects from the outside or from the inside. Research that takes one external impact topic and investigates its impact on project teams is a view from outside the project team, looking to the inside.

Another angle that could be used is to approach research from a project team's point of view from the inside looking to the outside. This puts a different angle on the external factors; the project team would look at ways to minimise negative impacts and leverage positive impacts to maximum benefit. This is the approach used in this report.

Other topics that are also important to a project team are team leadership, the composition of a project team, the communication channels within a project team, the evaluation criteria and measurement thereof.

This report focuses on the project team itself and investigates project teams from a project team perspective – in other words, it is outward looking. A number of characteristics of a project team are investigated with the focus on the qualitative or so-called softer issues, i.e. the people issues. Traditionally, the more tangible project management methods such as defining the work, timing and resources and following established procedures for project tracking and control are supposed to ensure project success. While these factors are still crucial, they have become threshold competencies: they are no longer regarded as giving a team the competitive edge and are unlikely to guarantee project team success [38].

1.3 Scope of the Research

The primary focus is on research and product development projects in the South African context. A model developed by Jordan, Hage, Mote and Hepler [18] defines the scope of research and development projects in three dimensions: the amount of funding, the complexity of project teams, and research orientation. The latter dimension, research orientation, is the nature of the research, i.e. whether it is:

- scientific research, with the goal of understanding; or
- technological research, with the aim of building a system or product with certain attributes.

For scientific and technological research, two organisational dimensions distinguish different management challenges, namely the size of the project and degree of complexity of the team or research task.

The size refers to number of staff and capital. The size of the project is related to whether the scope of the focus is broad or narrow. The second dimension, complexity refers to the number of research disciplines or specialities involved in a project. The greater the emphasis on radical advances, the more a complex team is required for success. Complex research teams often have members from multiple units within the organisation and possible with external organisations. The more complex the team, the more the potential for tension integrating diverse perspectives and specialities.
Combining these two dimensions results in four archetypes of research projects as depicted in Figure 1 below (these are called Research Profiles).

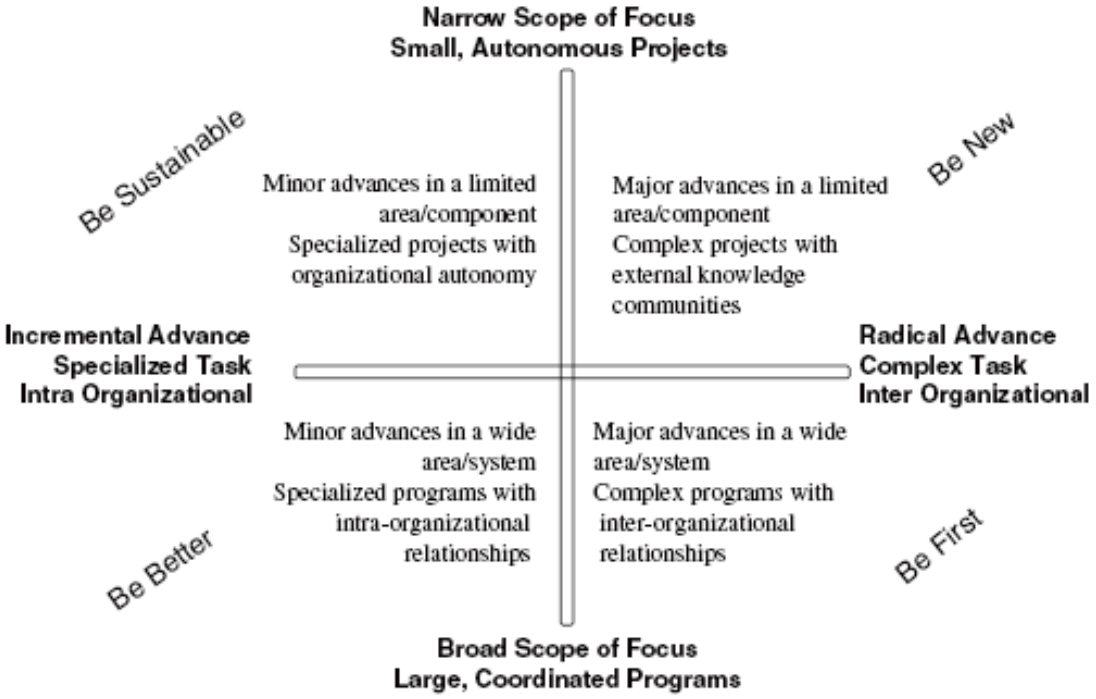


Figure 1: Research Profiles Framework Conceptual Overview [18]

Each of these categories of research projects is given a unique criterion for success. The type of project is determined by the output of the project and the measurement criteria of a successful project should be in line with the scope of the project. The research profiles framework is a valuable tool for helping managers better understand and improve the process of research by characterizing research profiles and recognizing and addressing issues and challenges faced by each research profile. This model also shows that research and development projects cover a wide scope – one size does not fit all [18] and there is no simple definition of a research and development project.

1.4 Model of Team Effectiveness

The competitive edge of a team lies in the ability of the team members to combine their efforts. The capability of a successful team is more than the sum total of the individuals that make up the team. There are many aspects to consider for successful project teams. The team effectiveness model [6] defines the major aspects of team effectiveness, in Figure 2. This model is useful to establish the key competencies and behaviours to achieve team goals as well as the type of culture and values that the team wants to maintain. This model will be used as the outline for the different aspects of successful project teams. Each of the elements of this model is discussed in more detail in the following chapters.

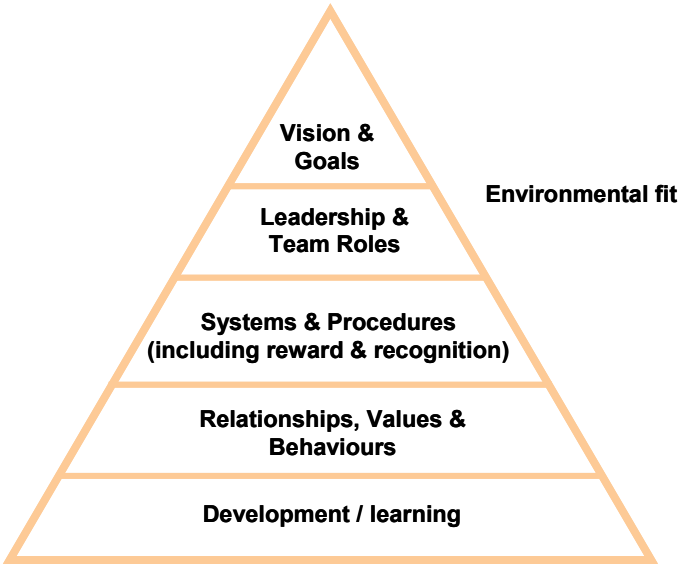


Figure 2: Model of Team Effectiveness [6]

2 ENVIRONMENTAL FIT

2.1 Introduction

The aim of the environmental fit investigation is to determine the boundaries that exist for development teams. Teams can influence some external impacts, others they cannot. Project teams need to know the external environmental issues that could impact on them and then adapt to operate within the boundaries created by the external environment.

This chapter firstly looks at Michael Porter's five forces analysis, followed by a summary of the South African environment, the impact of technology and lastly the company fit. This is not an exhaustive list of all the environmental impacts on a project team. The aim is to create an awareness of the impact of the environment on a project, apart from industry legislation, standards and regulations.

2.2 Five Forces Analysis

Project teams work in the context of an organisation, which in turn operates within a broader context of an industry, nationally and internationally. An industry is regulated by national and international rules and regulations.

Grundy and Brown [12] adapted Michael Porter's five forces competitive model to project management, as depicted in Figure 3. This illustrates the typical forces that impact on a project team.

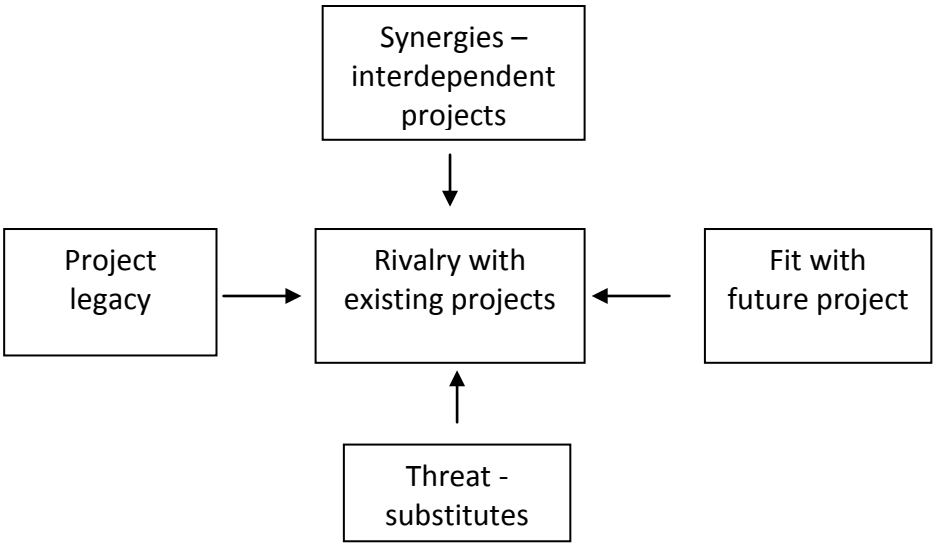


Figure 3: Project Forces Analysis [12]

Project teams, specifically research and development teams, are not only evaluated on the way they operate. The success of the widget (in other words the product) they develop should be seen as part of the evaluation criteria. This is where the forces analysis becomes an important factor. There should not only be synergy within a project group, but also with other projects, products and planned future products. A project forces analysis such as this one should be done at the start of a project and also throughout the project development as technology develops rapidly and there are continuously new threats that appear.

This model is generic. It is useful as a starting point, but a thorough understanding of the local industry, environment and legislation has to be part of such an evaluation.

2.3 South Africa

Project teams operate in a fast changing world economy that in turn impacts on a country's economy. South Africa is often referred to as a third world country and it is geographically separated from Europe with its extensive and sophisticated infrastructure and knowledge networks. It also has a much smaller local market compared to Europe and other first world markets, which in turn has an impact on economies of scale.

According to Porter [34], South Africa has one of the highest levels of prosperity (GDP per capita) and labour productivity in Africa, but its competitive position is clearly eroding. In addition, South Africa has registered only slow labour productivity growth, its export market share has been flat and it has low inflows of direct foreign investment.

Porter's recommendation is that countries can only be competitive if they have clusters, e.g. the Californian wine cluster or the Houston oil and gas cluster. The old system, in which a government drives economic development through policy decisions and incentives, must make way for a collaborative process involving government at multiple levels, companies, teaching and research institutions, and collaborating institutions.

These above-mentioned factors that affect a country's productivity will have an impact on project teams, directly or indirectly. Many local product developments have failed as a result of a first world mindset. Isolation and economies of scale are but two examples of the local environmental restrictions:

2.3.1 Economies of Scale

Generally, less funding is available for the development cycle, one major reason being smaller local market size and therefore lower volumes to recoup development costs. This in turn can have an impact on the product development not reaching full maturity, not being refined adequately, and not being able to compete in the global market.

2.3.2 Isolation

Isolation has an impact on community and legislation. The importance of specialist interest groups is an intangible that is difficult to measure, but it could potentially have a significant impact on research and development teams. Inside information, expertise and partnerships are a few examples of the advantages of specialist interest groups.

New standards, such as DVD standards, MP4 standard and Bluetooth standards generally originate from the USA, Europe and Japan. Companies in these countries are part of, or have close contact with, the technical workgroups of these standards. Sometimes they even create their own standards. South Africa generally has limited access to or impact on the development of new standards, with a resulting backlog of a few years.

This isolation will most likely have a limiting effect on research and development opportunities for South African companies. Niche markets and the application of new technologies are two examples where South Africa has however had some success – for example utilising the GPS and cellular phone technologies to develop fleet management systems. Furthermore, disinvestment in the past has also had a constraining effect on technologies being established in South Africa.

2.4 The Effect of the 'Fuzzy Front End'

Managers and researchers agree that the 'fuzzy front end' of R&D is critical for project success [42]. They define fuzziness as the uncertainty of customers, technology and competition. To succeed, companies need to develop better products (high quality, low cost and high differentiation) faster (speed and flexibility). Furthermore, most failures come from the fuzzy front end of research and development. To address this issue, Zhang and Doll [42] proposed to separate the cause and effect of the fuzzy front end. The front-end fuzziness, such as customer, technology and competitive fuzziness is not controlled by management and this can often lead to an unclear vision. This is best countered by clear team vision building and knowledge sharing. It is conducive to a project team's collecting and sharing timely and reliable information on customer requirements, technological changes and competitors' actions.

2.5 Company fit

Much has been said about company culture and structure and the importance of this for successful project management. Graham and Englund [11] list ten components of an environment conducive to successful projects, including company as well as project team components. These ten components include the various aspects of systems, structure, culture and expertise and provide a balanced overview of successful project management and project teams.

3 VISION AND GOALS

3.1 Introduction

Two aspects of vision are discussed: the integrated vision concept and communicating the vision. The focus is on the impact of a company's vision on a project team.

3.2 Integrated Vision, Mission Statement and Value System

A project team generally has to take a number of visions and goals into account: the team's vision, the company's vision and the client's (and/or other stakeholders') vision. It may not always be easy to align these, but if this is not addressed, a project team is doomed to failure as it will most probably not be able to meet all stakeholders' requirements.

A company's mission statement usually deals with a company's present business scope and purpose whereas the strategic vision statement's chief concern is where the company is going, and why [40].

Vision, mission and value statements have a personalised component as well. These statements are drawn up by a person or a team. The CEO, the executive team and managers are supposed to live out these statements. Human behaviour and idealised statements do not always agree. This also applies to project teams where the team members have to align themselves as a team and also with their major stakeholders.

Project teams (with the support of the company) must ensure that they are capable of delivering by developing appropriate competencies. In other words, a formal system must be in place to proactively align project strategy to corporate strategy.

3.3 Communicating the Vision

A vision should be something that everybody understands and commits to. Most visions remain a distant abstraction in people's minds and lack the necessary emotional buy-in and ownership [24]. Norrie and Walker [33] propose to address this issue by introducing a fourth constraint for project teams, namely on-strategy. This is illustrated in Figure 4 below.

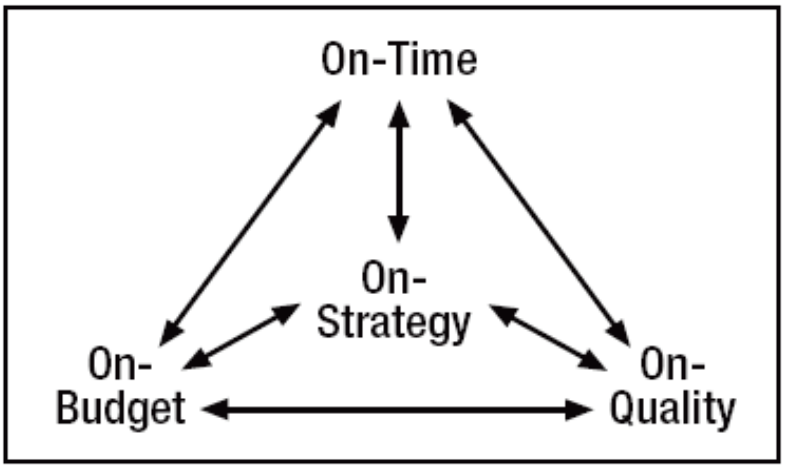


Figure 4: Four-constraint model [33]

This model seeks to align business strategy and project goals. As the model in Figure 4 illustrates, the added dimension is central to the achievement of the other three traditional constraints. The strategy focus is the joint responsibility of the project sponsor and project manager. The traditional constraints are the responsibility of the project manager and the project team. The balanced scorecard [33] is the proposed tool to implement the fourth constraint: it transforms strategy into operational plans and strategic measures that enables the organisation to decide whether or not a project is operating on-strategy.

Norrie and Walker [33] carried out a pilot study on two projects in a global telecommunications firm. These projects were vital to the company's business strategy. The one project was managed using existing company practices fairly consistent with the professional practices as specified in "A guide to the Project Management Body of Knowledge (PMBOK® guide)" [7]. The other project team received training and guidance in using the balanced scorecard and extending and integrating the methodology into the company's existing project management framework. Three key result areas were measured: on-budget, on time and on-quality. While the sample size was small there was enough statistical evidence to reject the null hypothesis and conclude that the balanced scorecard did have a positive impact on the project team that used it. One of the greatest benefits was the use of the balanced scorecard as an effective communication tool with internal and external project stakeholders.

4 LEADERSHIP AND TEAM ROLES

4.1 Introduction

The current fast changing and uncertain business climate requires project teams to engage in multiple activities. These activities could span numerous organisational functions involving a broad spectrum of personnel, support groups, subcontractors, suppliers, partners, government agencies and clients. Be it an art or a science, organising and managing contemporary project teams is a great challenge. Those who seem most challenged are the managers of complex and technology-intensive situations that are characterised by high speed, high change and high uncertainty [36] [43].

Project team leaders not only have to deal with technology challenges, but also with economic, social, political and regulatory challenges. In fact, current research shows that managerial challenges are dominated by behavioural and organisational issues, rather than technical difficulties [4] [13].

Current literature shows consensus amongst researchers about the differences between leadership and management [25]. The focus has shifted from project management to project leadership in order to more effectively address the challenges facing projects described above. Generally project managers are engineers or scientists who come from a linear cause-and-effect environment. Once mastered, the behaviour of the research or product is predictable. However, when dealing with project teams and team behaviour, there should be a paradigm shift towards leading a non-linear complex environment where the outcome is less predictable.

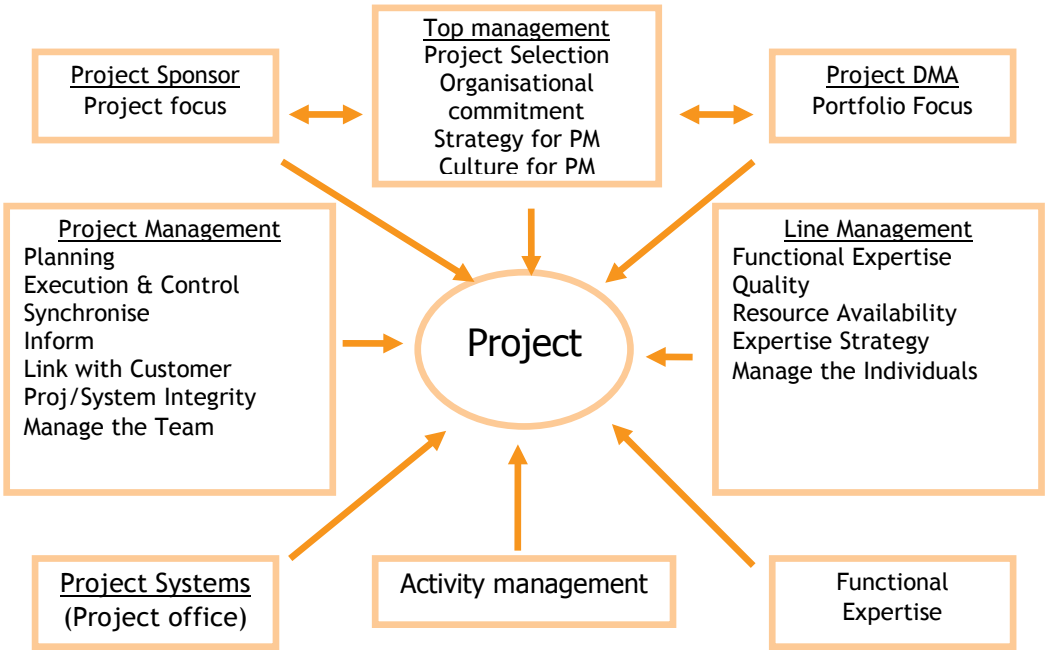
Teamwork augments project leadership. Thamhain [39] regards teamwork as a new managerial frontier. In today's more complex environment, the workgroup and its unified team performance is now regarded as crucial to project success. The roles and boundaries of teams are expanding towards self-direction and project success is largely dependent on effective interaction among the team members. Rapidly changing technologies, globalisation and digital communication have put virtually every organisation under

pressure to do things faster, cheaper and better. Team effectiveness is seen as a key success factor to gain a competitive advantage.

4.2 Leadership Models

Models are useful in that they simplify a complex issue and leadership models can be useful for project leaders.

The project leadership model [31] places the project in the context of all the stakeholders that have an impact on it. There are a number of stakeholders that interact with a project and each stakeholder has his or her own defined roles and tasks. It is important that roles are clearly defined and understood and that the stakeholders have a positive impact on the project. Too often stakeholders have their own agendas that have a negative impact on the project. The project leadership model is illustrated in Figure 5.



PM: Project Management
DMA: Decision Making Authority

Figure 5: Leadership Model [31]

This more balanced perspective places a project in the context of its surroundings and its support groups is in line with modern thinking. Project management is at a crossroad; leading projects is not just about management, it is about project leadership.

4.3 Project Leadership

The leadership styles of project managers working in technology based team environments have changed considerably, showing an increased emphasis on the human side of project management [39].

Leaders attract good people. It takes a leader to know a leader, to grow a leader and show a leader [29]. Managers that feel threatened will only appoint people of lesser capabilities to their project team.

A clear distinction is made between leadership and management. Under classical management, leadership is skewed towards three areas: standardization, specialization and functionalisation - the people side of management was largely ignored. This has changed, and nowadays a clear distinction is made between management and leadership.

4.3.1 Paradigm Shift

A paradigm can be defined as a framework or model that helps one to interpret and deal with reality. Barker [3] defines a paradigm as a set of written and unwritten rules and regulations that define boundaries of behaviour.

Kliem [24] identified ten patterns of action that distinguish project leaders from project managers: shift, visualise, integrate, understand, decide, motivate, team, trust, communicate and respond. The first word, shift, refers to the paradigm shift. Before moving on to the new paradigm, the current paradigm needs to be defined. Kliem [24] list five key characteristics of the current paradigm:

1. Perfection:
   An overemphasis on precision and detail before starting the project.
2. Analysis:
   The desire to explore everything on a project into discrete components in order to improve knowledge and understanding. This, coupled with perfection, can make it almost impossible for people to adapt to a dynamic environment. It also causes the loss of relationships among the components.
3. Logic:
   A well constructed sequentially oriented plan is put together in a cause and effect link and it is assumed that the project will follow the plan. Any deviation from the plan is seen as a problem.
4. Precision:
   A plan must be precise to be meaningful. It must be based on complete, accurate, clear and relevant content. However, this assumes that a project and its environment are static and perfectly definable.
5. Systematic:
   The view is that projects must be managed systematically, in a methodical step-by-step manner. This satisfies the human need to feel in control. However, this does not guarantee project success and can be counterproductive.

One of the consequences of the current paradigm is quantification. Project managers often focus on numbers, i.e. on criteria that can be measured. The assumption is that only what can be measured matters. In addition, these models and criteria can be used for a wide range of projects. However, this perspective is short sighted: numbers are only a gauge, a means to an end and not the ends themselves. A good performance index may indicate efficiency, but not necessarily effectiveness, and stakeholders may still be dissatisfied with the results. This emphasis on quantification could override qualitative considerations, resulting in unrealistic appraisals of projects.

4.3.2 New Paradigm

A new paradigm as proposed by Kliem [24] has the following characteristics:

4.3.2.1 Integration

The emphasis shifts from the components of projects to their relationships. This can be looked upon as a shift from function to system. This requires a look at interaction and interdependence. This requires a multidisciplinary view of project management. A project

should be seen as a dynamic interplay of process, performance, product and, most importantly, people. People play a pivotal role in improving process, performance and product.

This integration process should start by taking a macroscopic view of the project ("looking at the bigger picture"). Project managers should see projects as open systems influenced by external and internal forces that can impact on process, performance, products and people. This dynamic environment also requires systems and configurations to be flexible and adaptable.

The new paradigm leads to a systemic view of project management, because project managers put together all the different elements in the most effective way by systems thinking. This enables project managers to have a more holistic view to identify the key elements and the way they interact.

4.3.2.2 Non-linearity

A non-linear perspective recognises the importance of non-quantitative factors in addition to the quantitative factors. A project should be seen as a system consisting of a complex interplay of many elements and relationships. Predictability is very difficult; for example, there are too many local and non-local variables that affect outcomes. A typical straight line approach to project management is too simplistic; it is impossible to predict the next step due to the sheer number of variables with varying degrees of impact. This perspective assumes a larger and more complex project.

The non-linear perspective views a project as a system consisting of a complex interplay of many elements and relationships. The best way is to have a systematic approach to determine the quantitative and qualitative impacts from a dynamic perspective, identify the key elements (key success factors) and then take responsive action.

Change is viewed as neither positive nor negative; it may mean opportunity as well as risk. Variances are seen less as something to eliminate. This perspective enables greater flexibility and adaptability.

4.3.2.3 Probability

Project managers accept that they can only hope for approximation at best; it is fundamentally impossible to predict precisely what will happen. Projects and environments are too dynamic. Taking a probabilistic point of view requires a project manager to recognise that determination is impossible. Attempting precision by a deterministic point of view only increases the odds of failure.

The best is to predict the odds about what the future will be and to adjust accordingly while focusing on the goals and objectives of the project. Two key approaches are to apply ranges for estimates and to look for patterns. Patterns requires not focusing on individual factors or events, but looking at overall behaviour. This involves looking at behaviour patterns in the past and over time: project managers should take a more macroscopic view of their projects. The recognition of patterns is however no guarantee of predictability, but only of probability. In other words it cannot predict the future, but similar patterns are likely to produce similar results.

4.3.2.4 Subjectivity

The new paradigm [24] states that total objectivity on a project is impossible. Even quantification is subjective as it represents a belief or value system of what is important to measure. Subjectivity requires acceptance that an intimate relationship exists between participants and phenomena experienced on projects.

A project is less about achieving objectivity in measurement and more about leading people to achieve a common objective. By recognising projects as subject to subjectivity (rather than objectivity), project managers can become more tolerant of diversity – a diversity that goes beyond race, colour and religion, and includes differences in thinking and working styles. The emphasis is more on qualitative factors (e.g. morale) than quantitative factors and the goal becomes having people focus on the end result and involving stakeholders in a way that generates commitment and ownership.

4.3.3 Implications of the New Paradigm

The implications of the new paradigm proposed by Kliem [24] are best summarised by his definition of a project:

- A project is a *human endeavour*, because in its purest sense it is the result of people using their energies to produce something.
- A project is *integrated* in that decisions and activities are interdependent. An integrated view necessitates a more holistic perspective that recognises that decisions and actions have impacts. Managing a project becomes more of a deliberate orchestrated approach.
- A project achieves *a specific purpose*. All energies and efforts of a project are oriented towards achieving something that is shared among all stakeholders.

There is a focus shift from the existing paradigm to the new paradigm. Less value is placed on defining all the elements and more focus is placed on improving the relationship between the elements to achieve desired results. Defining the elements is a prerequisite for defining the relationships. Less emphasis is placed on determining what must be done and more emphasis on the question why. In other words, first ask the question why it must be done and why it must be done in a certain way.

More information does not necessarily equal better. The emphasis on responsiveness is achieved by determining why certain actions must happen; these actions provide the most leverage to achieve the desired results. Quantification is reflective of qualitative factors such as beliefs and values and is not the only driver of a project.

Projects are seen as dynamic entities due to interaction of a project's elements and their environment. The new paradigm stresses the acceptance of this reality.

People are put at the centre of a project and they are the main resource above time, money or equipment. Stakeholder involvement is crucial. Many causes of failure may seem to relate to the hard side of project management while the root cause of the problem is leadership. The challenge for project managers is to move everyone in the same direction and to manage the diverse relationships in such a way that the team furthers and not constrains the goal attainment.

4.4 Team Member Roles and Dynamics

A project team is not just about leadership, it is about a team and its leadership. Team dynamics are complex, subjective and difficult to manage and control. Each person is selected for a specific purpose, generally for specific expertise or ability.

There are many definitions for types of team roles. For example, Mottram [32] identified eight team roles: the chairperson, the shaper, the innovator, the company worker, the monitor evaluator, the team worker, the resource investigator and the finisher. This underlines the importance of team leaders to identify the role of each team member and allocate tasks to a team member with the best fit.

Klein, Jiang and Tesch [23] propose three dominant orientations or perspectives towards projects: technical, end user and socio-political. Technically orientated professionals recognise the importance of commitment, careful planning and the use of structured techniques. The end-user oriented developers believe end users should play an integral part in the development team. The socio-political orientation recognises complications involved with different end-user personalities as well as system failure often associated with turnover among end-users and top management. Managers are often seen as lacking knowledge of human needs and motivation. End-users are regarded as neither having the interest nor the ability to understand the details of projects. End-user involvement and commitment is however necessary to ensure that the project does not lose its focus.

Another issue is that of working project managers. The project manager is required to do some of the work and is torn between managing the project and getting his or her part of the work done. Generally work takes precedence in order not to let the project slip and the managing does not get done. When it comes to evaluation, the project manager is told that managing needs improving, where in actual fact the project manager was not allowed to manage [26].

4.4.1 Team Leader Competency

The Oxford Dictionary [14] defines competency as the “ability to do something”. The Institute of Electrical and Electronic Engineers (IEEE) defines competency by specifying:

- Statement: Statement of the competency itself, generally in terms of expected performance; and
- Performance: A set of statements, one for each level of performance including, level, conditions and criteria [16].

The word skill is often used in conjunction with competency. However, skills are visible and can be measured [41] . Competencies lie below the surface, out of the visible range, and cannot be measured directly. Wysocki and Lewis [41] list five competency characteristics of project managers, namely:

- Motives: The things a person wants and which drives a person to take one course of action rather than another;
- Traits: The characteristics a person possesses and causes a person to respond in a certain way;
- Self-concept: The image a person has of himself or herself –values and attitude are seen as a large part of a person’s self-concept;
- Knowledge: The awareness, data and information a person has about a certain topic or content area; and
- Skill: An observable and measurable performance of an individual to execute an assigned task.

For competency assessment, effective project managers require competencies and skills specific to the discipline in which the project lies as well as non discipline-specific skills. These non-discipline specific skills are grouped into five categories, namely business, personal, interpersonal, management and project management.

The next step is a way to measure the level of proficiency of each skill (and competency in an indirect way). Bloom's Taxomony of Educational Objectives [5] is a well-established system that is used in adult education and skills assessment. Six levels of skill are defined: Knowledge, comprehension, application, analysis, synthesis and evaluation.

The skills range from knowledge or learning at the low end to evaluation at the high end. The latter three levels are learnt by experience. Project team leaders require a wide variety of hard skills, such as scoping, planning and reporting. However, in addition to these skills, softer people issue skills are also required. Problem solving, conflict management, creative thinking and decision making as four of the most obvious soft skills that project team leaders require [41].

4.4.2 Team Leadership Effectiveness

Following from the concept of team leader competency, the boundaries of teams are expanding toward self-direction due to more open and organisational transparent processes. Managers of technology based project teams not only have to deal with contemporary technology challenges, but also have to contend with a wide spectrum of economic, political, social and regulatory challenges. Project management goes beyond a management science that defines a project's work, timing and resources. Project leaders have to build fast and flexible project teams. This requires effective networking and co-operation among people from different organizations, sub-contractors, vendors, government agencies and customer communities. Effective team leaders are social architects that understand the interaction of organizational and behavioural variables and are able to foster a climate of active participation, accountability and result orientation [39].

A four-year-long field study by Thamhain [39] involving 895 project professionals showed that the five most significant influences on team performance are:

- professionally stimulating and challenging work;
- opportunity for accomplishments and recognition;
- the ability to resolve conflict and problems;
- clearly defined organizational objectives relevant to the project; and
- appropriate job skills and expertise of the team members for the project.

Some factors had the opposite effect to popular perceptions: for example, stable project requirements and stable organisations could actually lead to lower overall team performance. Intrinsic professional needs showed a strong favourable performance correlation whereas extrinsic motivators (such as salary increases, bonuses and time off, and metrics-related factors such as team tenure, project duration, changes and complexity) were weakly associated with performance.

4.4.3 Integrated Project Development Teams

Traditional product development is a sequential process. It includes, for example, engineering, procurement, fabrication and assembly. The term integrated project development team refers to a concept of shortening the development cycle time while maintaining or improving the quality of the design. This idea has been in existence for a number of years under a number of names and methods for example, concurrent

engineering, fast tracking, parallel engineering, etc. The development process involves an overlap of the separate functions. It does speed up the process, but also adds substantial risks to the project such as re-work, scrapping of good parts and schedule delays, resulting in overspending.

Another way of fast tracking is to employ the 'project team' method. Team members of various multifunctional disciplines work together towards a common goal [9]. This approach requires that members of various disciplines be physically integrated to form a product development team. At each step of the product development cycle all functional issues are taken into account, e.g. procurement, fabrication, assembly and maintenance.
Empirical results obtained from these latter teams showed three benefits, namely shortened new product development cycle, reduced overall new product development costs, and a higher quality product at first release. Disadvantages found were that teams require more funding in the early stages of the project and not all people are team orientated people. Another requirement for successful integrated project teams is empowerment by management to act on their own and to be allowed to make technical decisions [9].

4.5 Team Member Assessment

Teams are groups of individuals, each one with his or her unique personality, style, value system and strengths and weaknesses. A good understanding of these dynamics is required for a team to become successful. A number of assessment tools exist, each of which has its strengths and its limitations.

All individuals are different. The number of different persons might be infinite, but still they can be grouped into a few groups. People think differently, work differently, learn differently, talk differently, act differently, etc. These differences need to be controlled and used to the advantage of a group to give it a competitive edge.
Psychologists have studied human behavioural patterns for many years and have proposed various models to simplify and to better understand human behaviour. One of the most well-known and popular personality indicator tests is the Myers-Briggs test [41]. This model does however have its shortcomings and limitations and therefore it is useful to look at other personality models as well:

- Keirsey's temperament model is used to evaluate a person's actions and communication style [20];
- Herrmann Brain Dominance Instrument is used to understand a person's thinking style [15]; and
- Kolb's learning style inventory is used to determine a person's learning style be it concrete experience, reflective observation, active experimentation or abstract conceptualisation.

These four models are not exhaustive, but cover most of the aspects required to understand and evaluate a team member.

5 DISCUSSION

5.1 Introduction

A successful project team is complex to define and to measure. It is also difficult to implement the so-called softer issues such as values, innovation and excellence. As a project team involves relationships, possible irrational behaviours and decision making, there is no simple system or recipe to ensure a successful project team. However, some

companies consistently have more successful project teams than other companies. Central to these successful project teams is the knowledge gained, applied and built on.

This research report has attempted to give an overview of the people issues of project teams, with the focus on research and development teams in South Africa. An integrated systems approach to successful teams is proposed. Such a type of approach is not normally followed in research studies, which generally isolate and investigate a single aspect. Whereas this might be ideal for research studies, it only has a focused, singular application possibility for a project team. An integrated systems approach that covers all aspects of a team is required for developing successful project teams. This integrated approach was followed in this study. Hence an overview of the integrated systems approach towards successful project teams is now given.

5.2 New Paradigm Thinking

The main recurring theme studied was traditional versus new paradigm thinking. Traditionally projects are managed by more quantitative methods: quantifying all aspects of project management and putting systems in place to measure and control them. In the quest for better control and higher accuracy, more information is often wanted. This could also encourage the use of more tools.

New paradigm thinking adds an additional thinking style and new perspective to this pool of knowledge. Project teams are made up of irrational people with subjective thinking and evaluation that cannot be quantified by traditional methods. The relational issues of a project are very complex and cannot be understood by a simplistic model.

5.3 Systems approach

The importance of a systems approach can be illustrated by using the analogy of water: [2] The ability of water to extinguish fire cannot be explained by studying separately its constituent elements of hydrogen and oxygen (Hydrogen is an explosive gas and a fire needs oxygen to burn).

When using a system approach to project teams, various external and internal factors need to be taken into account. A project fits into an environment and this determines to a large degree the success of the project. There are external forces and their interactions on a project are numerous and not always visible. The proposed solution to this issue is to stay informed and anticipate changes to these factors. These forces have various origins, as illustrated in Figure 3. Some examples of the influence of external force on the project are:

- the investors become worried about the project team experiencing technical setbacks and withdraw their funding;
- the project team does not have a thorough understanding of the regulatory processes, which could lead to time delays, a complete redevelopment and the requirement for additional funding;
- a competitor beats the project team to the market; and
- a new technology comes on the market that makes the current technology redundant.

The company culture is the controlling factor of the internal forces that interact with project teams on a daily basis. It is not a matter of one culture being better of superior than the other, but one culture is more suited to a specific situation than another, as shown in the following discussions:

- the company culture influences what systems are used, and whether these systems restrict and control project teams or assist and empower the teams;
- the company culture influences the mindset of the team. For example is the main focus of the project team on innovation or on cost saving?;
- the company culture influences the people it attracts to the team. For example, does the culture attract highly motivated and talented persons or persons that follow the system and do not make changes to the status quo?;
- the company culture influences the motivation of the team. For example, are the team members just willing do the job or are they motivated to give everything?; and
- most importantly, company culture influences the leadership of the team. For example, is the focus on talented and innovative leaders or managers?

The cultural environment within which project teams work is a key factor for encouraging innovation and for good product development. Companies like 3M pride themselves in their numerous inventions over the years, which they attribute to their culture of innovation [1].

The environment and culture are the influences external to a project team, but form the basis of the project team upon which it builds its team and the boundaries it operates within. Research by Ives [17] found that only limited research has been done on the context and fit of projects within an organisation. The stakeholders should be seen as part of the project team from the beginning and continuous communication is crucial.

One of the advantages of teams is the potential they have to be more effective and efficient than a group of individuals, through the development of synergy. Team dynamics are complex and not easy to steer in the desired direction, but it can be rewarding and even give organisations a competitive edge. In addition, complex research and development projects have to be done within a team context. The integrated approach has to cover all aspects of team dynamics.

The importance of a good team player is often overlooked. Very few would deny the importance of selecting quality people for a project, with reference to their technical skills and abilities. The tools listed under team assessment show the importance of not just selecting competent persons, but also good team players. The right selection of people that comprise a team is another foundation for a successful project team. Good tools are available to help with the team selection process. A few appropriate tools were listed, namely the Keirsey temperament tool that defines a person's communication method; the HBDI tool that determines a person's and/or a group's thinking style and the Kolb learning style tool. These tools provide a definable scientific foundation with which to define certain (project team applicable) parameters of people. These tools can be used to assist with team selection and also shaping the team to become a successful project team.

Incentives and motivation is a key success factor enabling teams to have a competitive edge. Effectiveness is very important for research and development teams, but it is difficult to measure (compared to efficiency). This is where motivation plays a key role.
Training needs to be integrated and become part of the process – from initiation through to completion. Training is not just skills training; it should include people issues such as learning methods and personalities.

Rewarding teams requires an additional evaluations system. Most performance evaluation systems focus on individuals. The right rewards and incentives can make teams much more effective and proactive. This could also be an important contribution to risk control in a

technologically complex environment. Team evaluation and appraisal can become a powerful tool to shape, focus and direct project teams.

Intellectual property is an issue that does not really impact on how good or bad a project team is, but failing to protect intellectual property could lead to disastrous consequences. Security and industrial espionage are realities and teams need to be very aware of this.
Knowledge management is more than just a new name for an old concept; knowledge can be managed more effectively and efficiently with the tools that are available today. Reflective learning journaling to promote individual and team performance, as proposed by Loo [27], is one example of knowledge management application.
Diversity is an added dimension to project teams. It can cause friction due to misunderstanding and differences, but it also encourages “out-of-the-box” thinking.

People should be regarded as the greatest asset of any project team. Leadership is the key to unlock these assets in order that teams can reach their full potential. Today the role of project managers expands beyond the realms of traditional project management. Project managers need to create a shared vision and inspiration (for example, how can an appealing design be specified?). They need to motivate, direct, communicate and sell the concept to all stakeholders, while simultaneously being aware of the fast changing environment the team operates in, and be proactive to be able to respond to changes. Furthermore, leadership is not merely one person knowing everything and making all the decisions, it should be distributed amongst the team members. Team synergy also plays a role in leadership.

6 CONCLUSION

This literature review barely scratches the surface of the myriad of articles that are applicable to successful project teams. The purpose of this review was not to assimilate this information and come up with a recipe for project success, but to show that project teams are complex, dynamic, open systems, with many elements and relationships. A project as a non-linear system has inputs (e.g. partners), processes (e.g. teams) and outputs (e.g. product and customers). It not only faces quantitative constraints such as personnel availability and budget, but also non-linear qualitative constraints such as company culture, motivation and value systems that are less easy to define, measure and predict.

There is no simple recipe for successful project teams. However, from the literature survey, there are vast amounts of information and tools available to use a systems approach. Whereas successful project teams could not easily verbalise the reason for their success and used terms such as experience and gut feel, there is enough information available to quantify the various aspects of project management using a systems approach.

A successful research and development project team firstly needs to understand and know its boundaries, its strengths and opportunities. The environment can change fast and teams need to be able to respond to these changes.

Secondly, research and development projects need team leaders and not project managers. The team members should be carefully selected, based on skills, experience, motivation and cultural and team fit. Cultural fit refers to the company and team culture, be it formal or informal. Project leaders need to shift their focus from planning, organising and controlling towards leading people as people are the most valuable resources of projects and they need to have a common vision and focus.

Thirdly, project leaders need to see the project as a system with many components that interact with each other. Using a systematic approach, project managers can better ascertain the quantitative and qualitative impacts, identify key elements or critical success factors and take responsive action [24].

Fourthly, the South African context presents unique opportunities. South Africa is uniquely positioned in Africa with the highest level of prosperity and labour productivity. Africa's problems of low levels of support, poverty and high levels of theft and crime of should be seen as a challenge and opportunity for innovation. In addition Porter [34] recommends that South Africa forms clusters of expertise e.g. the Western Cape wine industry to keep and improve its competitive edge. The prepaid electricity metering system is an example of a highly successful "South African" innovation. The diverse South African cultures, traditions, values and languages are virtually untapped inputs for new ideas, concepts and innovations. Innovative thinking, unique opportunities and a wide range of clusters of expertise (e.g. motor manufacturing, mining, tourism) go hand in hand for success. South Africa has all these core ingredients for success.

To summarise, the focus of research and development project teams must shift to people, their capabilities, their interactions, their motivation and their focus.

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