FIRM-BASED INVESTIGATION INTO BUSINESS PROJECT FAILURE AND DEVELOPING BUSINESS PROJECT MANAGEMENT DOMAIN MODEL USING UML

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2010

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A thesis submitted in full fulfilment of the requirements for the degree of Doctor of Philosophy

Laboratoire d'Informatique, Image et Interaction
Université de La Rochelle, France

2010

A HOLISTIC STUDY OF BUSINESS PROJECT FAILURES AND THE DEVELOPMENT OF BUSINESS PROJECT MANAGEMENT DOMAIN MODEL USING UNIFIED MODELLING LANGUAGE

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Faculty of Business and Management
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2010

ABSTRACT

Despite the efforts to improve the maturity of the project management profession, the failure rate of business projects remains high. It was realized that current project management standards do not take contextual requirements into consideration and business project management really has not been addressed in totality. The purpose of this interdisciplinary study therefore, is to obtain a better understanding of the subject matter by investigating why business project fails from the organization's perspective; and to specify the acquired knowledge in a format that facilitates future expansion and application.

Based upon the open systems model, 3 case studies were conducted to examine the moderating effect of the types of organization structure and Project Management Information System (PMIS) support on the causal relationship between project management competency and business project success. It was found that business project success should be measured in terms of meeting both project and organization objectives; and the essential components of business project management were identified to be (1) "Core business project management competencies"; (2) "Integrated programme management" and (3) "Integrated PMIS". It was conclusive that organizational factors do pose a significant impact in attainment of business project success in all 3 cases; and a theory that business project is likely to fail if it is not managed as an integral part of business enterprise with equal emphasis as its business-as-usual operations has been proposed. This implies that the way business project management is executed today should be reviewed; the role of IT in support of project

management work should be reassessed; and a clear distinction between business project management and traditional project management should perhaps be made.

The specification of the acquired knowledge on the other hand, was achieved by developing a domain model using UML; based on a domain modelling approach which was devised by modifying the conceptualization step of conventional ontology engineering process. Using the theoretical framework that captures the essential business project management components as the starting point, the model was constructed in 4 steps namely (1) defining the scope of work by expanding each component in the framework using prevailing standards; (2) integrating the defined scope with reusable existing work; (3) developing; and (4) testing the UML specifications which describe both structural and behavioural aspects of the subject matter. The successful creation of the domain model and the demonstration of how it can be used directly in the development of the desired PMIS and project knowledge ontologies showed that the approach of building a common semantic foundation to support both application system modelling and ontology modelling is workable and effective. Furthermore, since the modelling approach has built in the ability to reuse existing work, the domain model can be used as a foundation that accumulates domain knowledge progressively. This opens up a new horizon where software systems could be built based on domain model which is a direct reflection of basic research findings; and software systems in the future would compete primarily from the non-functional perspective as a result.

ABSTRACT (FRENCH)

En dépit des efforts destinés à accroitre la maturité de la profession dans le domaine de la gestion de projet, le taux d'échec des projets d'affaires (par opposition aux projets techniques) reste élevé. On s'est aperçu que les standards actuels en matière de gestion de projet ne prenaient pas en compte les contraintes liées au contexte d'exécution des projets, et que de ce fait, la gestion de projets d'affaires n'avait pas été étudiée en profondeur. L'objectif de ce travail de recherche transdisciplinaire est donc d'abord d'obtenir une meilleure compréhension du sujet en essayant de comprendre pourquoi l'échec d'un projet d'affaires est considéré comme un échec du point de vue de l'organisation, puis de formaliser la connaissance acquise dans un format qui permette par la suite de l'enrichir et de l'appliquer.

En nous appuyant sur le modèle des systèmes ouverts, trois études de cas ont été conduites, avec pour objectif d'étudier l'effet modérateur des différents types de structures des organisations et des systèmes d'information pour la gestion de projet sur la relation causale entre la compétence en gestion de projet et le succès des projets d'affaires. Il résulte de ce travail que le succès des projets d'affaires devrait être mesuré en termes de réalisation des objectifs du projet mais aussi de l'organisation. Ce travail a également permis d'identifier les composants essentiels de la gestion de projets d'affaires : (1) "Compétences de base pour la gestion de projet "; (2) "Gestion intégrée de programme" et (3) "Système d'information intégré pour la gestion de projet". Dans les trois études de cas, il apparait également de manière déterminante que les facteurs d'ordre organisationnel ont un impact significatif sur la réussite du projet. Une théorie est proposée, qui postule qu'un projet d'affaires a de grandes chances d'échouer s'il

n’est pas géré comme une partie intégrante de l’entreprise, en le traitant comme une opération courante au sein de l’entreprise. Cela signifie que la manière dont les projets d’affaires sont gérés aujourd’hui devrait être revue. Le rôle de l’informatique dans l’assistance à la gestion de ces projets devrait également être revu. Et il faudrait sans doute aussi faire une plus grande différence entre les projets d’affaires et les projets « traditionnels » plus techniques.

D’autre part, la formalisation de la connaissance acquise au cours de ces études de cas a été effectuée en développant un modèle de domaine à l’aide du langage de modélisation UML. Et l’approche de modélisation du domaine a été élaborée en modifiant l’étape de conceptualisation dans le processus traditionnel d’ingénierie d’ontologie. En prenant comme point de départ le cadre théorique qui prend en compte l’essentiel des composants de la gestion de projets d’affaires, le modèle a été construit en quatre étapes : (1) définition de la portée du travail en développant chaque composant à partir des normes en vigueur ; (2) intégration de ces développements en réutilisant les travaux réalisés et proposés par d’autres chercheurs ; (3) développement et (4) évaluation des spécifications UML décrivant aussi bien les aspects structurels que dynamiques du sujet traité. Le fait d’avoir réussi à développer un modèle du domaine et à montrer de quelle manière il pouvait être mis en œuvre directement pour développer un système d’information pour la gestion de projet ainsi que des ontologies portant sur les connaissances liées à la gestion de projet a montré que l’approche consistant à construire une base sémantique commune permettant de travailler à la modélisation de systèmes applicatifs et d’ontologies est à la fois réalisable et valide. De plus, le modèle de domaine proposé peut servir de socle permettant d’accumuler progressivement la connaissance du domaine, dans la mesure où l’approche de modélisation a pris en compte la possibilité d'intégrer des travaux et propositions antérieurs. Ce résultat ouvre de nouvelles perspectives de développement de logiciels s'appuyant sur un modèle de domaine qui est directement issu de travaux de recherche. Et de ce fait, ces logiciels pourront à l'avenir être utilisés dans une perspective non fonctionnelle.

ABSTRAK (BAHASA MALAYSIA)

Kadar kegagalan projek perniagaan tetap tinggi walaupun pelbagai usaha telah dilakukan untuk meningkatkan kematangan profesi pengurusan projek. Adalah didapati bahawa piawaian pengurusan projek yang ada kini tidak mengambil kira keperluan kontekstual dan pengurusan projek perniagaan sebenarnya belum lagi dikaji secara menyeluruh. Oleh itu, tujuan kajian antara bidang ini adalah untuk mendapatkan pemahaman yang lebih mendalam berkenaan subjek ini dengan menyelidik mengapa projek perniagaan gagal menurut perspektif organisasi; dan untuk menspesifikasikan pengetahuan yang diperolehi dalam format yang memudahkan aplikasi dan pengembangan selanjutnya.

Berdasarkan Model Sistem Terbuka, 3 kajian kes telah dijalankan untuk menyelidik pengaruh moderasi struktur organisasi dan sokongan Sistem Maklumat Pengurusan Projek (SMPP) terhadap hubungan kausal antara kompetensi pengurusan projek dan kejayaan projek perniaagan. Hasil kajian mendapati bahawa kejayaan projek perniagaan harus diukur dari segi pencapaian matlamat projek serta matlamat organisasi. Hasil kajian juga telah mengenalpasti komponen-komponen penting dalam pengurusan projek perniagaan adalah (1) "Kompetensi pengurusan projek perniagaan utama"; (2) "Pengurusan program bersepadu"; dan (3) " SMPP bersepadu". Kesimpulan kajian adalah faktor organisasi memang menimbulkan kesan yang penting dalam pencapaian kejayaan projek perniagaan dalam ketiga-tiga kes; dan mencadangkan sebuah teori bahawa projek perniagaan mungkin akan gagal jika ia tidak diuruskan sebagai sebahagian bersepadu dalam organisasi dan diberikan perhatian yang sama dengan operasi perniagaan harian. Ini bermakna cara pengendalian pengurusan projek

perniagaan hari ini harus dikemas kini; peranan IT dalam menyokong pengurusan projek perniagaan perlu disemak semula; dan perbezaan jelas antara pengurusan projek perniagaan dan pengurusan projek tradisional mungkin perlu dilakukan.

Spesifikasi pengetahuan baru tentang pengurusan projek perniagaan ini pula, telah dicapai dengan menghasilkan sebuah model domain dalam format UML; dengan menggunakan pendekatan model domain yang diubahsuai dari langkah konseptualiasasi dalam proses kejuruteraan ontologi konvensional. Dengan menggunakan rangka teori yang merangkumi komponen-komponen penting pengurusan projek perniagaan sebagai permulaan, model ini dibina dalam 4 langkah iaitu (1) menetapkan skop kerja dengan mengembangkan setiap komponen di dalam rangka teori dengan menggunakan piawaian lazim; (2) menyepadukan skop kerja dengan kerja sedia ada yang boleh digunakan semula; (3) membina; dan (4) menguji spesifikasi UML yang menerangkan subjek kajian dari aspek struktur dan juga kelakuan. Kejayaan penghasilan model domain ini dan demonstrasi bagaimana ia dapat digunakan secara langsung di dalam pembinaan SMPP yang diingini dan ontologi pengetahuan projek menunjukkan bahawa kaedah membina dasar semantik umum untuk menyokong kedua-dua pemodelan sistem dan pemodelan ontologi boleh dilaksanakan dan berkesan. Selain daripada itu, memandangkan pendekatan model domain ini berkemampuan menggunakan semula kerja sedia ada, model domain ini juga boleh dipakai sebagai asas untuk mengumpul pengetahuan domain secara progresif. Ini membuka suatu dimensi baru di mana sistem perisian boleh dibina berdasarkan model domain yang mengambarkan penemuan penyelidikan asas. Sebagai hasilnya, sistem perisian di masa depan dijangka akan bersaing dari segi perspektif bukan-fungsian.

ACKNOWLEDGEMENTS

I would like to express my deepest appreciation to my supervisors namely Professor Datuk Dr Mohd Zabid Hj Abdul Rashid and Professor Dr Patrice Boursier for their generous guidance and support throughout the PhD Programme.

I would also like to express my gratitude to everyone who had helped to realize, administer and/or participated in this joint programme between the Faculty of Business and Management of Open University Malaysia and Laboratoire d'Informatique, Image et Interaction (L3i) of Université de La Rochelle.

Last but not least, I would like to thank my family and friends for their patience, understanding and encouragement.

DECLARATION

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I hereby declare that this thesis is the result of my own work, except for quotations and summaries which have been duly acknowledged.

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TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1 INTRODUCTION

Project can be defined as a temporary endeavour undertaken to achieve specific objective(s), given limited time and resources. Since the project duration has a definite beginning and end, its existence is expected to be temporary. There may be other similar definitions but most of them are conceptually equivalent to the above despite the differences in phrasing (GAPPS, 2007).

From a narrow technical speciality of delivering unique product and/or services to external clients by the project based industries such as engineering and constructions, project has since evolved into a mechanism deployed by business enterprises to effect internal changes and used as a template for operational & strategic redesign (Cicmil, 1997). It is also evident that it is playing an increasingly important role in the organization. As reported by PriceWaterhouseCoopers (PWC)'s cross sectors survey, 200 companies from 30 countries are running a total of 10,640 projects a year worth in excess of US $4.5 billion (Maylor et al, 2006).

The temporary nature of projects stands in contrast to business as usual (or operations) which are routine, repetitive and functional in nature. Thus in practice, it is acknowledged that project management requires distinct technical skills and as a result, the demand for certified project managers has been on the rise over the last decade. These certifications can be obtained through project management professional bodies all around the world which include international bodies such as the Association of Advancement of Cost Engineering (AACE), International Project Management

Association (IPMA), Project Management Institute (PMI), International Association of Project and Programme Management (IAPPM); as well as country-specific associations such as Australia Institute of Project Management (AIPM), Project Management Association of Japan (PMAJ) and Association of Project Management (APM) of United Kingdom.

Given AACE's emphasis in cost engineering, the European-based IPMA is technically the oldest project management professional organization. US based PMI on the other hand, has the widest reach with close to half a million members worldwide (see Appendix C for details). Each of these professional bodies has their own version of project management standards and/or framework based on which the certifications are conferred. The more internationally acclaimed certifications are IPMA's certification based on IPMA Competency Baseline standards (ICB, 2006); PMI's PMP certification based on Project Management Body Of Knowledge (PMBOK Guide, 2008); and IAPPM's CPM examination based on the Certified Project and Program Management Guide (CPPM Guide, 2007). Amongst the national standards, "PRojects IN Controlled Environments" version 2.0 (PRINCE2, 2003) introduced by the Office of Government Commerce (OGC) has also managed to gain some ground due primarily to the worldwide presence of UK based multinational companies. Consequently, the practice of project management in the industry is largely influenced by these international standards.

Most of these project management standards are similar in nature and differ only in terms of focus, coverage and approach. PRINCE for example, was first developed by the UK government as a standard for IT project management. PRINCE2 is the second version of this process-based approach for project management which can be tailored for the management of all types of projects. PMI's PMBOK on the other hand, is a standard accepted by ANSI and IEEE which describes the sum of knowledge within the profession of project management. It expects the practitioners and academics to apply and advance it upon possession of this body of knowledge, as with the other professions such as law, medicine and accounting. The focus of PMBOK is the 9 Knowledge Areas (KAs) which refer to the key competencies required to manage any project namely 'Project Integration Management', 'Project Scope Management', 'Project Time Management', 'Project Quality Management', 'Project Communication Management', 'Project Cost Management', 'Project Human Resources Management', 'Project Procurement Management' and 'Project Risk Management'. Thus in comparison, the life-cycle based PRINCE2 standard is more of an implementation methodology providing guidance on how to run a particular project (Wideman, 2002), whilst PMBOK imparts project management knowledge as a complete discipline.

In addition to establishing project management standards, these project management professional bodies and associations actively promote further development in the field through publication of journals and hosting of conference to facilitate exchange of ideas. The notable ones are IPMA's International Journal of Project Management (IJPM) which is published eight times a year in collaboration with Elservier; and PMI's Project Management Journal (PMJ) which is a peer-refereed academic and research quarterly. In terms of conferences, IPMA organizes global congress annually to offer a platform for discussions among practitioners and academia; whilst PMI hosts biennially research and education conference to provide the opportunity to present and discuss new project management research findings and teaching methods. These new ideas, findings and way of practice in turn, become key inputs to the new releases of the project management standards. As such, project management standard can be viewed as a consolidated form of project management knowledge.

1.1 Problem Statement

Despite the availability of comprehensive standards and the continued efforts in developing the field, business project failure rate is still unacceptably high. Based on the survey conducted by PIPC (a global project management specialist firm), one in three projects fails to deliver on time or within budget; and 60% fails to deliver the benefits as set out in business case (PIPC, 2004). Standish Group's 3rd Quarter 2004 Research on the IT industry indicated that 18% of all surveyed projects have failed i.e. cancelled prior to completion or delivered and never used; while 53% are challenged i.e. late, over budget and/or with less than the required features and functions (Dinsmore, 2006). Evidently, the current emphasis on the qualifications and competency dimension of the project managers alone is insufficient. Furthermore, the call for a project manager to be proficient in all 9 knowledge areas as specified by PMBOK is difficult to achieve in reality.

It is noted that most project management standards do acknowledge that project management effectiveness can be affected by elements and conditions in the operating environment. PMBOK for example, refers to them as "Project Management Context" which comprises project stakeholders, organizational systems, culture, styles and structure. But since the targeted audiences of the standards are project managers at large and in support of project management as an independent discipline, not much interest has been placed on incorporating context-specific requirements into the standard project management practices and processes. From this perspective, none of the general standards today are found to have adequately addressed the subject of “managing business projects” with due considerations to the influencing organizational factors and their collective effects on the attainment of business project success.

In view of the above, the investigation into why business project fails must look beyond the project boundary into the organizational settings for answers; and there is a need to consolidate the understanding of what comprises an effective business project management.

In addition, research have shown that while theoretical developments typically lag behind practical innovations, the mismatch between theories and practice could also be attributed to practice lagging behind theories developed by academic research (Bryde, 2003b). This gap is currently filled by the project management standards and research literatures that reach out to the industry. In either case, the knowledge is expressed in the form of natural language descriptions which are subject to individual’s comprehension, and application of which may or may not yield results. Therefore it is also important that the acquired knowledge about business project management is represented in a manner where it could be easily incorporated into potential solutions that could be implemented systematically by the industry. At the same time, this new form of knowledge representation is expected to maintain the ability to assimilate new ideas and research findings as in the case of project management standards. In order to meet these requirements, the expression of knowledge must be unambiguous in order to prevent misinterpretation and ideally, in a machine readable form so that it can be used directly in the development of software solution(s).

1.2 Research Objectives

The objectives of the research therefore are:

- To obtain a better understanding of business project management by investigating why business projects continue to fail based on a more holistic approach, i.e. from the organization's perspective.

- To develop a more explicit specification of the new gained insight of business project management in order to facilitate future expansion and applications.

1.3 Research Questions

In relation to the research objectives, this research aims at addressing the following research questions:

- Despite the continued effort to improve project management effectiveness, why do business projects continue to fail?

- What are the organizational factors which must be taken into consideration in the context of business projects?

- To what extent do these organization factors affect the relationship between project management effectiveness and business project success?

- What are the essential components of business project management that must be in place in order to ensure business project success?

- What is the most suitable format to represent the business project management knowledge where it can be expanded in the future as well as immediately usable in the potential solutioning?

- How can the business project management knowledge be effectively captured into the desired format?

1.4 Significance of the Study

The research question of why project fails has always been approached from a project perspective and the outcome is a long list of critical success factors. Given a more complete understanding of business project management as a result of adopting a macro view and considering the effect of organization factors on standard project management practice, a more condensed explanation in a form of a theory could be offered. This will be the first theory ever developed to guide the practice of business project management; and it is hoped that this empirical research will spin off a new direction of studying business project management as a subject matter in its own right.

The delivery of a more explicit form of business project management knowledge on the other hand, provides project management practitioners and solution developers with a concise reference of the subject matter to guide their work. In addition, since the resulting specification will be in machine readable format, it can be fed directly into the engineering of technical solutions without any lost in translation or interpretation. As a result, the developed system would be of better quality and the time required for its development would be significantly reduced.

By addressing the gap in the body of knowledge and expediting practical implementation as described above, it is anticipated that more business projects would be successful in drawing their expected returns from the project investments.

Last but not least, the devised method of representing knowledge in a more precise manner could potentially be applied to other areas of business management, clearing the path for similar inter-disciplinary studies between social science and computer science in the future.

1.5 Scope of the Study

The key subjects of interest are (1) management of business projects; and (2) knowledge specification format and techniques. To prevent the study from losing focus especially since project management is an integration of various management theories (Koskela & Howell, 2002), the research examines the application of management concepts in the context of project management but does not drill into the fundamentals of these management concepts. Similarly, the research reviews the existing work in the knowledge representation regime to exploit its application in this research and does not go into highly technical discussions.

1.6 Definition of Terms

Two key terms which are used throughout this thesis are defined as follows:

- "Business project management" refers to the management of business projects. In order for long sentences to be more readable, it may at times be replaced with the short form "BProjM".

- "Business projects" refer to organizational change projects (Cicmil, 1999). For this research, this definition has been refined to refer to non-standard, cross-functional in-house initiatives that aim at effecting internal changes. These initiatives are expected to lead directly or indirectly to the improvement in organization performance, nature of which could belong to either one or more of the four quadrants in the balance scorecard namely financials, customer, business process, learning & growth (Kaplan & Norton, 1992). Some examples of business projects in this context are:

  a) Organization-wide transformation endeavour to improve profitability, reduce cost, uplift quality of customer services, upgrade organization learning capability and infrastructure, improve work processes in order to increase work productivity & operational efficiency.

  b) Information Technology (IT) initiative to integrate business data and processes across the organization for better visibility on overall business performance which in turn, enables timely decision making.

1.7 Organization of the Thesis

Due to its inter-disciplinary nature, this thesis is organized in such a way that all the key components are presented as a separate chapter:

1) Introduction – this chapter introduces the problem under investigation and sets the scene for the research by stating the research objectives and the research questions.

2) Literature Review – this chapter reviews the current state of related research in project management and knowledge specifications; identifies the key concepts that must be examined further and concludes on the desired specification format to capture the BProjM knowledge.

3) Conceptual Framework and Hypotheses – this chapter develops the conceptual framework based on the identified key concepts and lists the hypotheses to be tested by the research.

4) Methodology – this chapter describes how the research is carried out namely by conducting case studies for the firm-based investigations into why business project fails; and by deploying a proposed domain modelling approach that translates the acquired knowledge into the BProjM domain model.

5) Case Study Summary – this chapter provides a summary of each case study and presents the findings in relation to each variable in the conceptual framework.

6) Case Study Findings & Discussions – this chapter discusses and analyzes the findings of the case studies, identifies the essential business project management components, develops the business project management theory and presents the findings in a form of a theoretical framework.

7) Developing the domain model - this chapter describes how the BProjM domain model is developed by expanding on the domain modelling approach specified in chapter 4 and discusses the main findings.

8) Using the domain model – this chapters describes how the resulting BProjM domain model can be used to develop potential solutions that improve the chances of business project success.

9) Conclusions – this chapter summarizes the research, presents the conclusions, discusses the implications and recommends next steps.

CHAPTER 2 LITERATURE REVIEW

This chapter first presents an overview of related project management research to date, discusses why organizational factors are important considerations for business projects, justifies the need to embark on a firm-based approach and concludes on the use of systems theory and open system model as the basis to develop the conceptual framework. This is followed by an overview of ontology which is synonymous with knowledge representation, a discussion on why conceptual model may be the preferred format and finally, the conclusion of using domain model to represent the BProjM knowledge.

2.1 Related Project Management Research

Earlier project management research has been devoted mostly to engineering and construction projects with focus on optimizing the techniques of planning, scheduling and control (Betts & Lansley, 1995; Kloppenborg & Opfer, 2002; Turner, 2010). This is followed by efforts to incorporate management concepts into the practice such as application of organization learning (Kotnour, 2000) & total quality management (Bryde, 2003b) concepts into the project management processes; and linking project management with business strategy (Morris & Jamieson, 2005; Milosevic & Srivannaboon, 2006; Srivannaboon, 2006). A recent review that chronologically analyzing and categorizing more than 500 journal articles from 18 top management and business journal publications further reveals that there has been strong interest in project management research in eight allied management disciplines since the 1980s and the trends are likely to continue in the future. (Kwak & Anbari, 2009). This shows that project management today is no longer merely a practice of planning, scheduling, and executing projects effectively; but a multifaceted inter-disciplinary academic field that consist of both practical and empirical research. To maintain focus, this research will start by reviewing two most relevant areas i.e. previous research effort of defining project success and identifying critical success factors.

2.1.1 Project success criteria and critical success factors

The traditional definition of project success is to satisfy the "triple constraints", which is also known as the "iron triangle". This means that the project is only considered successful if it delivers on time, within budget and its output meets specifications (White & Fortune, 2002). The last criterion of meeting specification is often associated with meeting quality expectations and many other criteria have been proposed over the years which approach the subject matter from various angles. Shenhar & Levy (1997) for example, proposes a multidimensional universal framework to assess project success from the perspectives of project efficiency, impact on the customer, direct business success and future potentials. Atkinson (1999) on the other hand, states that the use of iron triangle is necessary for measuring the project management process but other criteria should also be used to measure the success of the project post implementation. In a similar way, Lim & Mohamed (1999) sees the three criteria as a micro view of project success and the macro view of whether the original project concept has been achieved should also be addressed. The more recent efforts in this category include assessment from the benefits perspective (Nogeste & Walker, 2008) and application of balance scorecard concepts (Niebecker et al, 2008). In summary, there is still no commonly agreed definition for project success and the viewpoint that it is a multidimensional concept (Shenhar & Wideman, 2000; Turner & Müller, 2006) is generally accepted. This is not difficult to comprehend as every business project has a unique set of stakeholders whose expectations are influenced by the individuals' background and experience as well as their roles and interests on the projects. In addition, there is a time dependent factor where the project may be considered successful one day and a failure on the next, subject to the point of view at that point in time. In retrospect, the multidimensional view of project success is really not a big advancement from the earlier opinion that it is impossible to objectively measure the success of a project (De Wit, 1988); since neither one contributes towards defining a common set of criteria that facilitates comparison across projects and companies. From this perspective, the iron triangle is still the most objective basis and a potential forth criterion capable of representing the multidimensional aspect would be "meeting stakeholders' expectations".

The other area of direct interest to this research is the study of project outcome through the investigation of the Critical Success Factors (CSFs) as predictors of performance. This topic has been researched extensively in the 1980s and one of the most important findings is the distinction between project management performance and project performance; and the theoretical justifications of positive relationship between them (Bryde, 2003a). Evidently this has led to the current industry's focus on the project management effectiveness and competency dimension of the practitioners. Based on this same principle, Cooke-Davies (2002) identifies a list of 12 factors upon assessing what contribute to successful project management, successful projects and consistently successful projects. The other identified success factors include project managers' leadership competencies (Geoghegan & Dulewicz, 2008), top management support (Zwikael, 2008), project politics (Faisal, 2006), effective development and communication of project vision (Christenson & Walker, 2008) etc. The list goes on depending on the angle which the matter is approached.

On the other side of the scale is the contingency school of thoughts which proclaims that there is no fixed sets of critical success factors and different situations call for different success factors. The determining variables include stages of the project life cycle (Pinto and Slevin, 1987), project types (Shenhar et al, 2002), project managers' leadership style (Turner & Müller, 2005), project manager's personality fit (Dvir et al, 2006) just to name a few. The more extreme thought in this category is Sauser et al (2009) who suggests that the root cause of project failure is the application of inappropriate approach for the specific project. Their proposal is to develop a contingency framework to determine a suitable management style for each project; and a new field of "project management design" should be established.

Despite the seemingly exhaustive list of critical success factors, the studies into the significance of organizational factors in the attainment of project success is relatively scarce and generally stops at creating awareness that the dynamics in the project's operating environment must be observed (Cicmil, 1997); as such, project managers must be political savvy (Peled, 2000) and cautiously leverage the organizational power grids (Bourne & Walker, 2004). This observation is affirmed by a recent study on 1681 articles published over the last 21 years that project related research has been based on a more silo "product creation" view, whilst considerations from the organizational perspective are taken up by the programme related research (Artto et al, 2009).

There is still no standard definition for programme today although the common emphases are its composition as a group of projects, its strategic importance and its objective of meeting longer term benefits. Due to this lack of clarity, a programme may take a variety of forms such as "Portfolio" i.e. a group of relatively independent projects that shares a common theme; "Goal oriented" i.e. a group of projects that effect typically one-off organizational change; or "Heartbeat" i.e. a group of projects which enables regular improvements in the organization (Pellegrinelli, 1997). It is therefore not uncommon that the terms "project" and "programme" are still used interchangeably in some organizations.

Having said that, a new perspective on projects and programmes as value creation processes has been proposed in recent years; and this has provided the much needed linkages between business strategy, programmes and projects (Winter & Szczepanek, 2008). Project Portfolio management (PPM) as a result, becomes a critical function in business organization which prioritises and dedicates project resources; consequently also manages the programme consisting of multiple projects. A study conducted by Blichfeldt & Eskerod (2008) further reveals that PPM is effective only if all projects are enacted, otherwise time and resources devoted to projects subject to PPM would be drained by those which are not.

The programme management processes on the other hand, can be grouped into 5 relatively discrete phases which is similar to that of a project life cycle namely "Initiation", "Defining and planning", "Project delivery", "Renewal and dissolutions" (Pellegrinelli, 1997; Thiry, 2002). In response to the development of programme management, many project management professional bodies have introduced this component into their suites of standards. PMI for example, has published “The standard for Program Management” (2008) to supplement their PMBOK guide.

Supporting the management of programme is the Project/Programme Office (PO) or Project/Programme/Portfolio Management Office (PMO). The different ways of naming the establishment is because as mentioned earlier, programme still means different things to different organizations. As a result, the office is set up to support programme in different ways; and the scope of work of a PO/PMO ranges from “operational” i.e. coordinating and supporting the programme activities; to “governance” i.e. developing, maintaining and enforcing project management standards and practices; to “strategic”, i.e. performing programme initiation and portfolio management activities. Given these differences in the principle and focus of their activities, Pellegrinelli & Garagna (2009) summarize the types of PMO into 4 categories namely “Project Office” which coordinates and supports single project or single programme; “Project Support Office” which is still operational focused but covers an expanded scope of multiple projects and multiple programmes; “Project Management Centre of Excellence” which is responsible of both operational and governance aspects of all project management related work; and “Programme/Portfolio Management Office” which refers to an enterprise wide set-up that emphasizes the strategic role of the PMO.

Although there is strong evident that the existence of a PO/PMO poses a positive impact on the attainment of project success (Dai & Wells, 2004), not much has been discussed with regards to how it should be optimally organized in order to reap maximum benefits. At present, the domineering thought is that PO/PMO is created in response to perceived needs which are temporary in nature, thus its relevance and value are to be continuously renewed as the needs that warrant its existence are progressively addressed (Aubry et al, 2008; Pellegrinelli & Garagna, 2009).

The findings above reflect that programme management is currently viewed as an extension of project management where it acts as an interface between the projects and the organization at large. Consequently, the direct impact of organizational factors at the project level is still relatively unexplored.

2.1.2 Importance of organization factors for business projects

The fundamental distinction between the traditional engineering/construction projects and business projects is that the former is client focused and the latter is organization centric. Thus traditional projects are typically granted with a high degree of autonomy, whilst business projects are more dependent on its parent organizations in terms of securing access to resources and identifying suitable work processes (Modig, 2007). This being the case, matrix organization which mobilises internal resources in order to capitalize on both flexibility and specialization has been the most widely cited project management structure for business projects (Gray et al, 1990). Nonetheless, the operating effectiveness of the matrix organization within a typically bureaucratic /functionally structured business organization remains questionable (Gray et al, 1990; Payne, 1993; Brown, 1999). Having said that, this problem can be overcome by organizational facilitator such as a comprehensive project management framework where project related policies and procedures are consistently applied throughout the organization (Loo, 2003). A fine implementation of such organizational facilitator can be found in Royal Dutch Shell, which has further strengthen their project management framework with a human resources development component by collaborating with the following 4 universities to develop "Shell Project Academy" (Cranfield University News Release, 2006):

- Cranfield School of Management (UK),
- Delft University of Technology (Netherlands),
- The University of Texas at Austin/McCombs School of Business (USA)
- Queensland University of Technology (Australia).

Targeting at employees working on all stages of projects, this is an integrated development programme which includes learning events, assessment and accreditation, coaching and mentoring services, a global online knowledge network, project community events as well as work experience opportunities. Nonetheless, most companies have not reached similar level of maturity and one of the reasons is the practical difficulties in implementing processes linking project management training to career & personal development (Bryde, 2003a). This oversight in the organization's management system is further supported by the findings of the global project management survey conducted by PIPC where (PIPC, 2005):

- A high 40% of the participating companies do not believe project management to be a serious path for employees;

- A high 39% say they do not provide appropriate level of project management training & development;

- A low 12% outsource their project management needs to fulfil shortfalls of skilled resources.

Without the support of a comprehensive project management framework that guides and recognizes project work, the type of organization structure chosen will significantly affect the success of the project (Gobeli & Larson, 1987). Among the three matrix organisation structures with varying degrees of shared authority and responsibilities between the project managers and the functional managers, “project matrix” is rated as most effective because the project manager is given a strong and formal role (Gray et al, 1990). In organizations where “functional matrix” or “balanced matrix” is adopted, project involvement are often perceived as a deterrent to the individual’s career development and thus, obstacles to project success are hit as early as the project mobilization stage. Even when the project team is sufficiently staffed, managing these two types of matrix organizations are no easy tasks. This is not difficult to comprehend as each type of organizational culture is often associated with a particular organization structure (Handy C.B, 1986). The functional organization structure is one that embraces the role culture with clear responsibilities & line of communication whilst the matrix structure depends on task culture in order to work well. Thus an ad hoc creation of project team in a matrix form within a structure full of vertical chains of command is unlikely to yield full cooperation and dual reporting arrangement often becomes a brewery of conflicts that drains unnecessary time & resources. As highlighted by Alsene (1998), this mismatch between the organization structure & organization culture can create undesirable organizational influences on project success. This is especially true for part time involvements where delicate arrangement must be maintained at all times to prevent clashes between operational work and project work. In most cases where such situation arises, attention to operational issues always gets the priority and risk is shifted to the project (Ives, 2005). Regardless of the special treatment given to operational work, most functional managers are unwilling to spare staff for project work fearing that the quality of operations will be sacrificed as a result. It is therefore not uncommon that some projects ended up with the "dispensable" resources which again, contribute towards a higher chance of project failure. These negative correlations between the levels of purposive threat and project success, as well as between levels of environmental threat and project success have been ascertained by Gray (2001) in his research; and it is proposed that management places attention to reduce such threats.

In summary, an underlying management systems and organization structure which have not been tailored to support business project implementation can create various organizational behavioural issues that impact business project success. As such, the influences of organizational factors at the project level should not be taken lightly.

2.2 The Need for the Firm-based Approach

On a high level, it would appear that current investigations into why project fails have covered all possible angles except considerations for organizational factors. Closer examination however, reveals that that unit of analysis of previous research has always been "project". In addition, the nature of these studies are mostly uni-variant descriptive analysis or bi-variant causal analysis between an independent variable and project success; and just about all the identified variables are found to pose some effect on project success depending on scenario. Most of the conclusions and recommendations on the other hand, continue to be individual-centric i.e. what the project manager must have (attributes, skills and knowledge), must be aware (context) and must do (applies skills & knowledge in context) to ensure project success. While it may be trivial to relate a managerial problem to the manager, making the project management team totally responsible for success is inappropriate (Munns & Bjeirmi, 1996), especially since the incompleteness in the underlying management system and inappropriate organization structure could also impact project success. Placing all the expectations on the project managers to manage the influences of these environment factors which are beyond his/her control is unrealistic and unsustainable.

It is also noted that there is still very limited empirical work that examines specifically the subject of business project management despite the earlier calls to focus on business projects as an area for future research (Morris, 2003; Winter et al, 2006). The situation has improved in recent years where more authors are covering the topic such as Heerkens (2006)'s book on the need for business project managers to be business savvy; and the launch of International Journal of Managing Project in Business (IJMPB) to boost business project management research effort (Walker, 2008). Nonetheless, a consolidated view of what comprises business project management in totality is still not in existence today.

In essence, it is realized that the current understanding of business project management is incomplete. The gaps which have yet to be filled are the assessment of the collective effect of all influencing factors in an organization that could impact business project success; and the identification of essential components of an effective business project management practice. Incidentally, this holistic approach is aligned with the call for a novel approach of combining project-centric and organizational-centric views to understanding projects and their contexts (Artto & Kujala, 2008), with an increased sensitivity to the possibility of oppression and exploitation in project settings (Hodgson & Cicmil, 2008).

The closest empirical works which adopted the similar approach of considering the effect of multiple factors are (1) the investigation into the project management effectiveness by considering organizational structure, technical competency, leadership ability and the characteristics of an effective project manager (Hyväri, 2006a); as well as (2) the study of relationships between project success and organization size, project size, organization type, project manager's work experience (Hyväri, 2006b). However, these two researches are still conducted from the project point of view and the approach omits the relevance of project management in business. The selection of the variables on the other hand, is motivated by the discrete areas which have not been addressed by previous research.

Instead of following the same approach, this research adopts a more objective means of identifying all the potential organizational factors which could impact project success, i.e. by applying systems theory which is synonymous to holism.

2.2.1 Application of systems theory and open system model

Based on the systems school of management theory and with reference to the open systems model as illustrated by Figure 2.1 below:

> "Organization can be viewed as open systems which take input from the environment (outputs from other systems) and through a series of activities transform or covert these inputs into output (input to other systems) to achieve some objective."
>
> (Mullin, 2007 : 84).

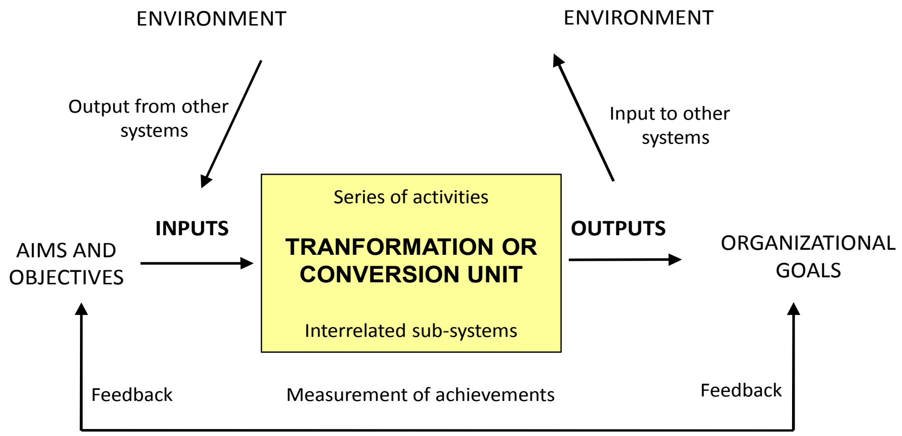

Figure 2.1 : The open systems model of organization (Mullin, 2007)

Furthermore, based on the social technical version of systems theory coined by Eric Trist and Fred Emery in the 1960s, the "transformation or conversion unit" in the open system model is made up of 5 interrelated subsystems which must work together to carry out the required series of activities in order to deliver the output (Mullin, 2007). As illustrated by Figure 2.2, these subsystems are:

1) Task – the nature of work activities to be carried out;
2) Technology – the manner in which activities are carried out;
3) Structure – the pattern of organization and formal relationship within which activities are carried out;
4) People – the nature of members undertaking the activities;
5) Management – the effective coordination of subsystems and direction of activities of the organization as a unified whole;

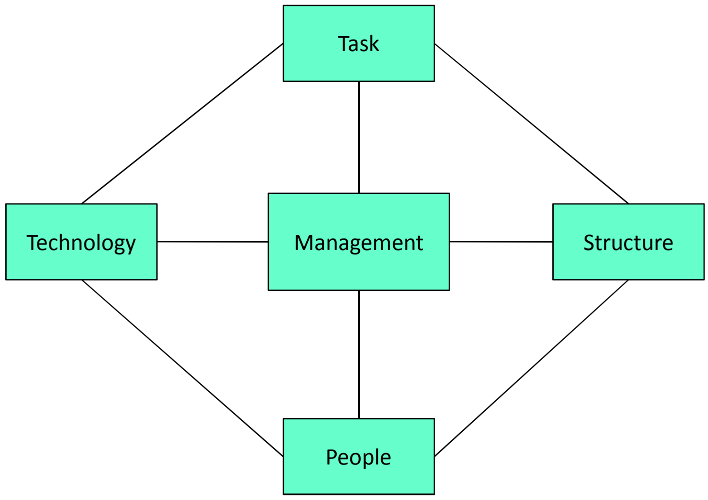

Figure 2.2 : Organizational sub-systems, a social technical approach (Mullin, 2007)

Given the open systems model, issues due to mismatch among organizational factors as illustrated by section 2.1.2 can now be explained. Since organization is a set of inter-related and inter-dependent parts that operate as a unified whole, adjustment to one subsystem must be accompanied with careful consideration to the others, failing which ineffectiveness is the consequence.

2.2.2 Identification of key influencing organizational factors

Given that project can be viewed as a temporary organization in its own right (Turner and Müller, 2003), the open systems model applies to project the same way it applies to an organization. Specifically, project takes input from the environment (the parent organization) and through a series of activities (project activities), transfer or convert the input (project resources) into output (project deliverables) to achieve some objectives (project objectives). In other words, the 5 inter-related subsystems are also applicable to the context of projects and by examining each of these subsystems in the project organization in relation to the parent organization; key concepts to be included in the conceptual framework could be identified.

Task subsystem

According to definition in the open system model, this refers to the nature of project activities. Since no two business projects are identical and the scope of this research has been defined to include only business projects that effect changes internal to business enterprises, the "task" subsystem can be considered as the extraneous variable i.e. the concept that sets the scene for the research rather than one that participates in the overall investigation.

Technology subsystem

According to the definition in the open system model, this refers to the manner in which project activities are carried out. The technology component that is common across all business projects within an organization would be the use of Project Management Information Systems (PMIS) in support of project work. There is a number of PMIS in the market today providing not only core project management related functionalities but peripheral functionalities such as resources management. The higher end systems such as Artemis and Primavera are further equipped with support for collaborative work, issue tracking and portfolio management. Most of them are standalone systems which are developed based on proprietary technology and many of them are now web-based or web-enabled. Earlier researches have shown that the most widely used function is Gantt Chart (White & Fortune, 2002) and the relatively unsophisticated Microsoft Project is consistently the most popular system (Fox & Spence, 1998; Hyvär, 2006a).

As of year 2005, the survey conducted by Meyer shows that the potential of PMIS still has not been fully exploited where only 20% of organizations surveyed have implemented PMIS to support multi-project programme and portfolio management; whilst 99% of the organizations uses it for scheduling and time management (Ahlemann, 2009). A more recent study on the other hand, confirms that the use of PMIS contributes significantly towards both successful project management and project success in terms of better planning, scheduling, monitoring and control (Raymond & Bergeron, 2008). Although this finding seems promising, the scope of this study is based on 5 categories of usages namely planning, monitoring, controlling, evaluating, and reporting; which may /may not have sufficiently covered the requirements of business projects. Thus, the research applies the open system model once again to identify all the key aspects which require PMIS support.

The purpose of information system is to improve availability of information to enable timely decision making that directs actions. The PMIS in support of business projects as such, must be able to track progress (of transforming input to output) and performance (of the project in terms of meeting project objectives).

Having said that, it is noted that project is also a known source of knowledge creation for an organization; and failure to transfer project knowledge effectively will lead to "wasted activity and impaired project performance" (Leseure & Brookes, 2004). But in reality, project information is rarely captured, retained or indexed so that people external to the project can retrieve and apply it to future tasks (Weiser & Morrison, 1998). Even in an organization where comprehensive project management methodology is strictly adhered to, project knowledge is usually captured only during post-implementation review and documented in the project closure report. As a result, lessons learned throughout the project implementation typically become private asset of the individuals directly involved in the project delivery. Since the project team would be dissolved upon completion of projects, it would be difficult to rely only on the "soft system" approach of coaching to achieve the purpose of knowledge sharing.

In view of the above, Information Technology (IT) should also be deployed to overcome the strong knowledge sharing barriers created by the boundary between projects and permanent organization (Disterer, 2002). In other words, the PMIS must be able to support the project review processes and capture project knowledge at 3 levels namely (1) operational i.e. project specific knowledge which will benefit mainly the project team in action; (2) tactical i.e. lesson learned which could also benefit the common processes among projects; and (3) strategic where knowledge from multiple projects are evaluated in terms of corporate strategy and consolidated to produce richer feedback to both present and future projects (Davidson & Rowe, 2009).

The effect of "technology support for project work" can therefore be represented by the concept of "PMIS support", based on the different levels of IT support for (1) progress tracking; (2) performance tracking; and (3) project learning.

Structure subsystem

According to the definition in the open system model, this refers to the pattern of project organization and formal relationship within which project activities are carried out. Given that project success depends on striking balance between the right kind and right amount of structure (Van Donk & Molloy, 2008), informal structure and organizational norms should also be taken into consideration as long as they are consistently implemented by the organization under studied.

By incorporating peculiarities of the business projects namely the PO/PMO set-up and the existence of project management framework into the 3 key components of organization structure (Daft, 2009), project organizations can be characterised in terms of:

1) formal reporting relationships – this refers to the span of control and chain of command of the project organization; in other words, the amount of control the project managers have over the allocation and management of the project resources.

2) departmentalization – this refers to the grouping of individuals into department(s) in support of project work; in particular, the formality of the project set-up and the extent of which project is supported by a PO/PMO that facilitates its linkages to the parent organization.

3) design of systems – this refers to the understanding/rules/guidelines/policies /procedures/recognitions defined for project work. In essence, this refers to the existence and comprehensiveness of the underlying project management framework.

Collectively, the setting in each of these 3 key components produce a configuration that reflects how project work is positioned, organized and supported in a parent organization. By mapping these combined considerations to the types of project organizations defined by Gobeli & Larson (1987), the 4 types of organization structures which are applicable to the context of business projects are:

- Task Force - This is "project" in its loosest form where the "project team" is formed as a reaction to an existing problem. The level of involvements typically stops at identifying root causes and providing recommendations; while the implementation of the solutions will be carried out by other parties. The project is coordinated by functional management and there is no formal project management framework. Thus all aspects of project work are conducted based on the personal style, experience and discretion of the appointed "project manager" or "task force leader". Concept of PO/PMO is also irrelevant in this case.

- Matrix - This is the conventional project organization structure where project resources are deployed from within the organization with dual reporting arrangement. Basic project management framework is in place with guidelines of how project should be run and reported, but compliance is not mandatory. Project Support Office is established to provide administrative support and to ensure effective management of common resources in a multi-projects environment.

- Projectized – This project organization is set up as a temporary organization and is given a high level of autonomy. Typically resources are seconded full time to the project and reports only to the project manager. Formal project management framework is in place with well defined project management standards & methodology, as well as policies and procedures that details working relationships with parent organization, reporting mechanism and documentation requirements. In addition, advanced PMO is established to provide project management capability, oversee delivery and integration of multiple projects, as well as to maintain and enforce the project management framework.

- Integrated - This project organization is set up in a similar way as a functional department. Formal and comprehensive project management framework is integrated into the parent's organization policies, human resources are officially transferred to the project organization and project work are given equal recognition in the overall career development plan. In addition, enterprise wide Programme/Portfolio Management Office with the added responsibility of managing cross-department collaboration to achieve the organization's desired business strategic goals is in place.

In view of the above, the effect of structure subsystem can be represented by the concept "type of organization structure".

People subsystem

According to the definition in the open system model, this refers to the nature of members undertaking the project activities. If the consideration for this subsystem is expanded to cover all the organizational behaviour (OB) related concepts, the nature of study will inevitably be diverted from the intended organization-centric to behavioural-centric. Leaving them out on the other hand will defeat the original purpose of adopting a holistic approach. Interestingly, a previous research by Pinto & Prescott had shown that "personnel factor'' poses only a marginal effect on project success. Belout & Gauvreau (2004) in their attempt to disprove this research outcome, found out that the "surprising" conclusion was caused by the human resources management construct in Pinto & Prescott's research which has not taken the specificity of project management context into account. In other words, the people subsystem could be and should be represented by determining factors that cause project team members to behave differently from their fellow colleagues in the parent organization, i.e. the people considerations in the project management framework especially in terms of how project participations will be embraced and rewarded.

Having said that, project management framework has already been incorporated into the structure subsystem under the consideration for "design of system". In retrospect, this convergence of reference by both the structure subsystem and the people subsystem affirms the role of the project management framework as the organizational integrator (as detailed in section 2.1.2) and ascertains its significance in the attainment of project success. In order to maintain the integrity of project management framework as a unified component that captures and governs all aspects of project work, the effect of people subsystem on project success will be represented through the structure subsystem, by incorporating the people related considerations into the "design of systems" dimension.

Management

According to the definition in the open system model, this refers to the effective coordination of subsystems and direction of activities of the project organization as a unified whole. In the context of project management, this merely describes the "integration management" aspect of the job. If the open system model's definition is adopted, other management competencies demanded of a project manager as the overall in-charge of the temporary organization would be severely discounted. In order for the effect of this "management" subsystem to be justly represented, the concept of "project management competency" which refers to "all knowledge areas that the project managers must be proficient in" is adopted instead. The most well received project management standard that captures this requirement (and thus adopted by this research) is the 9 knowledge areas defined by PMBOK namely "Project Integration Management", "Project Scope Management", "Project Time Management", "Project Quality Management", "Project Communication Management", "Project Cost Management", "Project Human Resources Management", "Project Procurement Management" and "Project Risk Management".

In summary, the concepts that represent the key influencing organizational factors which should be investigated further are (1) PMIS support; (2) Type of organization structure; and (3) Project management competency.

2.3 Related Knowledge Specifications Research

Ontology is chosen as the starting point in the search for a suitable specification format (to capture the acquired business project management knowledge) due to its origin as the centre piece in the Knowledge Representation (KR) paradigm. The word "ontology" came from Greek and in philosophy it refers to the study of the nature of existence or reality in general, as well as the basic categories of being and their relations (Gašević et al, 2006a). In information science and computer science, an ontology is a formal representation of a set of concepts within a domain and the relationships between those concepts. The most widely quoted definition for ontology today is "an explicit specification of conceptualization" (Gruber, 2005) which captures the essences of both perspectives.

2.3.1 Overview of ontology

First applied by the field of Artificial Intelligence (AI) as form of knowledge representation, ontology is encoded using ontology languages which are either proprietary or developed based on standards that support First Order Logic (FOL), Frame Logic (F-Logic) or Descriptive Logic (DL). Today, ontologies are used in many other areas such as enabling inter-operability between systems, improving requirement specifications in software engineering (Uschold & Gruninger, 1996) as well as the development of semantic web.

In the case of enabling systems inter-operability, ontology acts as an inter-lingua i.e. a role similar to that of a dictionary and a translator. It is used to bridge the differences in the usage of terms by different software systems/tools required by an integrated environment such as a business enterprise; where data exchange between departments and across organizations are common place.

In the case of software engineering, ontology which expresses semantics (meaning of an information) facilities the process of specifying systems requirements by providing an understanding of the domain under studied. Traditionally, software systems are built based on a model that represents a shared understanding of the user requirements at that point in time. When requirements change, the model will need to be updated and the system would typically require rework. In the context of a business enterprise, such inflexibility impairs the organization's ability to respond to changing market conditions. Since ontologies capture the essential concepts of the enterprise rather than the requirements, it can serve as a stable basis for the system's conceptual model and as a result, enterprise systems would be developed based on ontological view on enterprise, independent of how they may be realized or implemented (Dietz, 2006). The robustness of the model should then be tested against a wide range of anticipated requirements so that the developed software system would be less susceptible to change in the future. Otherwise said, the enterprise system should be built upon the single version of "universal truth" rather than just the user requirements which are subjective interpretations of individual needs, thus promoting reusability and assuring reliability of the resulting enterprise system.

The semantic web on the other hand, is an evolving development of the World Wide Web (WWW) in which the semantics and services on the web is defined, making it possible for the web to "understand" the meaning of the data it contains and thus, better satisfies the requests of the users. The call is answered by an implementation of a special form of ontology where information is given explicit meaning, so that machines can automatically process and integrate information available on the Web. Since WWW is based mainly on documents written in Mark-up Language interpretable by the browser software, a different type of ontology language i.e. the Web Ontology Language (OWL) is also introduced.

Developed based on descriptive logic, OWL is a knowledge representation language for authoring ontologies by describing the semantics of "Classes" and "Properties" used in web documents. A simple example to illustrate its application would be a search for 'transports' to go to a specific destination; and the semantic web returns a list of documents with information on how to get there by bus, train, subway, rental, flights. Since these different modes of transportations belong to a same "Class" and defined with "Properties" that represent their service offering to the specified destination, the semantic web is able to "make sense" out of the data and process the request as if it comprehends the human intent.

Thus by adopting ontology as the specification format, the new gained wisdom on business project management could be fed directly into the development of an enterprise software system and/or a semantic web application implementable by the industry.

In terms of types of ontologies, different scholars tend to classify them in a different way (Ben Sta et al, 2005). A closer look at these classifications shows that there are basically 3 mutually exclusive dimensions namely (1) subject of conceptualization; (2)

richness of internal structure (Ruiz & Hilera, 2006); and (3) formality (Uschold & Gruninger, 1996).

By "subject of conceptualization", it refers to categorization based on the nature of the knowledge it represents and below is an illustration after mapping some of the existing ontologies (Gómez-Pérez et al, 2006c) against this classification:

1) Metadata ontologies /Knowledge representation (KR) ontology – describe the content of ontologies and in the field of Artificial Intelligence, this refers to the modelling primitives used to formalize knowledge in a KR paradigm. For example, frame ontology and OKBC ontology.

2) Top level ontology /Upper ontology /Generic ontology /Common sense ontology - describe very general concepts which are common across domains and give general notions under which all the terms in existing ontologies should be linked to. For example, SOWA, SUO, CYC.

3) Domain ontology – describe specific domain which could either be task /methods /applications ontologies. For example:
    a) In the field of Medicine : GALEN, UMLS, GENE
    b) In the Chemical Industry : Chemicals, Ions
    c) For business enterprises: TOVE, EO

By "richness of internal structure", it refers to the categorization based on the sophistication of the knowledge content. A lightweight ontology in its simplest form is a list of terms intended for aggregating the facts about a certain domain of discourse (Rebstock et al, 2008). Heavyweight ontology on the other hand, contains explicit definitions of inter-relationships as well as logical constraints among the concepts in the domain. Below are some examples:

1) Controlled vocabularies: A finite list of terms.
2) Glossaries: Terms with their definitions stated in natural language.
3) Thesauruses: Terms with semantic additions, including synonyms.
4) Informal hierarchies: Terms with inter-relationships loosely defined.
5) Formal hierarchies: Terms with inter-relationship explicitly defined.
6) Frames: Include concept of inheritance.
7) Ontologies with value constraints: Include value constraints.
8) Ontologies with generic logical constraints: permit specific constraints between terms.

By “formality”, it refers to the level of technicality in the knowledge representation. This can be best illustrated by the continuum depicted by Figure 2.3. On one end of the scale is the highly informal ontology expressed loosely using natural language; on the other end is the rigorously formal ontology expressed in a highly technical form such as First Order Logic or Descriptive logic.

Formal Ontology

Highly informal	expressed in loosely in natural language, e.g. normal English terms.
Structured informal	expressed in restricted and structured form of natural language, e.g. specially selected English terms to represent key concepts of a particular domain of knowledge where the terms are well defined not only with what it means but the context of when they should be used and rules of how they should used;
Semi-formal	expressed in an artificial formally defined language. e.g. expression of key concepts in Ontolingua which is neither a formal nor an informal language;
Rigorously formal	expressed in meticulously defined terms with formal semantics, theorems and proofs of such properties as soundness and completeness.

Informal Ontology

Figure 2.3 : Formality of ontology (Uschold & Gruninger, 1996)

Based on these classifications, the resulting ontology of this research should be a domain ontology. In order to sufficiently represent the acquired business project management knowledge, it should at least be a “formal hierarchy” where both terms and their inter-relationships are captured and defined. As with formality, taking the mid-point of semi-formal specification would be ideal as the use of natural language is what this research wants to replace; while the use of rigorous formal language is likely to deter non-technical researchers from expanding the ontology in the future. Thus at this juncture, a business project management domain ontology in the form of formal hierarchy to be specified using a semi-formal language appears to be the most suitable specification format.

2.3.2 Ontology engineering & ontology modelling

Ontology engineering refers to the studies of the methodologies for building ontologies and a review of existing literatures shows that there is still no unified methodology to date since most ontology projects developed their own methods and techniques (Blomqvist et al, 2008; Gavrilova & Laird, 2005; Breitman et al, 2007; Corcho et al, 2006). Having said that, there are similarities in the activities deployed by these methodologies as summarized by Figure 2.4.

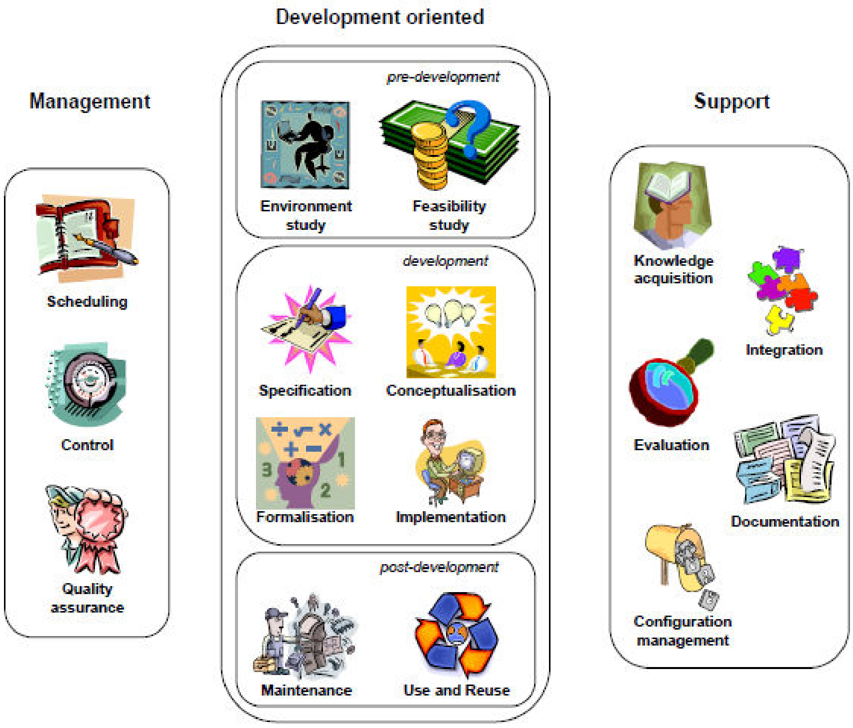

Figure 2.4 : Activity of ontology development process (Nagypal, 2007)

The activities of direct interest are the 4 steps positioned in the middle of Figure 2.4 namely "Specifications", "Conceptualization", "Formalization" and "Implementation". "Specification" defines the goal and the scope of the ontology and gives clear criteria for ontology evaluation; "Conceptualization" creates a model of the relevant domain knowledge at the knowledge level following either the bottom up, top-down or middle-out strategy; "Formalization" involves choosing a suitable formalism (e.g. First Order

Logic FOL, F-Logic, description logic DL) and transforming the conceptual model into that formalism; and "Implementation" codifies the formal representation using a specific ontology language such as OWL-DL which can be executed in a suitable reasoner. In the context of ontology engineering, the motivation of building the ontology is the need to implement an ontology-based application. Thus the conventional ontology engineering process contains "management" and "support" components; and the key output is a formal ontology in its executable form. Given the intent of this research is to produce a more explicit representation of the acquired knowledge rather than to implement a formal ontology; the only step that is relevant is "Conceptualization".

The notion of producing a model of the domain knowledge at the end of this step is enlightening since conceptual model is a format that is comprehensible by both the domain experts and the ontology engineers. In fact, it is recommended that formal ontologies be reverse-engineered for their underlying conceptual models so that a better understanding of the existing ontologies could be obtained before they are aligned and/or merged to form the new ones (Gómez-Pérez et al*,* 2006a). In addition, the use of conceptual model ensures that the target domain can be properly represented without being bounded by the limitation of the ontology languages which tend to compromise expressiveness in favour of efficiency. The only factor that requires further consideration is the choice of modelling language.

It is noted that the way ontology development process separates the "conceptualization" step from "formalization" and "implementations" steps is in line with the principle of Model Driven Architecture or MDA (Brown et al, 2005). Launched by Object

Management Group (OMG) in 2001, MDA is as an alternative software engineering approach that develops software through progressive transformation of models. Specifically, it defines three levels of abstraction /viewpoints for analyzing systems namely:

- the computational-independent model (CIM), as specified by the domain experts;

- the platform-independent model (PIM), a model assumed to be executed on a technologically independent virtual machine; and

- the platform-specific model (PSM), which finalizes the specification of the whole computer system.

Each viewpoint is in turn, supported by a 4-layer meta-modelling architecture comprising M0 which represents the real world; M1 represents the model; M2 represents metamodel and M3 represents meta-metamodel. By using OMG's established standards namely Unified Modelling Language (UML), Meta-Object Facility (MOF) and Common Warehouse Metamodel (CWM); platform independent CIM and PIM can be transformed automatically /semi-automatically into PSM and finally ISM (Implementation Specific Model) based on which physical codes of the open or proprietary platforms such as CORBA, J2EE, .NET, XMI/XML, and Web-based platforms can be generated (Brown et al, 2005). Based on this understanding, an ontology could also be formalized and implemented in a similar way if its conceptual model is expressed in UML.

Managed and created by OMG, UML is a graphical language for visualising, specifying, constructing and documenting the artefacts of a software-intensive system; which has now been used as a general-purpose modelling language including modelling of enterprises (Grangel et al, 2007). The idea to use UML in ontology engineering was first suggested by Cranefield (2001) given the connections between the standard UML and ontology concepts i.e. classes, relations, properties, inheritance. Although not all concepts are fully compatible with each other, various mapping techniques to bridge the gap have been developed since then (Pan et al, 2006). Consequently, model-driven ontology engineering approach takes off (Djurić et al, 2007); and UML tools have been used for modelling ontology (Gašević et al, 2006b). OMG is actively supporting this effort by developing the ontology UML profile so that ontology editor such as Protégé could import the UML model, further authors it and then generates the ontologies in OWL format. The development of Ontology Definition Metadata Model (ODM, 2008) on the other hand, further simplifies the transformation from UML to OWL.

Given the enabling mechanism, the option of using predefined conceptual models to develop or generate its corresponding (formal) domain ontology becomes viable. Related works in this area include:

- Jonker & Treur (2002) proposing a framework that uses AGR (Agent/Group/Role) enterprise model as the basis to development an enterprise ontology that integrates organization structure and organization dynamics;

- Gailly & Poels (2007)'s attempt to augment the REA business model to REA (Resource, Event, Agent) enterprise ontology; and

- Andersson et al (2006)'s creation of a reference enterprise ontology that combine the essence of various business models namely REA, e3value and BMO.

As highlighted in section 2.3.1, domain ontologies (that describe the problem domain) can in turn be used to develop conceptual models of software systems (that prescribe the solution domain). Works related to applying (formal) ontology in software engineering include:

- Abmann (2006) suggesting an approach where ontologies should be incorporated as a second dimension to the MDA on all levels with a logical integration between the dimensions at the CIM level;

- Zouggar (2006) proposing that enterprise modelling language be semantically enriched by incorporating ontologies.

In view of the role of conceptual model in both ontology engineering and software engineering processes, as well as the intention to take advantage of the MDA approach; expressing the essence of the business project management knowledge in the form of a UML model appears to be a more focused and promising option than the earlier thought of developing a semi-formal domain ontology.

2.4 Domain Model as the Specification Format

In relation to the potential of using conceptual model to build ontology and using ontologies to develop conceptual model of systems of the same domain, it is noted that the interoperability between conceptual model and (formal) ontology is not as straight forward due to their differences in format. Since ontologies are implemented using ontology languages and conceptual models are created using modelling languages, the desired interoperability between the two is currently achieved through indirect means such as mapping at the meta-model level (Vasilescas *et al*, 2006). A more ambitious effort is undertaken by Project ATHENA (Krogsite, 2005) where its proposed ATHENA Interoperability Framework (AIF) contains a semantic reconciliation framework comprising ATHOS (an ontology management system), A* (a semantic annotation tool), THEMIS (a repository), ARGOS (a transformation rules building tool) and ARES (a reconciliation engine) to provide semantic support for solving the interoperability issues (Berre et al, 2007).

An alternative and a more optimal way to approach this interoperability issue would be to build a common semantic foundation based on which the corresponding ontologies as well as the system's conceptual models can be generated. This semantic foundation or "domain model" which captures the fundamental concepts of the domain is essentially an ontology model, except that it is not constructed only when there is a need for an ontology-based application (i.e. the starting point of the conventional ontology engineering process); but as and when new knowledge of the targeted domain is acquired. In other words, this domain model also meets the demand of this research since its objective is to capture business project management knowledge progressively over time regardless of its future use.

2.4.1 A different domain modelling concept

In information science, the term “domain model” refers to a conceptual model of system which describes the common requirements, terminology, and functionalities of software programs constructed to serve the same problem domain. Thus “domain modelling” or better known as “domain analysis” in this context refers to the identification of the commonalities among the software systems in order to facilitate reusability in the production of new software application system as well as to validate the robustness of application models (Reinhartz-Berger & Sturmb, 2009). Given that this is a non-trivial task which involves a high degree of abstraction, semi-automated approach to create draft domain models by matching, merging and generalizing application models has also been recently explored (Reinhartz-Berger, 2010).

Based on this understanding, the nature of the proposed “domain model” is the same as its counterpart in information science; but its source of knowledge is different. Domain modelling for this research captures the domain knowledge based on basic research findings, whilst domain analysis gets them by “reversed-engineering” the systems. To avoid confusion in the usage of terms, the term domain modelling for this research shall be defined as the domain-motivated (rather than the system-motivated) act of capturing the invariant knowledge in a particular field of interest into a form of a model. Based on this principle, the required domain modelling approach can be developed by modifying the “Conceptualization” step of the conventional ontology engineering process. This is because both of them share the same aim of producing a conceptual model of the domain knowledge but modifications would be expected since the conceptualization step is designed as an integral process of ultimately implementing a formal ontology.

2.4.2 Positioning of the domain model and domain modelling approach

To conclude the discussion on the search for appropriate specification format and its development approach, Figure 2.5 presents the high level view of the positioning of the resulting domain model (hereafter refers to as BProjM domain model) and the proposed domain modelling approach in relation to the software engineering path on the left and the ontology engineering path on the right.

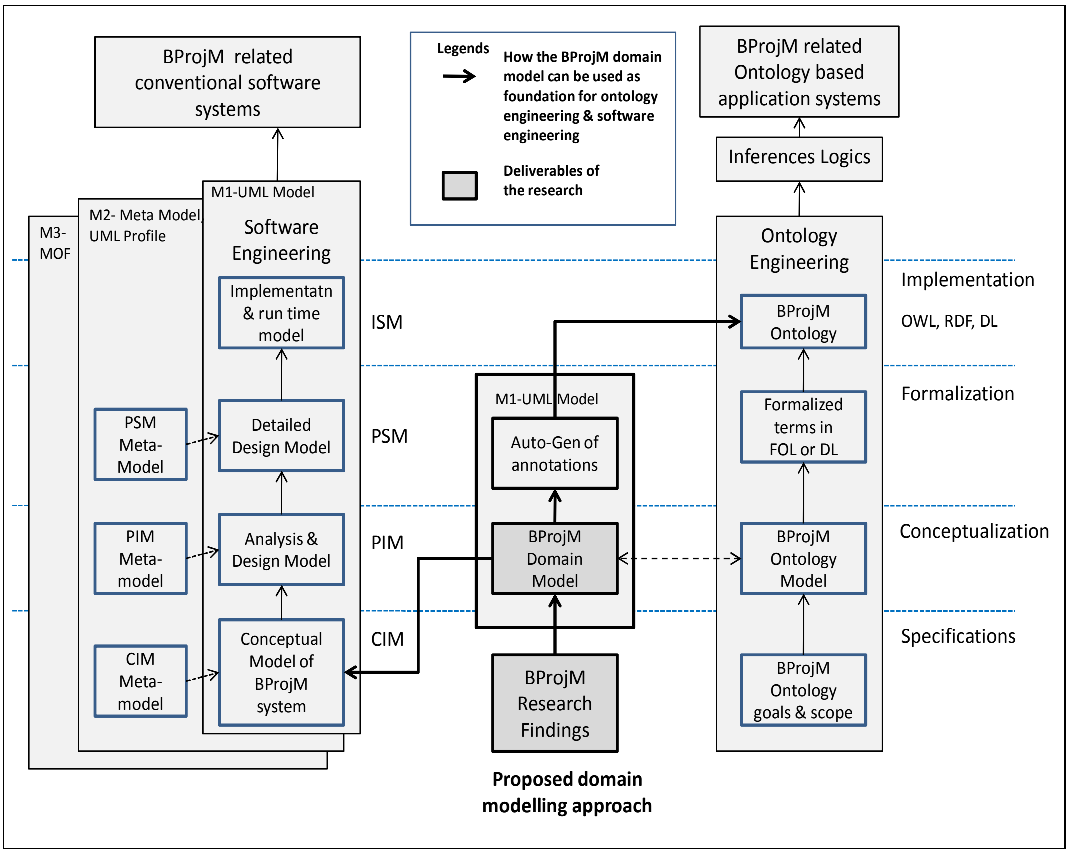

Figure 2.5 : Proposed domain modelling approach

In the middle of the Figure 2.5 is the proposed domain modelling approach and the two shaded rectangles represent the two key deliverables of this research namely the research findings of what comprises an effective business project management practice and the representation of this knowledge in the form of a domain model. Since the domain model is constructed using UML, it is an augmented version of its corresponding ontology model produced by the conventional ontology engineering path which may be expressed in any format by the domain experts such as excel sheets, mind map etc. The resulting BProjM domain model would also be more generic in terms of content since the basis of its development is not bounded by the competencies questions that must be answered by the BProjM ontology.

In terms of usage from the ontology engineering perspective, this BProjM domain model can be translated automatically into a canonical ontology in OWL format which can then be appropriately enriched via annotation and model weaving techniques based on OMG's ODM specification (Faucher et al, 2008). A potential semantic web application that further exploits this resulting BProjM ontology would be the implementation of a project knowledge ontology that enables project learning.

From the software engineering perspective, this BProjM domain model can be used as the basis to develop the conceptual model of BProjM related software system, for example, a Project Management Information System (PMIS) that caters specially to the requirements of managing business projects.

Putting it in perspectives in relation to existing work, this domain modelling effort differs from the Enterprise Knowledge Development (EKD) approach proposed by Rolland et al (1998) by focusing solely on describing the fundamental concepts of the organization (excluding the systems component); and the resulting domain model addresses only the "Enterprise Goals" and the "Enterprise Process" layers of concern in the EKD-CMM model (Barrios & Nurcan, 2004).

2.5 Summary of Literature Review

In summary, the literature review has concluded on the following:

- The concepts that represent the key influencing organizational factors which must be incorporated into the conceptual framework to guide the empirical study are (1) PMIS support; (2) Type of organization structure; and (3) Project management competency.

- The desired knowledge specification format is a domain model to be developed using Unified Modelling Language; where it will be a common semantic foundation based on which ontologies and conceptual model of software solutions can be built. The domain modelling approach on the other hand, can be developed based on the conceptualization step of conventional ontology engineering process.

CHAPTER 3 CONCEPTUAL FRAMEWORK & HYPOTHESES

Based on the literature review, the concepts that should be investigated further are (1) PMIS support; (2) Type of organization structure; and (3) Project management competency.

By feeding these concepts which are identified from the social technical view of organizational subsystems back into the open systems model, the conceptual framework comprising 4 variables is constructed in the manner as depicted by Figure 3.1:

- Dependent variable : Business project success
- Independent variable : Project management competency
- Moderating variables : Type of organization structure, PMIS support

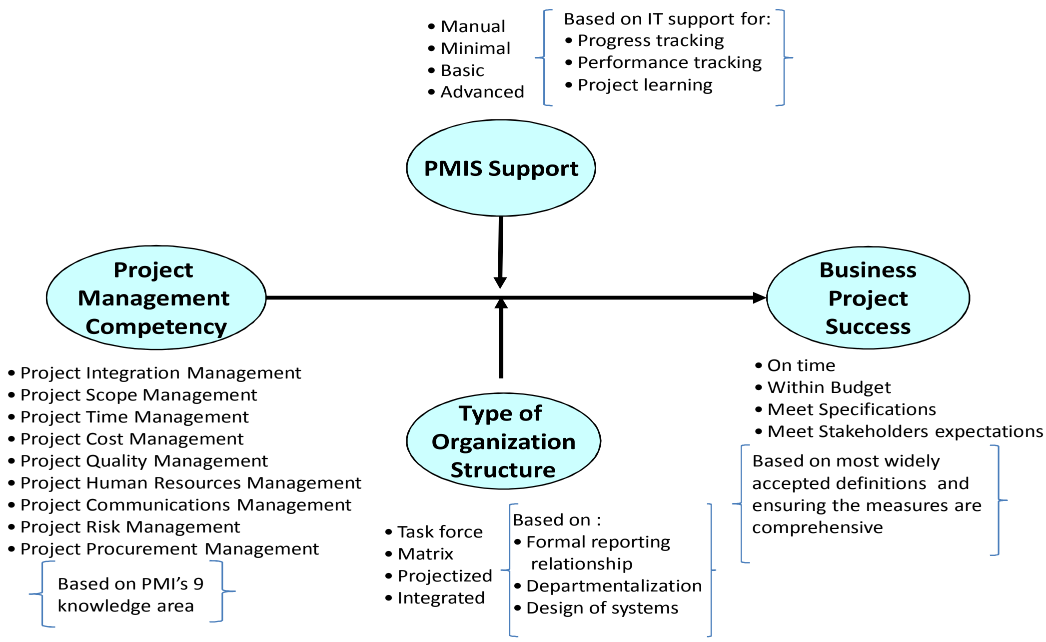

Figure 3.1 : Conceptual framework

3.1 Business Project Success

Taking the role of an output in the open system model, this variable refers to the list of criteria that determines if the business project is successful. Based on earlier discussions, business project success criteria can be defined as follows:

- On time – that the project is completed within the stipulated timeframe

- Within budget – that the project cost is contained within the given budget

- Meet specifications – that the output of the project is in accordance with its predefined specifications and matches the quality expectations

- Meet stakeholders' expectations – that all stakeholders are satisfied with the project delivery based on their own expectations of what should be the project outcome.

3.2 Project Management Competency

As the centre piece in the social technical interpretation of the transformation unit in the open system model and given the positive relationships between project management performance and project performance, this variable refers to the knowledge areas which the project manager must be skilled in order to perform project management effectively. Based on earlier discussions, these 9 knowledge areas as defined in PMBOK are:

- Project Integration Management – to ensure all elements of the project are properly coordinated.

- Project Scope Management – to ensure the project includes all the work required and only the work required to complete the project successfully.

- Project Time Management – to ensure timely completion of the project.

- Project Quality Management – to ensure project satisfy the needs for which it was undertaken.

- Project Communication Management – to ensure timely and appropriate generation, collection and dissemination, storage and ultimate disposition of project information.

- Project Cost Management - to ensure project is completed within the approved budget.

- Project Human Resources Management – to ensure most effective use of people involved in the project.

- Project Procurement Management – to acquire goods and services to attain project scope from outside the performing organization.

- Project Risk Management – to maximize probability and consequences of positive events and minimizing probability and consequences adverse to project objectives.

3.3 Type of Organization Structure

Taking the combined role of the structure subsystem and people subsystem, this variable refers to the different types of organization structure that reflects how project is organized, staffed, governed, supported and linked to the parent organization. The 4 types of organization structure which are applicable to the context of business projects are:

- Task Force - This is "project" in its loosest form where project team is formed as a reaction to an existing problem. The project is coordinated by functional management and there is no formal project management framework. Concept of PO/PMO is also irrelevant in this case.

- Matrix – This is the conventional project organization structure where project resources are deployed from within the organization with dual reporting arrangement. Basic project management framework is in place. Project Support Office is established to provide administrative support and to ensure effective management of common resources in a multi-projects environment.

- Projectized – This project organization is positioned as a temporary organization and is given a high level of autonomy. Typically resources are seconded full time to the project and reports only to the project manager. Formal project management framework is in place. Advanced PMO is established to provide project management capability, oversee delivery and integration of multiple projects.

- Integrated - This project organization is set up in a similar way as a functional department. Formal and comprehensive project management framework is integrated into the parent organization's management system. Enterprise wide Programme & Portfolio Management Office with the added responsibility of managing cross-department collaboration to achieve the organization's desired business strategic goals is in place.

3.4 PMIS Support

This variable refers to the use of IT tools in support of (1) progress tracking (2) performance tracking (3) project learning. Based on the different amount of automation in each of these three areas, the level of PMIS support is defined as follows:

- Manual – This means all project management activities are performed without the help of any IT system or tool.

- Minimal – This refers to the use of office automation software to support at least one of three areas.

- Basic – This refers to use of PMIS to support at least one of the three areas.

- Advanced – This refers to the use of PMIS to support all three areas.

Formulated Hypotheses

With reference to the conceptual framework, the hypotheses formulated for this research are as follows:

1) The effective application of Project Management Competency has a direct positive impact on business project success. It is envisaged that the more proficient and effective is the project manager in the 9 Knowledge areas, the higher is the chances of project success.

2) Type of organization structure affects the effective application of project management competency in delivering business project success. It is envisaged that the tighter is the relationship between the project organization and its parent organization, the higher is the project management effectiveness thus chances of business project success.

3) The comprehensiveness of the PMIS support places a positive impact on the effective application of project management competency in delivering business project success. It is envisaged that the higher is the level of IT support for project management work, the higher is the project management effectiveness thus chances of business project success.

CHAPTER 4 METHODOLOGY

While the research objective of investigating why business project fails is related to social science, specifications of the acquired business project management knowledge is an area of interest in computer science. In view of the inter-disciplinary nature, this chapter first presents the overall approach of the research, followed by a more detailed description of the method deployed by each discipline.

4.1 Overview

This research took four years to complete. With reference to Figure 4.1, it started with literature review in both disciplines in order to (1) develop the conceptual framework and hypotheses for the investigation into why business project fails, and (2) decide on the proposed format and approach for the knowledge specifications (which concluded on domain model and domain modelling respectively). Year 2 was dedicated to data collection i.e. conduct of case studies. Year 3 was dedicated to data analysis and development of BProjM theory, followed by the commencement of the knowledge specification i.e. the domain modelling work. Year 4 sees the completion of the domain model and the thesis.

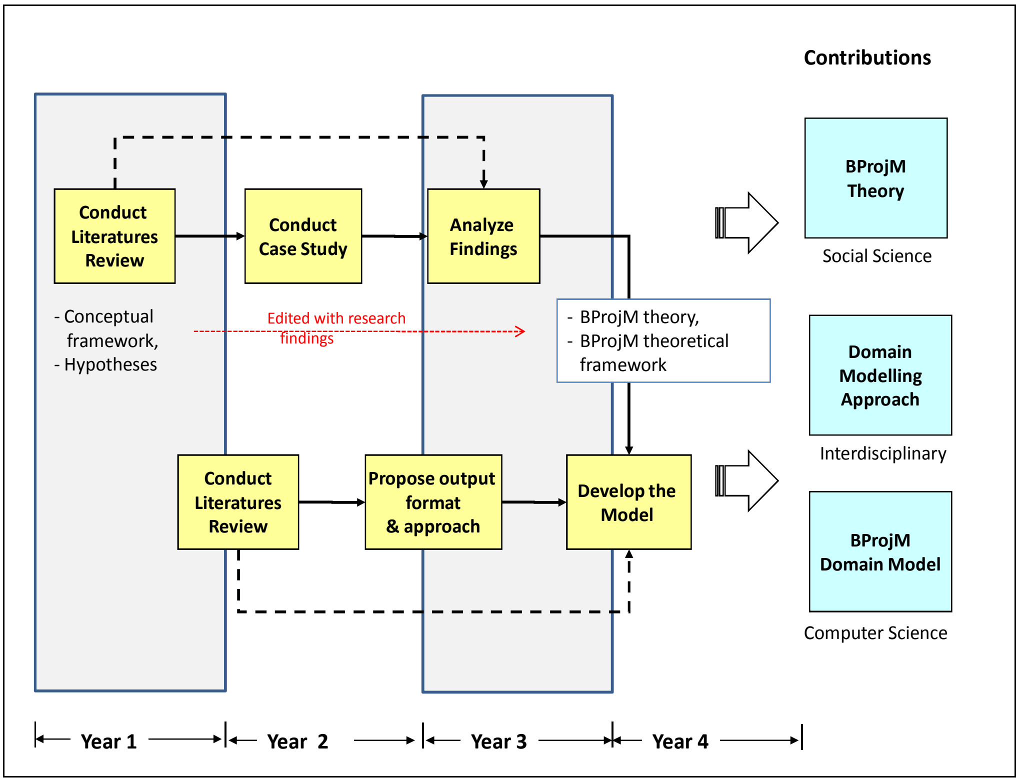

Figure 4.1 : Research design overview

The key component that bridges the two disciplines is the case study findings. Since it is the transition point between the first half of the work in social science and the second half of the work in computer science, lost of information at this juncture will result in the lost of integrity in this research. A mechanism must therefore be devised to ensure that the same underlying thoughts flow through the research from the beginning to the end. As illustrated by the dotted line in the middle of Figure 4.1, this is achieved by using the conceptual framework as the basis to develop the theoretical framework that summarizes the case study findings. Otherwise said, the theoretical framework that captures the identified essential BProjM components is built by editing the variables in the original conceptual framework to reflect the key influencing attributes. This resulting theoretical framework in turn becomes the starting point for the domain modelling exercise, providing the required consistency throughout the research.

As highlighted in chapter 1, the contributions of this research are (1) A BProjM theory that explains why business project fails; (2) A domain modelling approach capable of translating social science research findings into a domain model; (3) A BProjM domain model that captures the acquired business project management knowledge.

4.2 Research Strategies

Given the investigative nature of the key research question, the research adopts the deductive research strategy by formulating a possible explanation or theoretical argument to the problem, test the theory by deducting hypotheses, and then test the hypotheses by collecting appropriate data (Blaikie, 2005). Collection of quantitative data by conducting survey to test the developed hypotheses was considered at first but further examination of the conceptual framework shows that the conduct of case study would be more appropriate. Since the research is approaching a well researched topic from a fresh angle, a pure quantitative research can potentially stifle innovation, creativity and new way of thinking (Milliken, 2001). As such, the more ideal approach would be to mix the two paradigms by first conducting a qualitative research to gather more insights, before embarking on a quantitative research to generalize the findings. As highlighted by Lawrence (2010), it is imperative for researchers to move beyond the traditional adherence to a particular method of enquiry and the combined approach offers the following advantages:

> "… (1) it enables the building of a fuller, richer picture surrounding a phenomenon than either method on its own would be able; (2) it increases the robustness of results because findings can be strengthened through cross-validation when different kinds and sources of data converge and are found

congruent; (3) it helps find explanations for diverging results; (4) researchers can capitalise on the strengths of each and minimise weakness inherent in single strategies; and (5) it can increase the validity of the research findings."

Given the time constraint, the research only performs the first stage of the investigation by carrying out the qualitative research. Case study is adopted as the supporting research method since it offers the opportunity for a holistic view of a process (Patton & Applelbaum, 2003) where the researcher could probe for more details during data collection, request for additional materials as necessary and obtain a richer understanding of the phenomenon as a result.

The unit of analysis is company/organization as the key differentiator of this research is its firm-based approach. In which case, the research has to be a cross-sectional study where data collected for each variable must share the same time horizon failing which the examination of their inter-relationships as described in the conceptual framework would be invalid. The most accurate and practical way to achieve this is to base the research on current events and data, i.e. by examining the effect of current level of PMIS support, current type of organization structure in support of project work and current level of project management effectiveness on current projects. In other words, only projects with the same organizational settings should be included in the study.

4.3 Case Study

Case study is used in this research to obtain a better understanding of business project management through investigating why business project fails, using the developed hypotheses as the guide to ensure focus. This approach may be seen as unorthodox since conventional wisdom of social science research has defined case study to be useful only in exploratory research by providing hypotheses and preparing for the real study of larger surveys. Supporting the case of this research is Blaikie (2005) who disagrees with the conventional wisdom, claiming it to be a confusion of associating case study with techniques of data collection and analysis rather than a research approach; and asserting that case study can be used for various other purposes which include explanatory research and generation of theory. Supporting his point of view is Flyvbjerg (2006) who pronouns that the conventional definition if not directly wrong, is oversimplified and grossly misleading.

Nonetheless, the traditional criticisms of the case study (Yin, 2002) should still be looked into in order to ensure the quality, reliability, validity and robustness of the case study findings. These criticisms have been addressed by this research in the following manner:

1) Criticism: conduct of case study lacks rigor and thus leaving rooms for biased views.

   Measure: This is addressed by adopting Robert Yin's proposal of ensuring that the following 5 key components are clearly defined in the case study:

   a) Research question - This has been clearly defined at the beginning of the research;

b) Proposition - A conceptual framework with independent and dependent variables has been developed to guide the case study;

c) Unit of analysis - This is clearly defined as company /organization;

d) Logic linking data to proposition & criteria for interpreting the findings - This has been defined before the case studies were conducted, details of which can be found in the data analysis section of this same chapter.

2) Criticism: Case study provides little basis for scientific generalization.

Measure: Whilst generalization can be achieved through statistical inference, case study uses logical inference where features present the case study will be related in a wider population not because the case is representative but because our analysis is unassailable (Mitchell 1983). Furthermore, this research is positioned as a starting point of getting a better understanding of business project management; and it has been designed in such a way that the effort can be continued with more case studies as well as a survey at the later stage to enrich and generalize the findings.

3) Criticism: Case study takes too long and produce unmanageable amount of data.

Measure: The interviews were planned in advance and data collected were organized according to each variable in the conceptual framework and presented in the form of a table whenever possible. A chain of evidence is also maintained and the actual interview notes validated by the interviewees are enclosed as Appendix A2 for reference.

4.3.1 Selection of participating organizations

Since this is a cross-sectional study based on the company's current undertakings, the participating companies must be those actively engaging business projects as a means to effect internal changes. This is to ensure that some projects would be in action at the time the case study is conducted. Therefore, the participating companies were selected based on the researcher's knowledge on the maturity of business project management practice in large corporations listed on the main board of Kuala Lumpur Stock Exchange (KLSE). The KLSE criterion is added to the non-probability sampling to further ensure that the selected companies are sizable establishments which are under constant pressure to meet shareholders' expectations through running business projects.

At least 3 companies are required to participate in the research. The choice of three is deliberate in order to break the 50-50 argument should the scenario arise. Since the attempt of this research is not to generalize but to develop an initial model, 3 case studies should be sufficient to form a basis for more case studies to build on in the future. The case with the most number of respondents and supporting materials shall become the anchor case. The findings of the anchor case will be used as the basis for discussion while findings in the other cases will be used to validate them.

Before the commencement of the study, formal letters were sent to the identified companies to get official consent from their senior management. Thus the final choice of participating companies was dependent entirely on the willingness of the companies to take part in the research.

4.3.2 Data collection method

The case study was carried out by conducting face-to-face focused interview sessions with the stakeholders who are directly or indirectly involved in the project or the umbrella programme. Subject to agreement from the participating companies, the research plans to interview up to 10 persons in each company comprising:

- The top management i.e. CEO / Managing Director;
- The Project Management authority i.e. CPO / Project Heads;
- Two Project Sponsors from two different projects;
- Two Project Managers from the same two projects; and
- Two Project Team Members each from the same two projects.

The purpose of interviewing different levels of staff is to identify gaps in understanding if any, within the management hierarchy with regards to the effectiveness of their current project management set up and mechanism. As such, findings gathered from each interview were always cross-checked with those obtained from the earlier session(s) for consistency and completeness, so that clarifications can be sought as necessary.

Last but not least, each interviewee was presented with a souvenir to thank them for their participation.

4.3.3 Research instruments

The interviews were conducted by using a standard questionnaire which contains a list of guiding questions, in order to ensure consistency across all interviewees. There are 4 sections in the questionnaire, each of which corresponds to the variable in the conceptual framework. These segments are sequenced in the following logical manner and the questions are phrased in such way that the respondents could easily relate them to their real-life project experience:

- What encompasses project success?
- What is the project management competency that plays an important part in attaining that success?
- Does organizational influences play a part and to what extent?
- Does use of IT play a part and to what extent?

Within each section, the questionnaire uses mostly open-ended questions to gather background information and the respondents' view on the subject matter. Please refer to Appendix A1 for a copy of the questionnaire.

Upon completing each interview session, the interview notes are compiled and sent to the interviewees for their formal validation. Please refer to Appendix A2 for the interview notes.

4.3.4 Data analysis

Upon completing all interview sessions for a participating company, the following steps were carried out:

- Identify and summarize data gathered for each variable in the conceptual framework;

- Identify and validate the moderating effect of the independent variables on the dependent variables.

These steps were repeated for each case study after which a comparison across all the participating companies to identify the salient points worthy of further discussions. This is followed by an overall analysis against the developed hypotheses and based on the result of analysis, the essential BProjM components were identified and the BProjM theory that explains why business project fails was developed. Finally, the BProjM theoretical framework was constructed by updating the conceptual framework with the research findings.

To ensure that the data analysis is performed objectively, the determination of the type of organization structure and the level of PMIS support were based on the summation of scores (ratio scale from 0 to 3) assigned to their respective contributing attributes.

For PMIS support (as illustrated by Table 4.1 and Table 4.2), it is determined based on the summation of scores that reflects the level of IT Support in (1) progress tracking, (2) performance tracking and (3) project learning.

Table 4.1 : Measure for level of IT support

Score	Level of IT support
0	Manual
1	Leveraging on office automation tools such as word processors, spreadsheets application
2	Use of PM system such as Ms Project but the system is not integrated with the parent's organization's ERP system
3	Use of an integrated PMIS where the system is fully integrated with the parent's organization's enterprise system

Table 4.2 : Composite measure for PMIS support

PMIS Support	Description	Summation of scores from: 1) Progress Tracking 2) Performance Tracking 3) Project Learning
Manual	This means all PM activities are performed by the responsible parties manually without the help of any IT tool.	Score of 0
Minimal	This refers to use of office automation software to support at least one of the three areas.	Score of 1 to 3
Basic	This refers to use of PMIS to support at least one of the three areas.	Score of 4 to 6
Advanced	This refers to use of PMIS to support all three areas.	Score of 7 to 9

For type of organization structure (as illustrated by Table 4.3, 4.4, 4.5 and 4.6), it is determined based on the summation of scores that reflects the different intensities in (1) formal reporting relationships; (2) departmentalization; and (3) design of systems.

Table 4.3 : Measure for formal reporting relationships

Score	Formal reporting relationships
0	No formal reporting arrangement -Typically the resources is borrowed to assist in problem solving for a very short period of time
1	Dual Reporting arrangement - Typically part time involvement
2	Single Reporting arrangement - Typically through secondment for the duration of project
3	Transfer – Project personnel are transferred out from his original department to work full time in a project

Table 4.4 : Measure for departmentalization

Score	Departmentalization
0	Central agency in the form of PO or PMO does not exist
1	Project Office or Project Support Office is established for the purpose of operational support and administrative effectiveness.
2	Project Management Centre of Excellence is established for the purpose of operational support and governance.
3	Enterprise-wide Portfolio /Programme Management Office is established for the purpose of operational support, governance, portfolio management and marshalling project resources towards attainment of business strategic goals.

Table 4.5 : Measure for design of systems

Score	Design of system after incorporating the people related component in PM framework
0	• No proper project management guidelines • No discrete recognition for project work during performance appraisal
1	• Project management guidelines are available for reference • Project involvement is recognised during performance appraisal
2	• Project management methodology & standards is established and must be complied • Project work is recognised and rewarded during performance appraisal
3	• Comprehensive project management framework which governs all aspects of project management work is in place • Project work is recognised, rewarded and is an essential component in the career development plan

Table 4.6 : Composite measure for type of organization structure

Type of organization	Definition	Summation of scores from: 1) Formal reporting relationship 2) Departmentalisation 3) Design of Systems
Task force	This is "project" in its loosest form where project team is formed as a reaction to an existing problem. The project is coordinated by functional management and there is no formal project management framework. Concept of PO/PMO is also irrelevant in this case.	Score of 0
Matrix	This is the conventional project organization structure where project resources are deployed from within the organization with dual reporting arrangement. Basic project management framework is in place. Project Support Office is established to provide administrative support and to ensure effective management of common resources in a multi-projects environment.	Score of 1 to 3
Projectized	This project organization is positioned as a temporary organization alongside the parent organization where the project management is given high level of autonomy. Typically resources are seconded full time to the project and reports only to the project manager. Formal project management framework in place. Advanced PMO is established to provide project management capability, oversee delivery and integration of multiple projects.	Score of 4 to 6
Integrated	This project organization is a self-contained unit embedded within the parent organization, in a similar way as the other functional departments. Formal and comprehensive project management framework is integrated into the parent organization's management system. Enterprise wide Programme & Portfolio Management Office with the added responsibility of managing cross-department collaboration to achieve the organization's desired business strategic goals is in place.	Score of 7 to 9

4.4 Domain Modelling Approach

This section details the domain modelling approach which is developed based on the conceptualization step of the ontology engineering process. It explains the rationale behind the customizations, details the modelling activities to be performed and serves as the base reference for chapter 6, "Developing the domain model".

As discussed in section 2.3.2, there is no standard methodology for ontology engineering but similarities exist among them. For easy reference, the same figure that describes the common ontology development activities is included below (Figure 4.2).

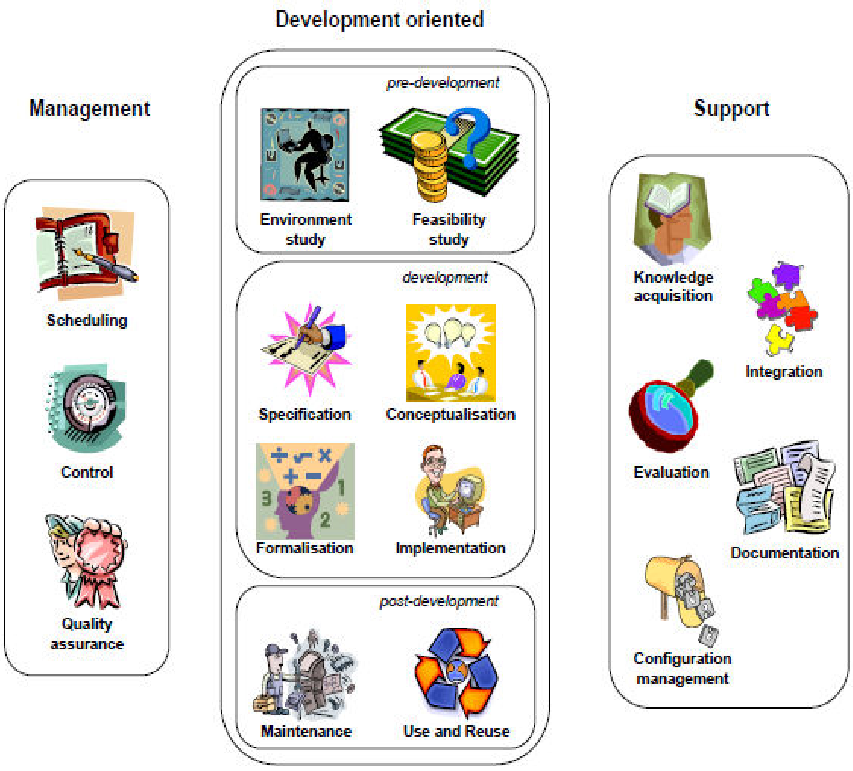

Figure 4.2 : Activity of ontology development process (Nagypal, 2007)

Note that "Knowledge acquisition" and "Integration" (with existing ontologies through ontology merging and alignment) are classified as "Support" activities which are conducted alongside the main "Development Oriented" activities. This is because conventional ontology engineering is motivated by the need for an ontology-based application system and thus, activities other than those directly related to the development of the ontology are classified as supporting or peripheral. The objective of the domain modelling for this research on the other hand is to capture and specify knowledge as and when they are acquired. In which case, “Knowledge acquisition” is a key activity as well as the starting point of this modelling exercise. Similarly, the junctures of “integrating” with existing work must be explicitly stated, so that the developed domain model would be reused in the next cycle of knowledge acquisition and specification. Furthermore, in contrast to conventional ontology engineering process where the output of the conceptualization step is an intermediate product to be fed into the next step, the output of the domain modelling exercise is the final deliverable of this research. As such, testing activity must also be incorporated into the development cycle in order to ensure that the resulting domain model is complete in representing the knowledge.

Based on the above considerations, the relatively straight forward “conceptualization” step of “creating a model of the relevant domain knowledge at the knowledge level” are modified as follows to support the development of a domain model :

1) Define the scope by adopting the top-down strategy i.e. translate the acquired knowledge which is already expressed in the form of a theoretical framework (see section 3.1) into a list of supporting concepts and relationships which must be captured and represented in the resulting domain model;

2) Reuse and integrate existing work into the defined scope so that the developed domain model would be reused in a similar way when new business project management knowledge is acquired in the future;

3) Build the domain model using UML based on the updated scope produced by step 2;

4) Test the completeness and integrity of the developed model by validating it against the defined scope as well as real-life scenario.

4.4.1 Defining the scope

Knowledge may be boundless but a modelling task should be based on a finite and manageable scope, otherwise the exercise becomes perpetual and the completeness of the final product could not be ascertained. Thus the scope of the domain model must be defined upfront so that a discrete piece of work can be delivered.

However, unlike the work of translating Bunge ontologies into an UML model (Evermann, 2008), the scope of work for this domain modelling exercise is not readily available. Given the theoretical framework, the challenge is how to translate it into a well defined list of concepts and inter-relationships.

This devised method is to (1) expand each component in the theoretical framework into a list of supporting concepts/terms with the help of prevailing standards in the domain; and (2) capture the result of the expansion into a "Specification Table". The use of prevailing standards is intentional so that the developed model will gain better recognition and acceptance from the other researchers in the field.

The next step is to capture the key relationships among the terms but rather than registering them in a table, the use of the "Key-relationships Diagram" (a loose form of an Entity-Relationship diagram) is proposed. It is not necessary to spell out all the inter-relationships in this diagram because the primary objective is only to provide an overview, otherwise the development efforts would be unjustly spent on building intermediaries. Furthermore by expressing the key inter-relationships in a graphical form, the format of the knowledge specification is a step closer to the UML's *Class Diagram*, making the transition to the next stage more intuitive.

The output of this step in summary are (1) a Specification Table that spells out the scope with a list of terms that must be captured by the domain model; (2) a Key terms-relationships Diagram that illustrates the key relationships among the terms.

4.4.2 Reusing & integrating existing work

In consideration that similar work may already exist and to ensure that the developed model will be leveraged by future research; existing work that contains fundamental concepts of the targeted domain should be sourced to see if they could be reused by comparing them against the terms already captured in the Specification Table.

If the terms in the existing work were not found in the Specification Table, the existing work is either approaching the domain from a different perspective or these terms have been missed out by the Specification Table. In any case, the Specification Table should be expanded to include missing terms; and the Key-relationships Diagram should be updated to reflect their linkages with the original terms in the table as necessary.

If the terms in the existing work overlaps or bears similar definitions as those in the Specification Table, the suggestion is to adopt the terms from the existing work especially if they are developed based on recognized standards. This can be achieved by (1) updating /adjusting the definition of the affected terms in Specification Table; and (2) adding new links and/or update the affected links in the Key-relationships Diagram as necessary.

The output of this step in summary are (1) the edited Specification Table; (2) the edited Key-relationships Diagram.

4.4.3 Building the model using UML

This is the crucial step of developing the UML diagrams that forms the resulting domain model. This thesis will not discuss the technical aspects of UML in details but will briefly describe the types of UML diagrams and justify the choice of diagrams for this research.

UML v2.2 has 14 types of diagrams which are divided into two categories as listed in Table 4.7. The first half (type 1 to 7) are structural diagrams which emphasize on describing the things in the system/domain being modelled; and the second half are behavioural diagrams that capture transition of the internal states of objects and collaborations among objects.

Table 4.7 : Types of UML diagrams (UML, 2005)

No	Types of Diagram	Description
1	Class Diagram	describes the structure of a model by defining their Classes and the relationships among the Classes.
2	Package Diagram	depicts how a model is split up into logical groupings by showing the dependencies among these groupings.
3	Object Diagram	shows a complete or partial view of the structure of a model at a specific time (Object is an instantiation of a Class).
4	Component Diagram	depicts how a model is split up into components and shows the dependencies among these components.
5	Composite Structure Diagram	describes the internal structure of a class and the collaborations that this structure makes possible.
6	Deployment Diagram	Shows how the model can be implemented in execution environments.
7	Profile Diagram	operates at the metamodel level to show stereotypes as Classes with the <<stereotype>> stereotype, and profiles as packages with the <<profile>> stereotype. The extension relation (solid line with closed, filled arrowhead) indicates what metamodel element a given stereotype is extending.
8	Use Case Diagram	shows a purpose that the actor can use the system/domain for.
9	State Machine Diagram	shows change in states of objects and the condition that triggers its transition.
10	Activity Diagram	Similar to State Machine Diagram, shows the overall flow of control.
11	Sequence Diagram	shows communication among objects in terms of a sequence of messages. Also indicates the lifespan of objects relative to those messages.
12	Communication Diagram	Similar to the Sequence Diagram but it uses free-form arrangement of objects and links as used in *Object Diagram*s. In order to maintain the ordering of messages in such a free-form diagram, messages are labelled with a chronological number and placed near the link the message is sent over. It is the choice of developer to use either Sequence Diagram or Communication Diagram. Both serves the same purpose but with variation in ease of use.
13	Timing Diagram	shows the timing constraints imposed on the communications among objects.
14	Interaction Overview Diagram	Based on Activity Diagram, shows linkages among the interaction diagrams i.e. Sequence Diagram, Communication Diagram, Timing Diagram and itself, Interaction Overview Diagram.

Given its origin as the system modelling tool, some UML diagrams may not be as appropriate for the purpose of domain modelling. *Deployment Diagram* for example, is useful in describing the hardware components required to deploy a system implementation; but will not be as useful as the *Class Diagram* in representing fundamental concepts of a problem domain in the real-world. In addition, this research intends to use the least number of UML diagrams to represent maximum amount of domain knowledge.

Berztiss (1999) suggested that there should be two kinds of domain models namely the concept models and the process models. A concept model assists in the interpretation of the structure and terminology of the domain while the process model represents the generic processes. In addition, a convenient mechanism should be found to link the process models to the concept models. In other words, a domain model is complete only if it captures both the static and dynamic aspects of the domain. Praxeme Institute shares a similar point of view, where it states that a model which truly represents a basic understanding of a domain must capture all semantics related to its concepts namely information, actions and transformations. This can be achieved by using UML's *Attributes* & *Operations* to capture information and action; and *State Machine Diagrams* to capture the transformations. *Class* on the other hand, can be used to connect these three dimensions (Vauquier, 2008).

Taking the above into consideration, this research uses 4 types of UML diagrams (as listed in Table 4.8) to capture the static and dynamic views of the domain model.

Table 4.8 : Types of UML diagrams used in the domain modelling

Different view of the model	UML diagram
Static view (Structural aspect)	• Package Diagram • Class Diagram
Dynamic view (Behavioural aspect)	• State Machine Diagram • Communication diagram

To specify the structural aspect of the model, *Package Diagram* is used to organize the relevant concepts into logical groups so that the model is more comprehensible, especially if the domain is complex and involves many inter-related concepts. The *Class Diagram* is the focal point of the model as it captures both the terms and their inter-relationships. The creation of *Class Diagram* is achieved by translating the terms derived from the theoretical framework into *Classes* defined with (a) *Attributes* to represent its properties; (b) *Operations* to represent the methods of processing; and (c) *Constraints* to be imposed on the *Attributes*, *Operations* and relationships with other terms. The inter-relationships among the terms on the other hand, can be expressed by defining *Inheritances* or qualified *Associations* among the *Classes*.

As for the behavioural aspect of the model, the key lies with the ability to specify the different states that the model may be in, the conditions that trigger the transitions of these states as well as the interactions among the *Classes* during each of these states. Since *Activity Diagram* emphasizes more on flow of control, it is suitable for describing processing logic of a software program or workflow in a business process; but not particularly useful in the context of domain modelling. In which case, the need for *State Machine Diagram* becomes trivial since it is capable of capturing the transition of state of the ruling *Class* (a *Class* of which its evolution will result in different instantiations of other Classes at different times) together with the specification of the conditions that must be met before the *Class* takes on a new state. *Communication Diagram* on the other hand, can be used to provide snapshots of the interactions among the *Classes* during each state. It is preferred over *Sequence Diagram* because of its free-form arrangement which allows a more compact layout; and its ability to reflect more than just the sequence of instantiations but dependencies among them as well.

More types of UML diagrams may be used to describe the domain knowledge in a more elaborated way but their value-add will not be as significant as these 4 types of UML diagrams. These 4 types of UML diagrams on the other hand, are the minimum failing which the domain knowledge may not be adequately represented.

Last but not least, the sequence of the built should be the development of structural diagrams first (to set the scene), followed by the creation of the behavioural diagrams.

4.4.4 Testing the domain model

The purpose of this step is to ensure that the developed model is complete in representing the domain knowledge.

The conventional approach would be to validate the output against the input i.e. checking if the model has represented all the terms in the Specification Table and all the relationships in the Key-relationships Diagram. These testing activities should be performed at logical junctures throughout the development (rather than at the end of the exercise), so that the model is progressively built on a sound foundation. In addition to performing validation against the predefined scope, the research takes on an unorthodox approach of checking the comprehensiveness of the model by using the raw data collected from the case studies.

Guided by these underlying thoughts, the specific testing activities are developed as follows:

- Upon completion of each package, check the structural and behavioural completeness within the *Package* against the predefined list of terms and relationships. This is then followed by a check on the completeness of the inter-relationships across *Packages*.

- Upon completion of the model, create an *Object Diagram* by applying real-life scenario and instantiating the *Classes* using case study data.

All omissions should be recorded in a list as and when they are uncovered, together with the details of the other affected UML elements and their required amendments. Last but not least, corrections should be carried out in an organized fashion after each round of testing.

CHAPTER 5 CASE STUDY SUMMARY

This chapter provides an overview of the case study exercise followed by a summary of each case study where the findings are grouped according to each variable in the conceptual framework.

5.1 Overview

Three large Malaysian companies meeting the predetermined criteria had participated in the case study. A fourth international petroleum company listed on KLSE was also invited to take part but they have declined the request. All three participating organizations have a nature of business which is sensitive to market and customer dynamics and thus, actively deploy project as a primary means to effect organizational changes. The descriptions of these 3 companies which have declined to be named are as follows:

1) An international airline company which had recently completed a highly acclaimed business turnaround programme (hereafter refers to as Co1).

2) An operator of satellite pay television services whose corporate-wide business transformation programme is currently on a recovery path (hereafter refers to as Co2).

3) A banking group which has just initiated a transformation programme as a result of a recent investment from a foreign bank (hereafter refers to as Co3).

Co1 has given the highest level of participation with 12 interviewees from top management to project team members. Furthermore, the researcher was personally involved in managing a segment of Co1's business transformation programme for 1.5 years (between November 2006 to April 2008); and had been given the permission to use the materials produced as well as information gathered during the course of the engagement in addition to those collected during the interviews. This level of participation is followed by Co2 with 3 interviewees and finally, Co3 with 2 interviewees. In view of the above, Co1 was used as the anchor case.

In terms of conduct, questionnaire was sent to individual participants appointed by their management at least two days before the interview date, so that the actual sessions would be more fruitful. Upon completion of the interview, interview notes were compiled and sent to the interviewees within 2 working days for their verifications in order to ensure that the details were captured correctly.

5.2 Anchor Case Study - Co1

This section first presents an overview of Co1 and background information of the programmes/projects understudied, followed by a summary of the case study data and findings organized by each variable in the conceptual framework.

5.2.1 Overview

Established since 1948, Co1 is an internationally acclaimed 5 star passenger air carrier flying nearly 50,000 passengers daily to some 100 destinations worldwide and receiving more than 100 awards in the last 10 years. Other than provision of premier passenger airline services, it operates subsidiaries that offer low-cost passenger flights to tertiary cities, inter-Borneo flights and charter flight services. In addition, it has a cargo subsidiary which manages freighter flights and cargo-hold capacity for all passenger flights; as well as an Engineering & Maintenance (E&M) division that manages Maintenance, repair, overhaul (MRO) and aircraft handling.

In year 2005, Co1 reported a loss of RM1.3 billion (9 months). Revenue for the financial period was up by 10.3% compared to the same period for 2004 but costs increased by 28.8% due primarily to escalating fuel prices. Several other weaknesses in the airline operations were also identified as the causes of the loss namely (1) increase in maintenance and repair costs; (2) poor yield management; and (3) an inefficient route network. As a result, there was a cash flow crisis and staff morale was at all-time low.

With the Malaysian government owning a controlling interest in the company, a new Chief Executive Officer /Managing Director was appointed to execute changes in both the company's operations and the corporate culture on 1 December 2005. Under this new leadership, Co1 launched its Business Turnaround Plan (BTP1) in year 2006 i.e. the programme under study.

The case study was conducted in April/May 2008 and in order not to create too much disruption to Co1's operations, the study focuses on two sub-programmes of BTP1 namely:

- Project Omega – which was led by the Network & Revenue Department (NRM);

- Engineering & Maintenance Breakthrough Programme (EBP) – which was led by the Engineering & Maintenance (E&M) division.

A total of twelve (12) persons of various positions in the organization chart were interviewed per plan and they are:

1) the Managing Director - representing the top management ;

2) the Acting Assistant General Manager of the Turnaround Management Office (TMO) - representing the Project Management Authority ;

3) Members of Project Omega (3 interviewees) :
    - The Project Owner who is also its Project Director ;
    - The Project Leader of the Inventory Management Team ;
    - A Project Member of the Inventory Management Team ;

4) Members of EBP (7 interviewees) :
    - The Programme Owner who is also the Senior General Manager of E&M division;
    - The Programme Director who is also the Assistant General Manager of the E&M Programme Office (PO);
    - The EBP Programme Manager, who is also a Manager in E&M PO;
    - The EBP Programme Support person who is also a TMO manager;
    - The Team Leader of Work Stream 1, People & Communications
    - The Team Leader of Work Stream 6, Assets Utilization

- The Team Leader of Work Stream 7, Enterprise Design

5.2.2 Background information

This section provides the background information gathered for the 3 programmes understudied namely Business Turnaround Plan (BTP1), Project Omega and E&M Breakthrough Programme (EBP).

5.2.2.1 Business Turnaround Plan (BTP1)

BTP1 has a clear goal of realizing a net income of RM500 million by year 2008 i.e. an all-time high profit for Co1. The expected deliverables were cash, profitability and growth over a period of 3 years; in that order of intensity and focus. In support of BTP1 implementation, a change management framework consists of 5 thrusts was put together:

1) Flying to win customers

   To reconfigure the network and product portfolio to ensure that the company has the tools and capabilities to be a top-tier player in each of the markets they serve, or they will leave.

2) Mastering operational excellence

   To build a unique operating capability unmatched by the peers. This capability will be reflected not only in improved operational reliability, but also in higher productivity and greater precision in all aspects of work.

3) Financing and aligning the business on P&L

   To relentlessly increase profits with the support of a world-class Finance function that ensures true financial accountability, transparency and performance orientation in our business.

4) Unleashing talents and capabilities

   To be committed to its people and to provide a working environment in which talents can thrive.

5) Winning coalitions

   To resolute support of the government, its employees, managers, customers, suppliers, agents and investors. It is only with the support of these stakeholders that the company can have the mandate it needs to make the changes that will ensure long-term success.

Project Omega is one of the sub-programme initiated under the thrust “Flying to win customers”, while EBP is a sub-programme initiated under the thrust “Mastering operational excellence”. Figure 5.1 denotes the relationships between BTP1, Project Omega and EBP.

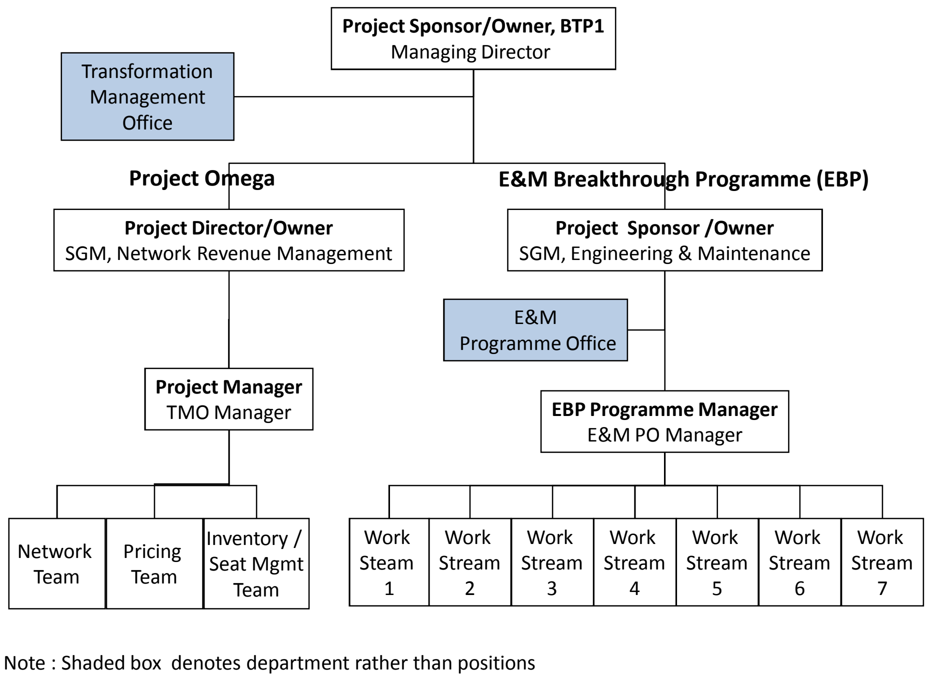

Figure 5.1 : Relationship between BTP1, Project Omega and EBP

Before the initiation of BTP1 and arrival of the new Managing Director, transformation efforts has been IT focused which include an IT outsourcing exercise worth RM1billion, and a series of attempts to integrate disparate systems supporting human resources management, cargo management, engineering & maintenance. Coordinating the implementation of these initiatives was the Project Management & Assurance (PMA) Department, which was set up to provide portfolio management services and project management support to the business divisions; as well as to govern the planning and implementation of these corporate projects. Since most of the projects are IT related, PMA had jointly developed the Project Management Manual (PPM) with the Group IT department to provide guidelines on expected activities and deliverables for each stage of project life cycle.

When the crisis arrived in year 2005, an immediate change in direction had to be made in order to address the following key issues which impact the bottom line directly:

- Low yield
- Network inefficiency
- Over-staff
- Uncontrolled escalation of operating cost

Given this change in emphasis, the PMA department became the Turnaround Management Office (TMO) with a revised objective of driving transparency and discipline of action towards attainment of goals for BTP1.

TMO – the command centre

The TMO is tasked to oversee the initiatives, track progress, measure impact and ensure effective cross-functional communications. In addition, the TMO works closely with the Finance department to produce daily cash reports, weekly financial reports and monthly progress reports for submission to the Board. In essence, TMO is the command centre that spearheads and manages the business change under the direct supervision of the Managing Director. As such, its key performance indicator is the corporate scorecard i.e. the overall success of the business turnaround plan. Having said that, the line management in-charge of the project are still the ones accountable for delivering the results.

In contrast to PMA which was established as a permanent department, TMO is now a temporary set-up and it will be dismissed upon completion of the change programme. Thus the TMO staffs comprising mostly new recruits who are ex-management consultants or experienced middle management are given an informal mission of eventually “graduating” from TMO by joining the operations workforce.

LAB – the solutioning approach

BTP1 was initiated with a series of ”LAB” sessions for each thrust where a team of 10 to 15 staff from various related departments are put together on a full time basis to address the specific business issues until a solution is found. Each of the identified issues is owned by a specific business division (typically the end receiver of the value chain). With the assistance from TMO (and sometimes external consultants), the divisional head runs and facilitates the LAB session which generally lasts for a week. At the end of the LAB session, sub-programmes and/or projects to implement the agreed solution are kicked off and the divisional head typically becomes the Project Owner.

Implementation

The project team mobilized to implement the spun-off projects comprises representatives from various business divisions whose operations would be directly affected by the implementation. With the exception of selected project teams where TMO resources are assigned to help on a full time basis (e.g. Project Omega), most of the teams are assigned with part time resources. In terms of project leadership, the Project Owner who is the divisional head or departmental head typically doubles up as the Project Director as well as the Project Manager.

Status Reporting & Monitoring

On a weekly basis, TMO will facilitate the submission of progress reports which will be reviewed by the senior management every Monday. Unlike the conventional meeting approach of reporting work done and referring to the minutes of the last meeting for outstanding matters, focus is placed on managing by exceptions i.e. what were not completed on time and whether the desired results have been obtained. On a bimonthly basis, the Business Council (comprising the management committee and senior personnel of the key projects) meets and reviews the more detailed status of the projects. On a quarterly basis, TMO audits the minutes of the meetings to see that all outstanding matters have been closed, whilst the extended leadership team reviews the performance of the company and closely monitors the impact/contributions of the projects on the bottom line.

Status of BTP1 Implementation Today

When this case study was conducted in mid 2008, the BTP1 implementation had already been declared as completed as of end 2007, one year ahead of its original schedule. The financial results for year 2007 (up to September 2007) was RM610 million, a highest net profit in the company's 60-year history, surpassing the BTP1's original target of RM500 million profit by year 2008. In anticipation of a tougher operating environment due to overcapacity, liberalization of air traffic in ASEAN etc, the management has launched another 5 year programme called Business Transformation Programme (BTP2) on January 2008 using the same framework. The new vision or goal is to become the "World's Five Star Value Carrier (FSVC)".

5.2.2.2 Project Omega

The sales team in Malaysia and overseas stations used to have absolute control on pricing. Since the sales team's Key Performance Indicator (KPI) is tied strongly to load factors, fare discounts were often given in order to boost sales but they were carried out in an un-orderly fashion with minimal coordination with the Revenue Management team at the head office in Kuala Lumpur. There was also limited interaction between Sales, Revenue Management and Airport Operations, which resulted in poor demand forecasting. A demand forecasting system AIRMAX from Sabre was already in place but its data structure was not optimal. All these led to the problem of low passenger yields across the network.

The first programme undertaken to address this issue was the Revenue Enhancement Project with an objective of getting quick wins, followed by the Route Profitability Project (RPP) which further analyzed the sales operations and revenue management in relations to route profitability. After the conduct of the BTP1's LAB sessions, Project Omega was spun off as the next step which aimed at fundamentally changing both the processes and its supporting systems in 3 key areas namely (1) Network; (2) Pricing; and (3) Inventory / Seats management.

Under the leadership of the Senior General Manager of Network & Revenue Management (NRM) department who is also the Project Director, the scope of work was developed after analyzing and identifying the gaps in the existing operations based on industry benchmarks. This is followed by an assessment on whether these gaps can be closed in-house and finally, Sabre Consulting was given the task to jointly implement the solutions.

The project was officially kicked off in September 2006 and despite the strong resistance to change, the pilot implementation went live in November 2006 where proposed changes were introduced to selected routes. Implementations of all key components were completed ahead of schedule by Febuary 2007, in a record time of 4.5 months.

5.2.2.3 Engineering & Maintenance Breakthrough Programme (EBP)

The Engineering & Maintenance Division (E&M) has over 3600 engineers & technicians, 6 hangars and the charter of planning, managing and executing all maintenance, overhaul and engineering services on the company's fleets. Given the spare capacities, it also renders airframe maintenance services, airport engineering handling services, engineering training services etc. to other airlines, earning non-aeronautical or "3rd party" revenue for the company.

The division has always been very supportive of the corporate-led improvement programmes, for example, the QCC initiative way back in the 1980s. Although the impact of this programme on the company's bottom line was not significant, it was well received by the workforce partly because it offered a break from the mundane routine work as well as an opportunity to improve their own work environment and processes. The following quality movement i.e. Total Quality Control /Total Quality Management (TQC/TQM) programme however, did not go well due to the lack of top management support and a formal framework to guide its execution. Similarly, the six sigma programme introduced after that did not take off because the nature of the programme was too technical for the workforce to master.

When the new E&M senior general manager took over the operations in year 2001, a cost-cutting programme with 19 departmental initiatives was initiated and a new Programme Office (PO) Department was created to coordinate the implementation efforts. Despite the resource constraints and a relatively inexperienced PO manager, the programme managed to deliver 12% cost reduction. Motivated by the future direction of becoming an independent Maintenance, Repair and Overhaul (MRO) service provider and in support of Co1's BTP1 programme, more departmental initiatives were identified and those with significant contributions to the company's bottom line were extracted and grouped to form a consolidated programme. The result is the birth of EBP in July 2006. In November 2006, the programme was supported by a structured and comprehensive programme management framework which an external service provider (led by the researcher) had helped to develop and operate. The framework as illustrated by Figure 5.2, details the project management approach, project tracking mechanism, management reporting requirements, issue resolutions and change management procedures, documentation templates etc. to systematically drive, manage & track the execution of all the initiatives under EBP. Subsequent E&M business change projects such as E&M Boot camp Initiatives (EBI), the Billing Project etc. were also initiated and managed under the same framework.

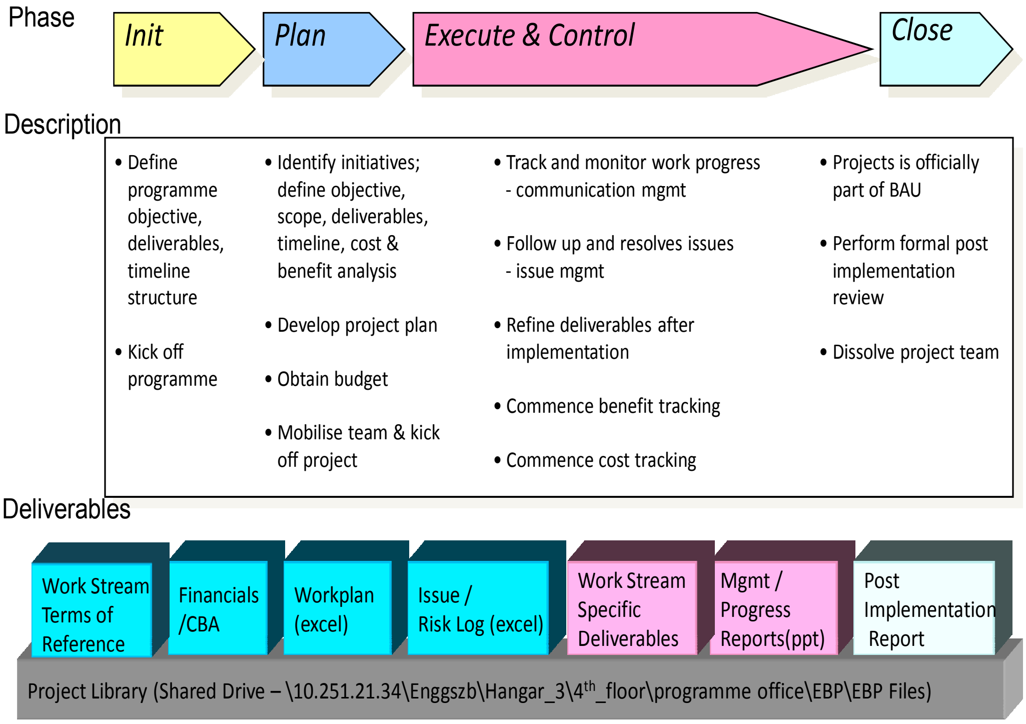

Figure 5.2 : E&M programme management framework

The objective of the EBP is to introduce fundamental improvements in all areas over a period of 2 years (July 2006 – June 2008) in addition to the on-going efforts of implementing departmental initiatives. With reference to Table 5.1, EBP comprises 7 work streams.

Table 5.1 : Objectives of the EBP workstreams

No	Work Stream (WS)	Objectives
1	People & Communications	The mobilization of the workforce around the future objectives of change.
2	Systems	The development of new processes and systems will support a modern E&M business.
3	Productivity	Bringing about a step change in productivity so as to exploit the competitive position of Co1 in the market
4	Customer Relationships	Equip the business with commercial attitude and capabilities, which support the customers
5	Components & Spares	Obtaining competitive supply chain support for the business and ensuring high levels of inventory management.
6	Asset Utilization	Optimizing the use of fixed assets; i.e. hangar and Workshops in SZB and KLIA, to ensure maximum return on investment.
7	Enterprise Design	Optimizing the use of fixed assets; i.e. hangar and Workshops in SZB and KLIA, to ensure maximum return on investment.

5.2.3 Business project success

At the BTP1 level and to the Managing Director, the primary success criterion is that the company is profitable again. Despite its completion ahead of schedule, the success of the programme was not without challenges:

- The first challenge was building the case for change or creating the burning platform to justify and convince all stakeholders on the necessity to change so that they are all on board the turnaround programme. As such, harsh news about planes will be grounded and inability to pay salaries after a breaking point were announced; "town hall" sessions were organized to explain the situation to the staff; and a collective agreement was signed with the Union etc within 2 months.

- The second challenge is about managing the phenomenon of "no breakthrough without breakdown". It was painful to reduce 3000 people, cut routes and sell the headquarter building. As such, results must be delivered as soon as possible so that people feel that the journey is worthwhile and would continue to tolerate the pain and as a result, the efforts will not slow down. The focus must therefore be placed on obtaining quick wins; and achievements must be visible in six months' time.

- The third challenge is about rewards and recognitions. People get tired and worn-out in such a massive transformation exercise, and could become disoriented / distracted over time. This is especially true when results are obtained and employees start asking the question of "what is it in for me?" This calls for an implementation of a performance management system which has not been in place for 60 years. The system aims at identifying the performers to give them due recognition and the Employee Share Options Scheme (ESOS) was introduced.

The Managing Director also felt that two areas in stakeholder management could have been better managed. In particular:

- the government – as a government linked company, the senate was briefed on the reason to change but the queries from the backbenchers were not well answered. Since then, efforts have been made to also bring them on board through bi-monthly briefings with the backbencher's club.

- the suppliers and the travel agents – they could have been engaged earlier so that they understand the rationale for Co1 to reduce cost and came on board at the very beginning.

At the TMO level, it is felt that the conventional triple success criteria of delivering on time, within budget and according to specifications should be extended to include (1) meeting the set financial targets, (2) ensuring that the value of implemented changes is sustainable. The success of the BTP1 was said to be attributed to:

- Top management support and strong leadership
- Well defined goal and focus
- Clear accountability and provision of incentives for successful implementation
- Participations from the operational level and a competent team with the right business knowledge, background and experience
- Open communications and transparency

At the Project Omega level, the primary success criterion is meeting the targeted contribution to the company's bottom line. Having said that, the Project Director was very specific in pointing out that there were other important criteria as well:

- That the project meets the stated business objectives "over time" rather than "on time". In support of this criterion, the network performance is measured and improved on a daily basis rather than right at the end of the project.

- That the project reflects a true comprehension of the business. This is of particular importance to Project Omega since NRM is a very specialized field. The project is allowed to do trial and error but the no mistake can be made twice.

The quoted key success factors for Project Omega were top management support, strong project management fundamentals, domain knowledge of the team members and effective open communications.

At the EBP level, success criteria quoted by the interviewees were as follows:

- That the project delivered per specifications, within the stipulated time and budget.
- That the project met its original objectives
- That the project meets its intended business needs, at both the divisional and the corporate level.
- That the project contributions are not one-off but realized consistently on an on-going basis and/or have a long term effect. In other words, the introduced change must be sustainable.

The success factor of EBP on the other hand, was attributed to the following:

- Strong top management support
- The effort of the E&M programme office in spearheading the change, integrating the work streams, tracking progress and sustaining the momentum of the programme. It was stated that since PO is positioned as an independent and objective party, it has helped to resolve cross-functional

conflicts and facilitate issue resolutions effectively. PO's effort of tracking and consolidating the programme's financial impact on the bottom line had also helped to align E&M contributions with BTP1, in addition, uplifted the team's understanding in this area as well as keeping the team focused on delivering performance rather than the physical output.

Having said that, it was also felt that improvements in the following areas must be made in order to ensure continued success for the programme:

- That the operating level should be directly involved in the project work so that they would be more receptive to the proposed changes and thus, the implementation would be more sustainable.

- That the general resistance to change due to lack of understanding on the need and impact should be better managed, for example, the fear that the project will result in downsize or more work should be addressed.

- That business change project should have the flexibility to adjust its scope, approach etc. according to its changing business needs. It is therefore, more viable to segment large business change programme into smaller executable chucks which can be completed within a year. Further expansion after that should be optional in case the company changes priority.

- That project participation should be aligned to the team member's functional responsibility, for example, if a part-time team member and/or team leader has been transferred to another functional department, his role in the project should be replaced by another representative from his original functional department.

- That the project has competent team members who understand the business.

- That the project team should be full time on the project to allow focus.

5.2.4 Type of organization structure

At the BTP1level, the Managing Director stated that the TMO may not be a temporary set-up after all, if Co1 wishes to continue the change effort in order to remain competitive. The business transformation plan (BTP2) for the next 5 years has since been launched and similar series of LABs have been initiated. This may be followed by a BTP3 that looks into business breakthrough i.e. a new way of doing business. One good example is the KLM-Air France partnership in order to realize synergy in both cost and value.

For Project Omega, it is owned and directed by the Senior General Manager (SGM) of NRM department and Figure 5.3 summarises its team structure.

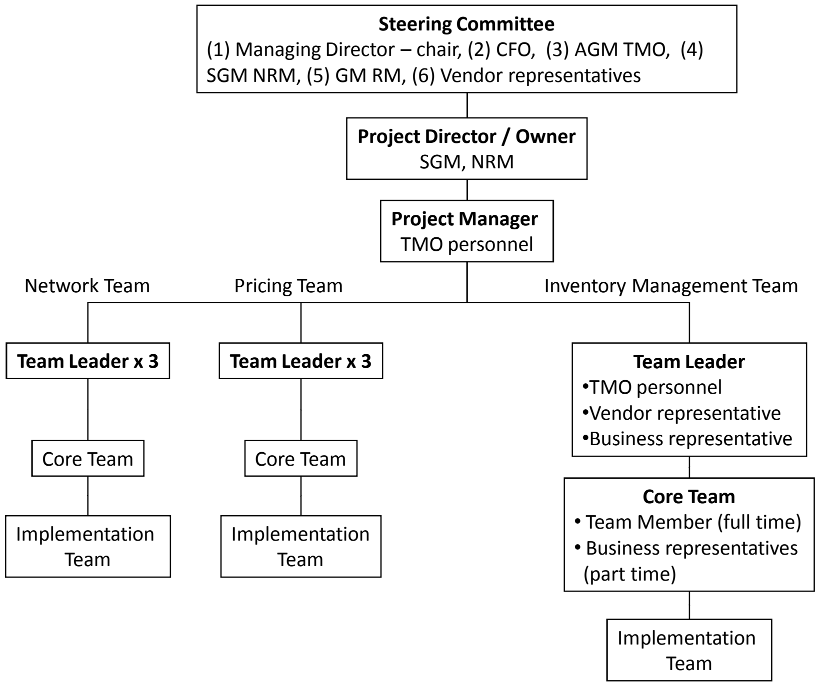

Figure 5.3 : Project Omega team structure

The set-up is relatively conventional except that all 3 project teams are co-led by 3 persons and thus, the responsibility for the project success /failure is shared. Taking the inventory management team as an example, it is jointly led by (1) a TMO assignee who is responsible of overall coordination; (2) vendor representative who is responsible of proposing system solutions and performing the corresponding system configurations; and (3) business representative who is responsible of data analysis and solutions review. This co-led arrangement apparently works well and the classical issue with dual leadership did not arise. This could be because there is one more party namely the TMO leader who moderates between the service provider and the business user.

Similarly at the core team level, there are representatives from the TMO, vendors and business departments. The TMO reps and the vendor reps are full time whilst involvements from the business reps are part time. Most business reps do not have prior project experience and thus the project did face issues with business users slipping deadlines. The project was successful nonetheless due to the strong commitment from the team members and because the initiative was top-driven.

In terms of implementation, a separate team is formed to roll-out the solution in phases by geographical regions; and the project rides on the methodology and tools of the consulting firm Sabre, which was engaged to implement the project. This approach of setting up a separate implementation team approach is especially important to the pricing team since changes need to take effect in all the offices worldwide. This is done by bringing representatives from the remote offices back to the HQ for debriefs so that all the implementation issues can be sorted out before they return. For the inventory management team, the “cooking pot” approach was used for the roll-out where the end users are provided with a checklist and briefed on what needs to be done. This is followed by workshop sessions where the core project team member sat with each end user to ensure that the items in the checklist are carried out correctly and the new processes are signed off.

In terms of progress reporting, project status is tracked very closely on a daily basis. At 5pm every day, the team assembles and examines the network performance, identifies the issues so that they can be addressed online real-time if possible. If a higher level decision is required, it is brought to the attention of the management as soon as possible for resolutions. From the stakeholders’ standpoint, progress report is submitted every Friday; steering committee meeting are held periodically to ensure timely update; and ad hoc meetings are arranged as and when required to secure buy-in from stakeholders on specific matters.

In terms of staffing, it is felt that the initial selection of team members could have been better since some in-house team members as well as Sabre consultants were found to be unsuitable for their roles and had to be replaced. When the project was completed, the team members returned to their previous operational team whilst the TMO assignees were transferred to the operational team in order to ensure continuity for the implemented changes.

In terms of rewards and recognition for project work, the team has been rewarded based on the overall success of BTP1 but not on the success of Project Omega. The project team is able to request for a special bonus but has not exercised the option thus far. It is also noted that some of the project team members were promoted when they are transferred back to the operational team.

A total of 24 operational reports are now generated by the fine-tuned Network Management system on a regular basis. These reports accompanied by analysis findings, are reviewed by various levels of management including the SGM himself for identification of gaps and/or market opportunities (through comparison with set KPIs and industry benchmark). This on-going review in turn, had triggered new projects and initiatives, for example, project MOSAIC to enhance Hub-and-Spoke network by establishing strategic alliances; and project SURPLUS to offer “Everyday low fare”.

For EBP, the programme is owned and directed by the E&M Senior General Manager (SGM) and the programme organization is as illustrated by Figure 5.4.

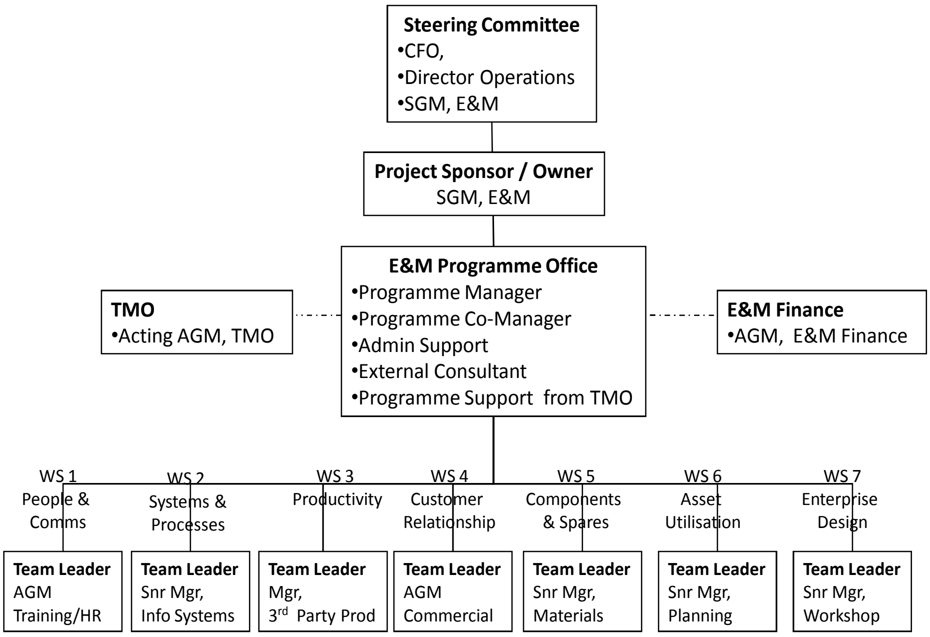

Figure 5.4 : EBP team structure

With the exception of work stream 7, the project managers of most work streams were heads of the functional departments who are the direct beneficiaries of the project implementation. Under this project organization structure, considerable amount of pressure is placed on the departmental heads as they need to manage both the daily operations and the project initiatives. The project team members on the other hand, are operational staff appointed by the departmental heads to participate in the project activities on a part time basis. Thus in most cases, the work streams are essentially a subset of the corresponding functional department. The E&M PO on the other hand, is headed by a Assistant General Manager (AGM) and assisted by a Manager. The other key position in the PO is the "Programme Support" executives, who are tasked to ensure that the PO adds value by participating actively in team meetings, mediating cross-functional conflicts, as well as filling in for the part-time team leader when operational duties caught up with them etc.

The PO is responsible for the following scope of work:

- Ensure convergence of all initiatives towards organisation goals and objectives;
- Integrate project activities, timelines & deliverables of the EBP work streams, departmental initiatives and any other new initiatives as they are introduced;
- Identify, track and resolve integration issues;
- Drive, track & monitor progress of all projects/initiatives;
- Track & monitor cost and benefits of all projects/initiatives;
- Facilitate project activities and issues resolutions as required;
- Provide project management assistance to project teams;
- Generate management reports.

In addition to the integration role within E&M, the PO is also given the charter to link E&M initiatives to the corporate-led programme by ensuring that the E&M projects remain relevant, as well as spinning off new initiatives to close the gaps if any. As such, the PO reports directly to the E&M's SGM to ensure that its operations are sensitive to the latest change in its business environment at both the divisional and corporate level. Last but not least, the PO is accountable for providing feedback to the corporate management on the progress and success of E&M projects.

Since the PO covers both strategic and operational aspects of programme management work, the AGM felt that it should be a permanent function in the organization to execute continuous business improvements in order for E&M to remain competitive in the market. Other interviewees on the other hand, stated that although the project management framework currently maintained by the PO is sound, the delivery capability of some of the PO staff needs to be improved due to their lack of formal training and exposure to project management work before taking up their current positions. In addition, the PO should be more proactive in their work i.e. foreseeing issues and perform active facilitation to ensure work progresses, rather than reacting to issues after they have been raised.

In terms of progress reporting, project status is tracked closely on a weekly basis. At 3pm every Friday, team leaders would present work status, highlights key issues and seeks management endorsement on the recommended next steps. On a monthly basis, steering committee meeting is held to ensure timely update on progress and resolutions of issues which could only be addressed at the divisional level.

In terms of recognitions for project work, the team was rewarded by the success of BTP1 but not the success of EBP. However it is also said that the E&M staffs are not particularly fond of participating in project activities, as project work has been perceived as more beneficial to the organization rather than personal development. To make things worse, there have been cases in the past where project team members have no position in the functional department to go back to when the project completes. The other reason behind the unwillingness to participate in project work was said to be the reluctance to venture into the uncomfort zone, which is a rather common behaviour among technical personnel. Although the nature of the aircraft check resembles that of a mini project, delivering relatively abstract business change work is an unexplored territory for most staff. To improve the situation, the following has been proposed by the human resource department:

- To include project exposure/experiences as criteria for career advancement in order to encourage project participations;
- To implement a more comprehensive framework that embraces project work e.g. to support seamless inflow/outflow of personnel between projects and functional departments;
- To provide structured project management training to prepare technical staff in dealing with their conscious incompetency in project management of non-technical projects; and
- To complement E&M's current technical training curriculum with soft skills training in order to build a strong foundation for project management competency.

5.2.5 Project management competency

To the Managing Director, project management is an essential skill but it is no more than an enabler because it is still the project content that matters most. The project has to be doing the right things so that the right capabilities can drive it towards achieving the right goals.

For TMO, it is acknowledged that project management is an essential competency for the project managers and communication management is the most important skill set due to its strong affiliation with effective change management. It is also pointed out that the required competency of the TMO manager is slightly different since the nature of their work demands higher integrity, objectivity and versatility.

For Project Omega, the Project Director felt that the key responsibility (thus required competency) of the project manager is to uphold "discipline of actions" namely to organize and control the project timeline and project scope, ensure timely delivery by the responsible parties and perform timely progress reporting. Knowledge of the industry/business is not a necessity but the project managers are expected to work closely with the business users during implementation. The Project team leaders on the other hand, felt that different project management competencies are required at different stages of the project management life cycle. For example, project definition stage requires good scope management to set the scene; whilst project execution stage requires good time management to diligently track progress, communications management to support issue resolutions etc. Budget or cost management is felt to be of less importance since the required project investments have already been built into the operating expenses of the business unit.

While the importance of project management competency is acknowledged, it is felt that the required skills are not difficult to acquire. One should understand its fundamentals in order to start; the rest can be gained through hands-on experience. In terms of whether it is a necessary skill for career progression, it is said that project management exposure is good to have but not essential especially for operational positions.

For EBP, all the E&M interviewees felt that project management competency is an important skill set. The SGM highlighted that the skill is even more important for senior management as the nature of running a business or an operation supported by multiple functional departments is fundamentally similar to running a project supported by a project team comprises representatives from various functional departments. There is however, no formal training for project management competency within E&M today, and it is realized that human resources management, risk management and communications management are the competency areas requiring further improvements.

In terms of relative importance among the 9 project management knowledge areas specified by PMI, project management fundamentals namely time and scope management were given the highest ranking followed by communication management. More than one interviewee on the other hand, has highlighted the importance of leadership skill quoting that the project manager is essentially playing the role of a change leader.

5.2.6 PMIS support

To the Managing Director, the use of Information Technology (IT) is a necessity for business rather than a differentiator. The real differentiator is execution i.e. how well the key business activities are carried out. Having said that, technologies such as blackberry has been very useful in enabling direct access to business performance related information such as daily P&L, On Time Performance (OTP) of the flights etc. If IT were to be deployed in support of project management, it should be used along the same line of delivering online real-time information.

For the TMO team, MS-Project is used to track deadlines and manage resources; MS-Powerpoint is used for management reporting; MS-Excel and MS-ACCESS (due to data volume) are used for data analysis. Email is the primary tool for communications whilst the company's financial management system is currently used to track benefit realization at the organizational level. It is also noted that approximately 3 hours per day is spent on gathering status of projects and maintaining issue log based on input which came in different formats. Given the opportunity to design a project management information system, the suggestions were for the system to automatically track timeline and prompt the project managers for actions as necessary, as well as to reflect project status on a real time basis. The system should also have a knowledge management facility which captures issues and the details of how they were resolved. An ability to refer to lesson learned from previous projects will also be very useful for planning, resource deployment and content management of future projects.

For Project Omega, similar standard office automation tools are used in support of project work namely Microsoft Project for tracking timeline, Microsoft Excel for tracking issue log while files are shared through email exchange. These tools are chosen due to their ease of use and because they are readily installed in all desktops. It is felt that the scale of Project Omega does not warrant a PMIS as compared to for example, a global initiative which requires the system to consolidate weekly status based on input from project teams from all around the world. Such a PMIS may also be useful for the Programme Office given the higher volume of coordination and administrative work. Thus even if a comprehensive PMIS were to be installed for free, the Project Omega team would first evaluate if it is worth the implementation effort by assessing its functionalities, user friendliness, set-up time, maintenance efforts etc.

As with the use of IT to capture lesson learned, the team felt that such a system will be essential to a consultancy firm but not necessary for a business unit like theirs. Their issue with IT system in the past has been the suboptimal implementation of a good application system. The implementation efforts tend to focus around customizing the new system based on current processes rather than adopting the best practices embedded in the new system. If the intent is to automate the internal processes, outsourcing the operations could have been a more viable solution. In addition, there is a general lack of IT proficiency among the business end users attributed to the lack of training.

For EBP, with the exception of work stream 1 which uses MS-Project to track timeline, MS-Excel is used as the all-purpose tool that tracks project timeline, project issues as well as project cost and benefits. MS-Powerpoint on the other hand, is used for project documentations and management reporting.

The interviewees acknowledged that there is a general lack of awareness among them about what PMIS can offer. Given the opportunity to design the system, the following were listed as the functional requirements:

- Tracking and updating of all project related activities namely project timelines, work status, issue, expenditures, man-hours spent as well as values/benefits attained by the project to date (which should tie to company's performance in terms of revenue increment and cost reduction);

- Auto-triggering / prompting on delay or potential delay of project tasks;

- Online real-time status reporting in "traffic lights" format for the management;

- A repository for project archives to ease future learning;

- An automated project management framework that guides those which are still new to project management in executing their project management tasks;

- That the system is easily accessible and hassle free to use as well as accessible through the mobile phones.

One of the interviewees was very specific in pointing out that the IT department should spend more time on researching, educating and exposing its business users to the latest technology available to support their work. The IT team should also possess good knowledge and understanding of the business they support in order to play a more effective role.

5.3 Supporting Case Study 2 – Co2

This section first presents the overview of Co2 and background information of the programme/projects understudied; followed by a summary of the case study data and findings organized by each variable in the conceptual framework.

5.3.1 Overview

Listed on the Kuala Lumpur Stock Exchange (KLSE), Co2 is the sole operator of direct-to-home satellite pay television services in Malaysia. Its entertainment network today encompasses 110 multi-lingual, multi-genre channels, out of which 27 are Co2 branded or affiliated. In addition to distributing third party content, the group is actively involved in the in-house production of entertainment, information and news programmes in Malay, Chinese, English and Indian languages; provision of interactive TV services through other communication means such as mobile devices; as well as publications of entertainment and lifestyle magazines. Other related businesses parked under the subsidiaries of the group include:

- Airtime Management & Programming services of eight FM terrestrial radio stations, which cumulatively reach over 10 million listeners a week or half the total radio listeners in Malaysia; and command a substantial proportion of the radio industry's advertising expenditure;

- Entertainment content services which create content for distribution primarily to the Malaysian and Indonesian markets. The Group is also a premier producer and distributor of Malay films and provides a platform for leading local producers and directors to hone their creative skills and capabilities in film production;

- Film distribution services which own and distribute the world's largest Chinese film library as well as operates a Chinese Movies Channel;

- Animation services which produces popular animated content.

The Group also plans to increase its participation in large under-penetrated economies that will benefit from the anticipated liberalisation of the media industry and the fast-growing consumer sector, particularly in the developing regions. Today, Co2 has already invested in radio and television services in India and Indonesia.

As of 31 January 2009, the group revenue rose 17% to RM2.6 billion as subscription and advertising sales improved. This rise in revenue however, was partially offset by rises in content cost and customer growth related operating activities. The EBITDA (Earnings Before Interest, Tax, Depreciation and Amortisation) margin was therefore lower at 21% against 24% in the previous year. Coupled with the start-up costs of its overseas investments, the group incurred RM6.2 million of losses, its first since public listing.

In view of the escalating cost and the expiry of its exclusive licence for satellite DTH transmission in Malaysia by year 2017, the group initiated the "Transformer Programme", a corporate wide transformation programme in preparation for the open market as well as the increasingly competitive media industry given the rise of mobile

TV, free channels and internet TV enabled by availability of high speed broadband and change in regulations for the industry.

The case study started in April 2008 and the programme understudied is the Transformer Programme. The first interview session was conducted with the Transformer Programme Director, followed by 2 interviews with the project managers. But there was no follow through after that due to the heavy workload of the programme. In July 2008, the study came to an abrupt halt when the Programme Director left Co2 upon completing his contract. Official request for Co2 to participate had to be resubmitted and with the support of the Corporate Programme Management Office, the exercise finally recommenced in November 2008 and completed in February 2009.

By then, a new Transformer Programme Director had come on board and the programme was already in the midst of systems design. Again due to their heavy workload, interview with only 3 persons were granted namely:

- Head, Corporate Programme Management Office;
- The newly appointed Programme Director for the Transformer Programme;
- Business Owner for Transformer Programme, who is also the Chief Operating Officer (COO) of Consumer Business.

Per agreement with their senior management, only information gathered by the second batch of the interviews shall be used in this study.

5.3.2 Background information

The nature of business projects undertaken by Co2 can be loosely grouped into the following categories:

1) Customer focused
   - Introduction of new content
   - Expansion of distribution channels
   - Upgrade of customer equipments
2) Branding
3) Internal Improvements
   - Upgrade of service infrastructure
   - Upgrade of supporting business systems

The Transformer Programme falls under the third category where it is an IT enabled business transformation programme with the objective to enhance end-to-end customer experience from the time they sign up, to their everyday exposure to the services. This is expected to be achieved by:

- Strengthening front line customer service capability with process improvements;
- Stabilizing Customer Relationship (CRM) & Billing System; and
- Refreshing the ancillary IT and technical infrastructure.

5.3.2.1 The Transformer Programme

The programme was organized into 6 work streams and the specific areas of application systems development are (1) CRM and Billing; (2) Web portals for dealers and customers; and (3) end-to-end fulfilment management. The CRM and Billing system enhancements would be performed by the software developer Amdocs, whilst the web portals and end-to-end fulfilment solutions would be developed from sketch by Accenture. The requirements study phase was completed in December 2007 and the programme was officially kicked off on 17 March 2008. A Transformer Programme Management Office was set up to coordinate the work of all key parties involved which include two external vendors (Accentures, Amdocs) and two key stakeholder groups (IT, Business). The previous Programme Director is a General Manger with limited project management experiences; and each work stream is headed by a project manager who is in turn backed by a team comprising representatives from the 4 key parties as mentioned above.

In August 2008, the new Programme Director introduced major changes to the programme in order to address the following key issues:

- The Transformer Programme Management Office (PMO) is “split” because it was jointly run by 3 parties (namely Co2 IT, Co2 Business and Accenture); and each of them is responsible only for their own team and scope of work. In addition, this set-up did not go down well with the other service provider Amdocs.

- There is no prime vendor. As a result, Co2 is playing the integrator role by pulling everything together but the rep in PMO does not have the required competency. Consequently, work of one vendor was carried with limited involvement from the other vendor.

- The programme adopts a big-bang implementation approach which adds on to the complexities and difficulties of the integration work.

The revised approach moving forward was as follows:

- Current Accenture led systems design work will continue and complete by Feb 2009. After which Amdocs will be appointed as the prime vendor and takes over Accenture's original scope of work, with the option of contracting Accenture directly if necessary.

- The programme will become vendor led. The Programme Director will take on the governance role with the support of the Steering Committee.

- Co2's corporate auditor, PriceWaterhouseCoopers or PwC, will change its current post-mortem audit role and become a proactive "Gate Guardian". It will be responsible for determining suitable milestones and validating quality of work delivered.

- The programme will adopt a phased-implementation approach where primary focus shall be placed on the upgrade of Amdocs' core system modules, followed by out-of-box functional increments (i.e. with minimum customization). Amdocs professional services will be engaged to perform gap analysis (in alignment with the company's 3 year business plan) as well as to lead the subsequent configurations and implementation of new functionalities.

In support of the revised approach, the new Programme Director will be preparing a new business case for the board's review. The focal point of the business case is the qualitative benefit of replacing the current IT platform which is unstable due to extensive customization. The quantitative benefits on the other hand, are those related to improvement in operational efficiency & customer experience etc. A total of 1,967 user requirements have been identified and success criteria for each are expressed in terms of Key Performance Indicators (KPIs). It is proposed that PwC be responsible for tracking the attainment of these KPIs, as part of their quality assurance role to ensure that the programme is delivering the expected impact on the business. The vendor's payment schedule will be tied to the attainment of these KPIs at the programme level, whilst the Business Owner will be responsible for achieving the corresponding business KPIs at the organization level. In other words, KPIs will be implemented throughout the lifecycle of the programme and not just post-deployment.

5.3.2.2 The Corporate Programme Management Office

Aside from the Transformer PMO, there is a Corporate PMO which is a permanent set-up that oversees all project initiatives within Co2. This PMO is headed by a PMO Head, who is supported by a team of 6 namely 3 Portfolio Partners, 2 Programme Managers and 1 Process Officer. Portfolio Partners are responsible for supporting series of projects which are organized under the customer, content and technology portfolios. The term "partner" is used to denote their close working relationships with the business divisions. Programme Managers are deployed to assist execution of programmes whilst the Process Officer is responsible for supporting activities related to new process design etc. The PMO Head used to report to the company's General Manager, but the department is now parked under the Financial Controller of the TV division. Nonetheless, the department has always functioned independently and extends its support to projects outside the TV division.

The key responsibilities of the PMO include (1) portfolio management for the CEO; (2) project management governance; (3) project management advisory and support. It is claimed that Co2 may be the only organization in Malaysia where its Corporate PMO does true portfolio management work. This means the PMO is given the authority to review the feasibility of the projects within each portfolio, assign priority, cancel or propose more initiatives as deem necessary. Last but not least, the Corporate PMO conducts corporate wide project management courses in order to upgrade project management awareness and competency throughout the company.

The engagement level of the Corporate PMO however, differs by divisions and/or projects. For projects under the portfolio of direct interest to the CEO, the Corporate PMO plays an active role in the development of business case, project plan etc. For projects initiated at the divisional level, only some of them go through the Corporate PMO via the Portfolio Partner. The involvement of the Portfolio Partners in these projects on the other hand, ranges from consultative to execution of detailed work such as developing the project plan. The Portfolio Partners in essence, are filling up the gaps as they see them.

In terms of progress tracking, Portfolio Partners update the PMO Head periodically to ensure that all initiatives align and converge to the organizational goals. The PMO Head in turn, submits a management brief comprising a dashboard, updated timeline and detailed status to the CEO every 2 weeks; and discusses project status with the other senior management through a face to face meeting on a monthly basis.

The Corporate PMO has planned to standardize the project management practices and processes across all business divisions; and had conducted a gap analysis exercise in 3 areas namely (1) critical success factors (2) stakeholders (3) maturity of tools. Consequently, an action plan detailing the milestones to be achieved and the steps required to close the identified gaps has been developed. Changes are expected to be rolled out in phases every 6 months but the implementation of this corporate wide programme /project management framework has been slow due to the lack of senior management sponsorship.

Nonetheless it is said that since the establishment of the Corporate PMO, projects are kicked off in a more organized manner and work is now supported by a more formal matrix structure. In terms of resources commitment, although part time project involvement still prevails today, the situation is changing where more departments are beginning to reorganize themselves to better support project work. For example, instead of having 2 persons dividing their time between operational work and project work, the arrangement now is to have 1 person full time on operational work and the other person full time on project. In addition, project exposure has found its place in the personal development plan for managerial positions although it is still not a formal criterion in performance appraisal. The need for professional project management services on the other hand, is also better recognized these days where selected divisions have insisted on engaging professional project managers to run their projects.

5.3.3 Business project success

All interviewees felt that project success should be defined at 2 levels:

- At the project level, the goals are more specific namely meeting time, budget and specification.

- At the programme level, the goals would be to deliver the business case, in terms of both qualitative and quantitative benefits.

It was also stated that meeting business objectives are of higher importance in comparison to meeting the project's iron triangle. At times, adjustments to the time, budget and specifications may be required in order to meet the stated objectives.

In terms of key success factors, the following were stated:

- Planning – to set the scene in terms of both direction and content, as well as to systematically guide subsequent activities.

- People – to have an enthusiastic team with the right attitude, who are resourceful in problem solving and flexible in responding to changes. Although specifications are always spelt out at the beginning of the project, there will always be changes along the way.

5.3.4 Type of organization structure

The current team structure of the Transformer Programme after the new Programme Director came on board is as depicted by Figure 5.5.

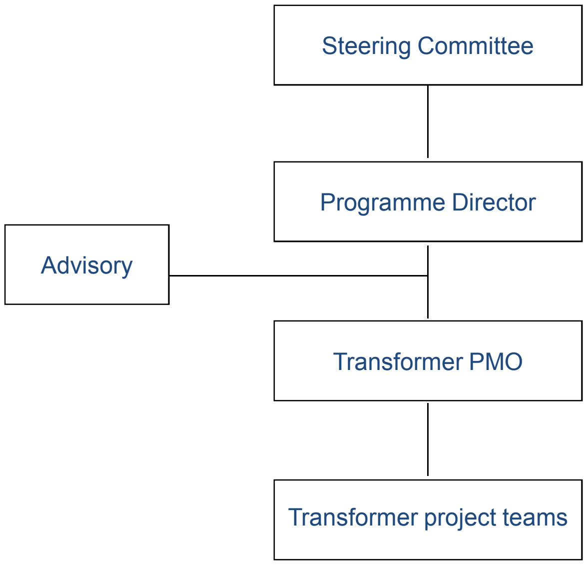

Figure 5.5 : Transformer team structure

The Steering Committee is now chaired by the CEO and the members are (1) Business Owner of the programme, who is also Business COO; (2) Transformer Programme Director; (3) the IT Director; (4) the Commercial Director; (5) the Broadcast CTO; and (6) The Financial Controller. The large number of business representatives in the Steering Committee reflects that the programme is led by business, executed by IT.

The Transformer PMO is still co-managed by 3 persons at the present moment (representatives from Accenture, Co2 IT and Co2 Business); but this arrangement will change with the revised approach since the role of Co2 personnel in the programme is expected to change from directing the "how" to specifying the "what". The advisory role in the team structure has not been filled but it is proposed that PwC takes up this responsibility.

In terms of staffing, the project manager positions are filled by external recruits since in-house resources do not have the technical and industry knowledge as well as similar project experiences. The project team members on the other hand, are full time representatives from the business departments, IT department and the software vendor. Given the magnitude of the programme, the business representatives are assigned to the Transformer project on a full time basis. While full time project involvement may cost them their positions and/or lost of seniority in their original functional department, the business representatives are encouraged by the opportunities of gaining project exposure. Thus there has not been much of an issue in terms of staffing business representatives into the programme.

In term of recognitions for project work, there is no explicit human resources policy at the corporate level that rewards project participations; but the Transformer Programme has introduced incentives for completing the project.

In terms of progress reporting, there is plan for the Steering Committee to meet more regularly i.e. every 2 weeks. In addition, since Amdocs will be playing the key role in the programme moving forward, the last 0.5 hour of the Steering Committee meeting will be dedicated to resolving Amdocs related issues. A bi-monthly meeting will also be held between Co2's CEO and the Vice President of Amdocs who is accountable for the programme delivery.

In terms of programme execution, the current thought is to organize the programme into 3 phases:

- Phase 1 : Technical, i.e. upgrade of Amdocs core modules;

- Phase 2 : Realization, where focus shall be placed on usage and business integrations especially for the implementation of customer segmentation, account hierarchy, simplified billing etc.; and

- Phase 3 : Business As Usual (BAU), i.e. assimilation of implemented changes into daily operations.

The Transformer PMO will decrease its involvement starting phase 2 and eventually, the programme will be taken over by the IT PMO (which has yet to be formed). It is hoped that by doing so, good practices from the vendors such as packaging modifications into releases would be picked up and followed through by a functional department rather than a temporary set-up within Co2. Phase 2 is also when the benefit tracking will start.

From the Business Owner's point of view, it is agreeable that there should be only one "master" in the Transformer PMO. However, it is felt that the revised approach has not explicitly defined the change management responsibilities. It is currently assumed that the Business Owner will take up this role. It is also felt that the project organization should be an integral part of the permanent business, but large scale transformation programme with long implementation timeline can end up executing independently. This is especially true when the programme is taken over by "second generation" management who may not relate to the original project goals/objectives as well as the project initiators, as in the case of Transformer Programme. It is therefore important that the alignment between the project organization and the permanent organization is consistently assured.

Given the self-contained organization structure and the magnitude of programme, the new Transformer Programme Director envisages that Transformer PMO would have little interaction with the Corporate PMO other than general information sharing. While he supports the need for a robust and demonstrable Corporate PMO, he also thinks that the current Corporate PMO has not been very effective in their work. This view is shared by the Business Owner who felt that the consolidation work currently executed by the Corporate PMO has incurred a lot of overhead and is adding on another layer of bureaucracy.

5.3.5 Project management competency

In general, scope management is considered to be of utmost importance, especially since external service providers are involved. If scope is not well controlled, many other components will be affected.

At the project level, it is sufficient for the project manager to focus on meeting the time, budget and specifications (i.e. the black and white or more technical issues). Based on past experiences, a good project manager is one who comes with relevant experience and the ability to engage with stakeholders. PMI certification of the practitioners is seen as less relevant than the above qualities.

The programme personnel on the hand, is expected to fill the gaps and attend to the grey areas, e.g. the integration issues. They are expected to possess a good understanding of the business as a whole, so that they could manage both the business's expectations and the vendor delivery effectively. Therefore it is said that the PMO role is not for those who only understands theoretical aspects of the work but an experienced practitioner with similar programme exposure as well as a proven track record of mediating and problem solving.

Other than scope management and integration management which are considered fundamental to project and programme management, the emphasis on soft skills and work experiences are agreeable by all 3 interviewees as reflective in their ranking for the 9 PMI KAs:

1) Scope management and expectation management
2) Integration management (especially planning)
3) Human resources management
4) Communication management
5) Time management
6) Risk management
7) Quality management
8) Cost management
9) Procurement management

It was also felt that the strength of the in-house expertise lies with scope management and areas requiring improvements are integration management, communication management, time and cost management.

To the Business Owner, he felt that all managers practise some form of project management in their operational work, perhaps unconsciously. Thus, project management should technically be considered as a basic management skill, which is a combination of science and applications of common senses. Experience is a key attribute of a competent project manager and similar to other management skills, it cannot be taught in school. Thus the required level of competency and experience of a project/ programme manager really depend on the magnitude and technical complexity of the project /programme. In the case of Transformer Programme, it is a job for a specialist project /programme manager especially since the technical knowledge of the Amdocs billing system is essential.

5.3.6 PMIS support

Project activities are currently supported by basic office automation tools namely Ms Excel, Ms Word and Ms Powerpoint for documentation and reporting; and Ms Project for timeline tracking.

To the Business Owner, the most apparent lack of IT support is the use of collaborative software such as Lotus Notes, to facilitate effective sharing of project materials as well as information exchange. Similarly to the new Transformer Programme Director, the main issue he faced was not having enough information to work with. When he first came on board, the project plan was not underpinned, individuals keep project information in their own spreadsheets and there was no consolidation of any form. As a result, he has to put the following improvements together in order to move forward:

- For project planning & progress tracking, the team will be guided by a detailed project plan (down to daily activities) developed jointly by all parties. MS Project will be used since it is readily available and introducing a new tool may create issue with cost and familiarity;

- For cost tracking, 3 person (representatives from Corporate PMO and Finance) have been assigned to perform the related tasks including developing the budget / cost tracking processes. Status as of today, 75% of the processes are already in place and the implementation of procurement processes is next; and

- Issues, risk, dependencies, management actions etc. are now centrally captured and tracked effectively by the Rationale tool, which also comes with a “DashBoard” feature.

Tools to support benefits /KPIs tracking have not been identified at this stage although the Programme Director envisages that this activity will be driven by PwC in their advisory and monitoring capacity. The Business Owner also agreed that a tool to track project cost and benefits is necessary, and added that segregation of these items from the overall business performance reports is possible. The Corporate PMO Head however, felt that it would be easier to track project benefits using Ms-Excel rather than a PMIS. This is because different projects are expected to yield different types of benefits. An automated system that has the intelligence to map and track the convergence of all these types of benefits in relations to the overall organizational performance is likely to be sophisticated and thus, may not be worthy of the development effort.

In the case of project learning, the corporate PMO is planning to develop an intranet portal to support knowledge sharing ("community of practice"). At present, the corporate PMO is itself the project knowledge exchange, with the support of shared file folders. The role of the PMIS in project learning would be to present the data in an organized /systematic fashion to support the analysis and learning processes. The Business Owner also agrees with the need to capture project knowledge although he doubts if the collected wisdom would actually be referred to in practice.

In terms of level of sophistication, all interviews agreed that high end PMIS such as Primavera would be an overkill; and the search for a suitable system to support business projects according to the Corporate PMO Head, has not been fruitful to date.

In general, the new Transformer Programme Director felt that it is only meaningful if the PMIS is used to support the bigger picture i.e. the complete project management framework rather than selected areas in isolation. The implementation however should not be obsessive (as in the case of six sigma implementation in Vodafone) and senior management sponsorship will be crucial to success. The Business Owner on the other hand, felt that the success of a PMIS implementation depends on usage which can be achieved either through enforcement by the company or users exercising self discipline. Self discipline on the other hand, will be motivated by how well the user requirements (in terms of both content and presentation) have been met.

5.4 Supporting Case Study 3 – Co3

This section first presents an overview of Co3 and the background of the programme/projects understudied; followed by a summary of the case study data and findings organized by each variable in the conceptual framework.

5.4.1 Overview

Founded since year 1975, Co3 is now a leading banking group in Malaysia with almost 10,000 staff. It offers an extensive range of banking and financial services which include investment banking, commercial banking, retail financing, leasing, stock broking, insurance, asset/fund management, futures and options trading, as well as offshore banking. The group is a pioneer in many areas in the banking scene of Malaysia, for example:

- the first private sector institution in Malaysia to issue public bonds;
- the first venture capital company to undertake private equity investments;
- the first merchant bank to be listed on the KLSE;
- the first merchant bank to offer offshore banking services;
- the first to launch the first equity unit trust fund; and
- the first to launch the first Islamic unit trust fund.

In addition, the group are winners of numerous prestigious awards in recognition of its excellence in investment banking, automotive hire purchase business, product innovation as well as friendly services, in particular:

- 1996 Member Excellence Award for the Most Creative Card Programme in Asia by Visa International;

- Most Customer Friendly Services Award for the Contact Centre by Banking Expo 2007;
- No. 1 Automobile Lender in Asia Pacific, Gulf States and Central Asia; by Asian Banker Excellence in Retail Financial Services Awards 2007;
- Best Equity House by Finance Asia Country Awards for Achievement 2007;
- Seven RAM League Awards for its outstanding achievements in the domestic bond market by Rating Agency Malaysia (RAM).

In May 2007, a foreign bank became the single largest shareholder in the group as Co3 works towards positioning itself as a leading institution in the increasingly competitive financial services industry, both locally and regionally. Since then, the group has introduced new businesses in Foreign Exchange (Forex), Interest Rate, and Commodities Derivatives. In addition, it has initiated an internal business transformation programme called "Strategic Agenda", i.e. the programme understudied.

When the case study was conducted in October 2008, the Strategic Agenda programme has just completed the planning stage and was transiting into the implementation stage. Due to the heavy workload of the staff, interview sessions with only two persons were granted namely:

- Head of Group Projects - who is posted from the foreign bank to Co3;
- Head of IT PMO - who is also the Head of IS Strategy & Business Office, from the Group Information Services Department.

5.4.2 Background information

The Strategic Agenda Business Transformation Programme aims at providing an overview for reaching specific profitability and market position aspirations with the following key goals:

- Build on the position as a leading financial services company in Malaysia and be recognised as an Employer of Choice in financial services;
- Double the underlying profit by 2011 or 20% compound annual growth;
- Target a Return on Equity of 20% and Cost to Income ratio of 40% in the medium term
- Achieve top three market position in all of chosen business segments in the medium term

To realise these objectives, the following areas must be worked on in order to address the key challenges facing the group and to accelerate key growth opportunities:

- Addressing the big strategic issues – Non Performing Loans (NPL's), Cost of Funds and Auto Finance;
- Building Retail and Small and Medium Enterprise (SME) Banking to become the main revenue growth engine for the Group and expanding their distribution footprints;
- Diversifying the Investment Bank's revenue streams and building a new Forex and derivatives platform;
- Growing the insurance business to contribute a bigger share of the group outcomes;
- Accelerating growth in credit cards and mortgages; and
- Improving Risk, Finance and Governance frameworks within the Group.

Against this backdrop, the programme has two components with the objectives to develop and implement the solutions as well as the measures in order to realize the strategic intents:

1) Core Programme

   This component is organized into 9 work streams and they follow a formal program /project management approach. Five (5) work streams are related to improving the delivery and banking services, whilst 4 others are initiatives related to support services such as technology, human resources, distribution channels etc.

2) Initiative Portfolio

   This component is organized into 6 portfolios as an extension to the Business As Usual (BAU) operation. In essence, projects are developed to improve operations within the respective Business Unit (BU) and thus, their management are contained within each BU. The project sponsor as such, is the head of the BUs and generally these initiatives are smaller in terms of both scale and investments.

The Strategic Agenda programme is expected to complete in 3 years by year 2011. The high level planning phase started in the form of workshop where senior executives of the group were brought together to develop the strategy. Upon endorsement by the board, the solutions to support the developed strategy were worked out by the senior management. Details including project cost, benefit realization timeline, resource requirements etc. were then followed through by appointed personnel in their respective BUs. This planning stage has taken a year to complete and a change in the leadership team was announced in October 2008 in order to accelerate the progress by creating focus and enhancing the execution capabilities.

5.4.3 Business project success

To the Head of IT PMO, the most important success criteria of a project is meeting stakeholders' expectations on scope, timeline etc. In addition, delivery of expected project benefits that tie to the overall business performance should also be considered. But such linkage is often difficult to establish especially in the case of IT projects.

It is also said that despite the general recognition that projects should be business driven (as evident from the appointment of project sponsor from the business community), delivery accountability is still unclear especially since most of the initiatives are cross-functional and multi-dimensional involving changes related to people, processes as well as technology.

In view of the above, the group will be implementing a corporate-wide benefit realization framework where project benefits become an integral component of the BU's performance. This BU performance on the other hand, forms part of the key performance indicators for the BU Heads as well as the Project Sponsors. In this case, the Chief Financial Officer (CFO) plays a bigger role in the programme since the project benefits are directly reflective in the company's bottom line. The implementation of this framework on the other hand, will be supported by a formalized tracking process. What have already been put in place today are as follows:

- New cost centres have been set up to capture project related expenses, including the salary of the seconded personnel. In the case of a cross-BU project, the cost would be apportioned accordingly;

- Project cost (and similarly for project benefits at the later stage) are tracked by respective project managers using reports provided by finance department. This information would then be consolidated at the work stream level by the Project Directors and finally summarized by the Group Projects department for management reporting.

5.4.4 Type of organization structure

It is said that most of the change initiatives in the past are either IT-driven or discrete efforts of the business units which do not necessarily converge to a common corporate goal or strategy. Since the involvement of the foreign bank, the concepts of programme and portfolio management have been introduced to the group and a top-down integrated approach of initiating projects and programmes from the organization's perspective has been adopted. The group's project management framework has since been revised accordingly and today, all project reporting goes through a newly formed Group Projects department.

The objective of the Group Projects department is to coordinate all projects, programmes and initiatives in the group. It is made up of 3 teams namely Operations, Project Management & Quality Assurance and Administrative Support. Led by the Heads of Group Projects, this central agency is tasked to:

- Coordinate all program/projects/initiatives;
- Manage project portfolios;
- Optimize use of project resources;
- Introduce and promote use of best practices;
- Improve Return Of Investment (ROI) of projects;
- Improve project management competency through training & development;
- Govern the project management practices through provision of methodology, templates and guidelines etc.

The Group Projects' site in the corporate intranet portal is the primary platform to reach out to its audiences where the following are published:

- PMO charter;
- Background information, project plan and expected deliverables of the Strategic Agenda Programme; and
- Project management guidelines, documents and templates.

Other than managing the "Core Programme" component through a formal project /programme organization, Group Projects also oversees the "Initiative Portfolio" component of Strategic Agenda. The activation of this supervisory role on Initiative Portfolio has recently been soft-launched and the transition to this new regime is currently in progress. Under this new arrangement, each BU has a Project Coordinator who will work closely with Group Projects on all project-related matters and the level of involvement from Group Projects will vary according to the project's needs. The Project Coordinator is to report status to the Head of Group Projects on a monthly basis; and he in turn holds quarterly update session with the Head of BUs.

The Strategic Agenda Programme's Core Programme component on the other hand, is organized as depicted by Figure 5.6.

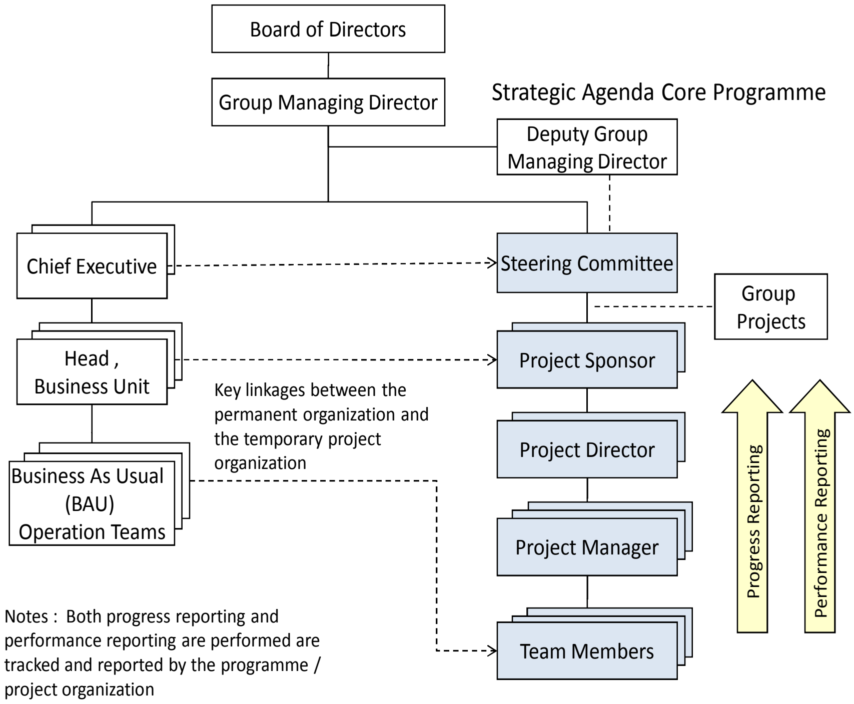

Figure 5.6 : Strategic Agenda team structure (Core Programme)

At the group level, a Steering Committee is set up to oversee the delivery whilst each work stream has a Project Sponsor who is typically the BU Head who will be benefiting directly from the project. He /she on the other hand, is supported by a Project Director. Since the status of the programme is monitored centrally by Group Projects, the Project Director is responsible to both the Project Sponsor and the Head of Group Projects. Each work stream in turn, has multiple projects under its umbrella, each of which is assigned with a project manager with a team consists of subject matter experts, project and technical personnel.

The Strategic Agenda Core Programme team together with the Group Projects are responsible to the Steering Committee and the Board where performance and health report of each project will be presented to them on a monthly and quarterly basis respectively.

Since most initiatives in the Strategic Agenda's Core Programme have an IT component, a IT PMO to coordinate all these implementation efforts has been introduced and it will be formalized as a department very soon. It is believed that there is no "ideal" structure or environment supportive of project work but one that adjusts according to the changing requirements over time, based on learning from the past.

In terms of staffing, the project teams are formed by both full-time and part-time employees as well as external recruits (who may be retained to run new projects later on or absorbed into BAU operations). The positions of Project Directors in particular, are staffed by mainly new recruits on a contractual basis. The IT involvement on the other hand, is supported by a pool of designated project managers from the existing IT workforce, who will be released to work on project full time as the need arises. But in reality, most of them continue to work part-time in both BAU operations and projects. So the tendency of operational work taking priority is still there, but the situation is expected to improve through reassignment of work within the IT department. An engagement model between the BUs and the Strategic Agenda has recently been developed and as a result, the group is now equipped with a complete profile of the resources requirement for both BAU operations and projects for the next 12 to 18 months, as well as clarity on the resource gaps that must be filled either through resizing, recruiting new staff or hiring contractors.

In terms of recognitions for project work, feedback from both the project and the posting functional department are obtained and taken into consideration during performance appraisal. Reward will be based on the overall performance of the person in the organization.

5.4.5 Project management competency

The project manager is expected to play the role of overall in charge. Thus although they could leverage on the in-house expertise on more specialized areas such as procurement management, risk management etc. in a context similar to services outsourcing, business project managers are expected to possess understanding of all 9 knowledge areas as defined by PMBOK.

Backed by this principle, an on-going training programme has been initiated by the Chief Information Officer (CIO) even before the start of Strategy Agenda, in order to upgrade the overall project management competency in the group. The training was initially targeted at the IT project managers but has since been extended to all levels of staff within the organization including the senior executives. A total of 62 project managers have been trained to date and these trainees are either nominated by the respective heads of departments to develop their staff; or to equip the individual with the necessary knowledge to fulfil his/her project responsibilities. The trainee will attend a 5 day course, followed by 6 months coaching by an external mentor to put his/her acquired knowledge into practice and to consistently recalibrate his mindset from operational to project focused. At the end of this training period, the project manager will complete a computer based test which will rate their competency on a scale from 1 to 5. So far, the effectiveness of this training programme has been promising with 99% of the trainees getting a rating of 3.

Despite the emphasis on all 9 knowledge areas, the interviewees have expressed that PMI certification does not guarantee good project managers. Working experience is important as project management is in some ways, application of common sense and problem solving skills. As such, work exposure (e.g. local versus regional projects, homogeneous versus heterogeneous project environment) should also be a key consideration for a project manager's ability to manage large programme or project.

With regards to relative importance of the 9 PMI's knowledge areas, Head of Group Projects states that communication management is a key competency, whilst Head of IT PMO chose stakeholder management based on the argument that project manager must have the ability to "read the terrain" (assess the project environment), identify all project variables and to devise a strategy to guide the project execution towards success. In essence, the common emphasis is soft skills and the ability of the project manager to adjust their approaches while managing the stakeholders.

Both interviewees also agreed that the "ideal" project manager profile should be a combination of project management experience, banking industry experiences and subject matter expertise. If there must be a trade-off, project management knowledge and skills must not be compromised. Domain knowledge such as industrial background and subject matter expertise are relatively less important (as opposed to the case of constructions or engineering project, also because it is difficult to find a all-rounded person), although most Project Sponsors would prefer to have a project manager who has a good understanding of the business. Nonetheless, the project managers are expected to pick up the domain knowledge as soon as possible in order to play a more effective role.

5.4.6 PMIS support

To the Group Projects department, the use of project management tools is important but the current focus is to deliver change results. At this initial stage of project management maturity where education and support are the focal points, it is felt that the use of simple tools and processes is more appropriate. As the organization builds skills and expertise, more sophistication can be introduced. Thus project management tracking and reporting activities are carried out manually at present, including the compilation of project financials. Having said that, improvements to current financial reports generated by the financial management system to better support the work are currently underway.

To the Group Information Services or IT department, a business process management system called "Team SYNtheisis" has been implemented along with the roll-out of the project management training programme, in order to support the management and delivery of IT projects. It is now used by the project community up to the Project Director's level and the system functionalities include support for (1) project planning, management & reporting; (2) project management methodology enforcement, (3) project knowledge generation, management & sharing as well as (4) rating & tracking of the project managers' performance on the scale from 1 – 5, against the 9 PMI knowledge areas. The use of this system however, is not a critical success factor for the project although it has helped to streamline project activities and improve productivity.

CHAPTER 6 CASE STUDY FINDINGS AND DISCUSSIONS

This section consolidates the findings from all 3 case studies and performs an overall analysis of the collective influences of the independent variables on business project success. This is followed by the identification of essential BProjM components and the development of the underlying BProjM theory. Based on which, the theoretical framework to kick off the domain modelling is constructed.

6.1 Consolidated Findings & Discussions

The adopted approach as mentioned in chapter 4 is to use the key findings of the anchor case study (Co1) to form the basis for discussion. The findings from the other two cases (Co2 and Co3) will then be assessed accordingly to see if they are in agreement or in contrast with that of Co1.

The first and foremost finding is that the understandings obtained from the literature review are still valid today where (1) programmes and projects are defined differently by different organizations; (2) the terms project and programme are still used interchangeably. Project Omega of Co1 for example, is called a "project" likely because there is a common software system supporting the scope of work. But based on its magnitude and Pellegrinelli's definition of programme, it is in effect a "goal-oriented" programme in disguise comprising multiple projects. EBP programme of Co1 on the other hand, called its supporting projects "work streams"; whilst Strategic Agenda of Co3 used the same term to refer to its sub-programmes which contain multiple projects. Another example would be EBP which is recognized as a programme, called its sponsor "Project Sponsor/Owner" rather than "Programme Sponsor/Owner".

To ensure apple to apple comparison, the definitions of programmes and projects in all 3 case studies are aligned before further analysis is carried out. In the case of Co1, BTP1 is the overall change programme and both Project Omega and EBP are considered its sub-programmes. Project Omega and EBP in turn are supported by multiple projects led by project managers which they called "team leaders". In the case of Co2, Transformer Programme is a corporate wide programme supported directly by many projects. In the case of Co3, Strategy Agenda is a group wide programme supported by 9 divisional sub-programmes each of which comprises multiple projects.

It is also important to note at this juncture that although the business transformation programme of each case study appears to take centre stage, the focal point of this research is the success of the underlying projects.

6.1.1 Business project success

To Co1, the success criteria for business change projects are the iron triangle of meeting time, budget and specifications as well as the following:

1) That the project meets the intended contributions to the company's bottom line. This is evident from the clear financial targets set by all 3 programmes and the project performance which were quantified and mapped to items in the profit & loss statements. This indicates that the evaluation of a project

must not stop at just meeting the specifications of the deliverables but creating the desired impact on the overall business performance.

2) That changes brought about to the organization are realized progressively. This is demonstrated by the monitoring mechanism implemented by all 3 programmes to closely track benefit realization on an on-going basis so that adjustments to the project execution can be made as necessary over time. This in turn, reflects that gone are the days where benefits is reaped only at the end of the project in 2 to 5 years time. With the increasingly competitive market conditions, organizations have to react fast and projects must be able to support this by delivering results within a shorter period of time.

3) That the implemented changes are sustainable. All 3 programmes highlighted the importance of sustainability because the organization is aiming at gaining the long term effect rather than the one-off impact right after the project implementation. This is achieved by involving the functional departments affected by the eventual changes from the start during the project/programme design stage, and by injecting the project team back to the operational work force. In this case, those who implement the changes will become those who maintain the changes. Consequently, change management issues caused by improper transitions should not arise.

Co2 was found to be in full agreement with the above. Firstly, it asserts that business project success should include meeting the expected contributions at the organization level in addition to meeting the fundamental criteria namely time, budget and specifications. Secondly, the change from the big-bang approach to a phased implementation approach is an attempt to realize benefits in shorter term over time. Lastly, the deliberate effort of dedicating 2 out of 3 phases during programme execution to see that the system implementation is assimilated into business operations is a clear endorsement for the effected changes to be sustainable.

Co3 supports the viewpoints in a similarly way. The recognition for project /programme to contribute at the organization level is reflected in their attempt to incorporate project benefits into the respective business unit's performance through an introduction of a benefit tracking framework. As a result, project benefits would be measured at the same frequency as the operational performance which is shorter term. Their expectation for the effected changes to be absorbed into the routine business activities on the other hand is in agreement with the need to sustain the intended changes.

A clearer picture of this finding is presented by Table 6.1 which summarizes the case study data with regards to business project success in the conceptual framework:

Table 6.1 : Summarised findings on business project success

Dimensions of business project success	Do the participating companies agree with the set business project success criteria?		
	Co1	Co2	Co3
On time	Yes	Yes	Yes
Within budget	Yes	Yes	Yes
Meet specifications	Yes	Yes	Yes
Meet stakeholders expectations	Specifically - meeting organization's bottom line	Specifically - delivering the business case of the programme	Specifically - delivering business performance
Others (as obtained from case studies)	• Benefit is realizable in short term • Change is sustainable		

From the summary table, it is clear that the traditional iron triangle is still commonly recognised as the main criteria for determining business project success. As with "meeting stakeholders' expectation", all 3 case studies have called for its inclusion as an additional success criteria. Unlike traditional projects which typically produce brand new and discrete deliverable based on well defined specifications, business projects aim at delivering better business performance through effecting change(s) in an existing chain of interrelated business processes. Thus the measures for project success for business projects must not stop at the project level of assessing the success of delivering the desired output; but extended to the organizational level in terms of "meeting organization's bottom line", "delivering business case", and "delivering business performance". This difference between "delivery objectives" (delivering the direct output /product of the project according to specifications, within time and cost constraints) and "project goals" (the ultimate benefit or purpose of the project) has been highlighted before but there has been limited understanding of the dynamic links between the two (Faisal, 2006). But from the open system model point of view, the relationships between the two can be explained where the "delivery success" can be mapped to success at the inner layer i.e. success of the project organization; whilst "product success" refers to the success at the outer layer i.e. success of the project in relation to the parent organization.

In summary, it is found that success of the business projects should be evaluated at 2 separate levels namely (1) at the project level i.e. expectation on the project in delivering the immediate output; (2) at the organization level i.e. expectation on the contributions of the project output towards its operating environment, in particular, how well has the implemented changes been assimilated into the business-as-usual operations and improved the overall business performance of the parent organization.

6.1.2 Type of organization structure

Based on how Co1 organizes and supports its project work, it was found that the following elements had played a significant role in their business project success:

1) Convergence of efforts by the Programme Management Office. With the support of TMO, the BTP1 charter detailing the need to change, the underlying business issues and the LAB approach etc. were clearly defined and communicated to all level of staff. As a result, the divisional improvement effort such as Project Omega and EBP had their efforts well aligned with the corporate directions and goal, creating an impeccable force to transform the organization. With the support of E&M PO, the EBP project team managed to remain focus and delivered results despite their part time project involvements. Based on the activities led /facilitated /participated by these two agencies, their most important value-add lies with

enabling the integration between projects and programmes, functional departments and business divisions, as well as closing the communication gaps between the top management and the operational teams.

2) Availability of domain knowledge in the project. Its importance was clearly reflected in the conduct of LAB sessions in BTP1 where domain expertise are gathered for problem solving; and the trio-led arrangement in Project Omega which places the domain expert on par with the project manager to better support project execution. Unlike a traditional project where specifications of the deliverables can be clearly defined at the start of the project, the business change project team is given only the desired goals based on which they must first identify the underlying issues and then devise the solutions. As such, it is critical that the project is consistently supported by members of the existing operational teams who have both the industry and working knowledge to work on the problem. Having said that, it is noted that in Co1, except for selected positions at the programme level, project participations from functional departments are part-time with dual reporting arrangement. This is especially true in the case of EBP where the departmental heads doubled up as the project owners, project directors and sometimes even as the project managers as well. The team members on the other hand, have to cover both operational and project duties throughout the project duration. Signs of fatigue are beginning to show.

3) Existence of a comprehensive project management framework. Although the project management framework has not been formally documented, its

components were held together and successfully implemented /enforced by TMO. As a result, the initiation of LAB as a prelude to official project scoping and kick off, formal appointment of project involvements, standard timing for progress reporting and use of standard templates etc. are consistently practised throughout the organization. The importance of having a comprehensive project management framework was also realized at the EBP level when the programme failed to deliver the desired results during the first 6 months. The situation was turned around when a project management specialist was engaged to formalise and implement a comprehensive project management framework. It is also worth nothing that in Co1, project contribution is well recognized by the organization where reward in the form of career advancement had been materialized.

Co2 organizes their projects in a similar way with two PMOs, one at the corporate level and another for the Transformer Programme. The importance of Transformer PMO in ensuring project success is now well recognized as the current bumpy state of the programme was partly attributed to the ineffectiveness of its PMO. As such, corrective actions to improve its current set-up are underway. However this Transformer Programme PMO is notably operating independently from the corporate PMO, and the two offices liaise with each other only on a need basis. The corporate PMO in other words, has not been given the full mandate to integrate all projects and programmes within the company. The importance of domain knowledge i.e. involvement of domain experts in projects is also well recognized as evident from the full time involvement of the business representatives. This move was apparently motivated by a lesson learned from an earlier project undertaking which had failed due to lack of focus. The existence of the project management framework on the other hand, is a bit of a calamity. The need for a corporate wide framework is acknowledged and high level project management guidelines at the corporate level do exist. In fact, these guidelines have successfully injected some structure into a previous culture of initiating and running projects in an informal way. Having said that, these guidelines have not reached all its intended audiences in the company and its implementation by those who know of its existence is voluntary. The readiness and roll-out of a more comprehensive corporate-wide project management framework on the other hand, is still not evident.

Co3 does not have a PMO but it has a Group Projects department with a similar charter. The Group Projects has played an active integrator role during the planning stage of Strategic Agenda programme and has coordinated the identification of the supporting projects in a similar way as Co1's LAB sessions. The need to have domain knowledge in the project team is also well recognized and acted upon with the development of a comprehensive staffing plan. Having said that, only Project Directors (who are mostly new recruits) and IT project managers are assigned to the project full time, the rest of the team members deployed from the existing operational teams would still work on the project on a part time basis. Last but not least in recognition of the need for a formal project management framework, a set of guidelines and documentation templates have already been produced. A benefit tracking mechanism will also be incorporated into the framework at the later stage so that the performance of the projects can be tracked in a consistent and systematic manner. Having said that, the developed guidelines have not been formally rolled out and the Group Projects department has yet to fulfil all its stated roles.

As highlighted in chapter 4 under the data analysis section, the type of organization structure shall be determined by a composite measure comprising formal reporting relationships, departmentalization and design of systems. Since the unit of analysis of this research is company, the scoring to derive the type of organization structure should be based on the comprehensiveness of project management framework at the corporate level rather than at the project's or programme's level. In addition, only elements which have already been implemented shall be taken into consideration. This is because what have not been implemented could not have posed any effect on the current business projects under scrutiny.

Based on the above findings and considerations, the case study data in relation to type of organization structure can be summarized into Table 6.2:

Table 6.2 : Summarized findings on type of organization structure

Measures for type of organization structure	What are the characteristics of their organization structures?		
	Co1	Co2	Co3
Formal Reporting Relationship	Mixture of part time and full time, dual and single reporting.	Full time, single reporting.	Mixture of part time and full time, dual and single reporting.
Departmentalization	Corporate PMO is managed directly by the MD and was set-up to perform governance, portfolio management. It is fully entrusted to oversee all project deliveries in order to ensure attainment of organization goals. Sub-Programme's PMO was set up to do the same and works closely with Corporate PMO.	Corporate PMO is currently performing governance and portfolio management. However, it is still not fully empowered to execute its roles. Thus, PMO of larger programme break away and operate independently.	Corporate PMO is currently filling the coordination and governance role; benefit tracking will be included at a later stage. Set up of PMO at the sub-programme level has not been determined.

Measures for type of organization structure	What are the characteristics of their organization structures?		
	Co1	Co2	Co3
Design of Systems	Comprehensive project management framework is in place although not saliently documented. Project work is recognized and rewarded.	High level project management guidelines have been implemented at the corporate level but they are not enforced.	Project management guidelines at the corporate level have been developed but have not been formally rolled out.

With reference to the scoring guidelines for each key component as described in chapter 4, the type of organization structure for these 3 companies can be derived accordingly (as illustrated by Table 6.3).:

Table 6.3 : Type of organization structure by case study

Measures for type of organization structure	What is the type of their organization structures?		
	Co1	Co2	Co3
Formal Reporting Relationship	1.5	2	1.5
Departmentalization	3	2	1
Design of Systems	3	1	0.5
Total Score	7.5 Integrated	5 Projectized	3 Matrix

Based on the total scores, Co1, Co2 and Co3 are mapped to the type 'Integrated', 'Projectized' and 'Matrix' respectively. In summary, Co1 has a project organization which is tightly integrated with the parent organization; Co2's Transformer programme organization is running alongside its parent organization; whilst Co3 is the only one that falls within the conventional paradigm of matrix organization.

6.1.3 Project management competency

For Co1, the first observation was that none of their project managers and programme managers is certified member of any project management professional bodies. In fact, most of them have not gone through formal project management training. As such, their understandings of the 9 competency areas are based on common sense and tend to vary by individual. The interviewee responses therefore, were first mapped to the standard definitions in the PMI's PMBOK guide before they are summarised. The key findings are as follows:

1) "Time Management", "Scope Management" and "Integration Management" were considered to be fundamental and mandatory project management competencies. Having said that, these tasks are executed in a relatively informal way. Other than the project plan, the execution of these management activities are supported by the use of "Issue Log" which captures and tracks all outstanding matters that requires follow-up.

2) "Communication Management" was ranked the next most important competency. The project managers spent extensive amount time and effort in providing timely updates to various stakeholders such as publishing monthly newsletter to inform staff of the programme status, holding periodic press conferences to announce results to shareholders, organizing frequent dialogue with the ministry of transport to ease political pressures etc.

3) “Stakeholders’ Expectation Management” was highlighted by most interviewees as an area that warrants special attention, including the Managing Director who quoted it as the only thing he would improve if he were to run BTP1 programme all over again. Unlike traditional project which has a relatively well defined list of stakeholders, the stakeholders of a business project are multifaceted because the project output implicates a much wider and larger population. For Co1, this includes internal management and operational workforce, shareholders, customers, suppliers, regulatory bodies as well as politicians. Its importance is clearly reflected by the intensity of stakeholder management related activities throughout the programme implementation, for example, getting the functional departments’ feedback on changed business processes to ensure acceptance; getting government’s consent before terminating unprofitable routes; holding dialogues with union to secure support for the change programme; briefing the suppliers on the cost-cutting rationale to secure continued support; conducting customer survey to ensure that change of in-flight services would be welcome by passengers; giving advanced notices to travel agencies on the revised commission scheme etc. These activities are essentially various types of communications that must take place between the project and its stakeholders throughout the project life cycle. PMI defines project communication management as “ensuring timely and appropriate generation, collection and dissemination, storage and ultimate disposition of project information”. Thus by definition, communication management should cover the needs of all stakeholders but the term “project information” may have misled the effort to concentrate only on the

stakeholders in the steering committee. This finding as such, further strengthens and justifies communication management as an important competency which must be applied to a wider context.

4) "Cost Management" was seen to be a competency of lesser importance to the project manager despite the fact that "within budget" is a key success criterion for project success. For Co1, the focus was not about how much they can gain from a project investment, but how much utilization of the existing resources can be maximized. Thus project cost was generally minimal and can be absorbed by the operating budget of the participating functional departments. In the case where significant amount of additional fund is required, the allocation will still be parked under the benefiting functional department(s) using the existing cost management mechanism. Since the responsibility of cost monitoring remains with the functional managers or heads of department, the role of cost management for the project manager becomes less important.

5) "Risk Management", "Quality Management" and "Human Resources Management" competencies were mentioned as important by some interviewees but there is no evidence suggesting that these management activities are led by the project manager, in fact, they are spearheaded by the programme office or existing functional departments. For example :

- For risk management, the assessment of risks and formulation of mitigation plan were championed by the programme office and conducted at the programme level in conjunction with the company's risk management department;

- For quality management, quality of project deliverables are monitored and reviewed by stakeholders in the functional departments who will be receiving and owning them. In the case of technical deliverables for E&M, the quality department is actively engaged in the project activities;

- For human resources management, sourcing and assignment of project personnel is in accordance to the existing human resources management policies /procedures; and are executed by the human resources department. Since project involvement is considered temporary, no formal transfer of internal staff was effected and the career development responsibility of the individual remains with the functional managers.

6) Procurement management competency was considered unimportant. This could be due to the generally minimal project investment. In addition, since the procurement function is relatively specialised, the need of the project in this area has been supported by the procurement department.

Co2 agrees with Co1's view that the key competencies demanded of a project manager are scope management, time management and integration management. Cost management has also been taken out of the equation since it is managed at the programme level. Other than that, emphasis should be placed on soft skills such as communication management and stakeholders' expectation management. It is also felt that experience is more important than accreditation from project management professional bodies.

Co3 agrees that experience is important but also felt that the project managers should at least be trained with awareness of all 9 PMBOK knowledge areas. Having said that, it assents to Co1's and Co2's views that (1) it is not necessary for the project manager to master all 9 PMBOK knowledge areas since the non-fundamental project management competencies such as procurement management and risk management could be led and/or supported by the respective functional departments in the parent organization; (2) soft skills such as communication management and problem solving are of highest importance among the non-fundamental project management competency areas.

Last but not least, all 3 companies felt that it is not necessary for the project managers to come equipped with prior experience in the same industry although such exposure would be an added advantage.

A clearer picture of the above findings is presented in Table 6.4 which summarizes the case study data with regards to project management competency:

Table 6.4 : Summarized findings on project management competency

PMI knowledge area	Which competency areas demanded of the project managers place a direct impact on the attainment of project success?		
	Co1	Co2	Co3
Scope Management	Yes	Yes	Yes
Time Management	Yes	Yes	Yes
Integration Management	Yes	Yes	Yes
Communication Management	Yes	Yes	Yes
Human Resources Management	No	Yes	No
Risk Management	No	No	No
Quality Management	No	No	No
Cost Management	No	No	No
Procurement Management	No	No	No

It is clear that all three companies shared the same view that project management competencies expected of the business project managers are less demanding than the traditional project managers. The common "core" business project management competencies as indicated in Table 6.4 are "integration management", "scope management", "time management" and "communication management". In essence, business project manager is not expected to be the master of all trades but to play the role as an integrator, i.e. one who facilitates, enables and manages the work of the domain masters.

6.1.4 PMIS support

For Co1, most of the respondents are not aware of the existence of Project Management Information System (PMIS). In fact, all of them did not see much value in deploying a system which is more sophisticated than MS-Excel to track timeline, issues and project benefits; MS-power-point for project reporting and shared drive for basic file sharing. Having said that, evidences show that they spent significant amount of time everyday tracing and collecting information on progress from various sources, manually updating the project plan and issue log, broadcasting the changes made, reformatting status information into presentation slides which are unnecessary duplication of work and non-productive in nature. This is a classic example of how project managers spent most of their time focusing on delivering project output without taking time out to assess and improve their own work efficiency and effectiveness. In addition, since project cost information is embedded in the cost centres of the participating functional departments, manual consolidation must be done before a complete view of the project financials can be obtained. Not only does this add on to the project manager's workload, manual compilation could also be error-prone and leads to unnecessary confusions as a result. As with capturing of project knowledge, all respondents are of the opinion that it is a good-to-have feature but not a critical requirement. Most of lesson learned were drawn directly out of the participating team members. In terms of defining expected functionalities in the PMIS to support project and programme management, their requests are no more than the conventional requirements of enabling online real-time information access to facilitate timely decision making. The only difference is that other than project information, latest business performance affected by the project implementation must also be provided.

While Co1 is not particularly concerned with the use of IT to support project work, Co2 is well aware of its importance. This is especially true for the Transformer Programme which has gone through a change in management and the new management had very little information to work with. Since then, they had enforced the use of Ms Project for project planning and progress tracking; as well as the implementation of the "Rationale" system for issue tracking and status reporting. Nonetheless at the corporate level, the use of IT to support project work is still very basic where the use of Ms Excel is deemed sufficient.

Co3 is the most advanced among the 3 companies where the use of the "Team Synthesis" system has been enforced on all IT projects. The system provides support to all phases in the project life cycle which includes project knowledge generation, as well as rating of project manager performance upon project closure.

Last but not least, all 3 companies felt that the PMIS designed to support traditional projects are too expensive and too sophisticated for the purpose of business project management.

In view of the above findings and with reference to the predefined scoring guidelines, the level of PMIS support can be summarized into Table 6.5.

Table 6.5 : Type of PMIS support by case study

Measures for level of PMIS support	What is the level of PMIS support?		
	Co1	Co2	Co3
Progress Tracking	1 (Ms Excel)	1.5 (Rationale is used but not deployed corporate wide)	2 (Team Synthesis is used for all IT projects)
Performance Tracking	1 (Ms Excel)	1 (Ms Excel)	1 (Ms Excel)
Project Learning	0	1.5 (Rationale for issue log etc. but not deployed corporate wide)	2 (Team Synthesis is used for all IT projects)
Total Score	2 Minimal	4 Basic	5 Basic

Based on this summary table, Co1's BTP programme and projects were carried out successfully with hardly any PMIS support. Assuming there is no error in the scoring system, then either one of the following scenarios must be true:

1) That the level of PMIS support places an adverse effect on the attainment of business project success;

2) That the level of PMIS support has no effect on the attainment of business project success;

3) That the level of PMIS support does place an effect on the attainment of business project success but not all aspects of PMIS support have been identified.

Based on the data collected, both scenario 1 and 2 are invalid as the use of PMIS has evidently enabled the project managers in Co2 and Co3 to be more productive and effective in their work. This reflects that level of PMIS does place a positive effect on the project management effectiveness which in turn, poses an impact on the attainment of business project success. In other words, scenario 3 offers the most likely explanation for the phenomena. Nonetheless, no conclusion can be drawn at this point and the effect of PMIS support must be further examined in conjunction with the effect of other variables in the conceptual framework.

6.2 Overall Analysis

All 3 companies have unanimously highlighted the need of measuring business project success at the organizational level. This brings out an interesting and important point that the ultimate stakeholder of any business projects is the business enterprise. The criteria to measure "product success" should therefore be expressed in terms of direct relevance to the organization performance; rather than indirectly through the perspectives of the stakeholders i.e. individuals who work for it, the customers it serves etc. As suggested by earlier researchers (Bryde, 2005; Niebecker et al, 2008) and demonstrated by Co1, this can be achieved by the use of Key Performance Indicator (KPIs) where project benefits are expressed in terms of "Performance KPIs" which are uniquely defined for each project and mapped to the corresponding organizational KPIs. If the projects are grouped into programmes, "Performance KPIs" of the projects would be mapped to those of the programme's, which is in turn mapped to the corresponding organizational KPIs.

If this principle of associating project performance to organization performance is to be strictly adhered to, then the "cost" component of the iron triangle should be taken out and parked under "Performance KPIs" since project cost places a direct impact to the organization's financial performance by offsetting the effect of project benefits. This approach of analyzing cost and benefits together is not new and has been adopted in the preparation of business case during project initiation (Gray and Bamford, 1999). Given that actual performance of a project should rightfully be measured against the basis of which it was justified, the approach of monitoring the net effect of project cost and benefits on an on-going basis would be theoretically more appropriate than the current practice of tracking them separately during different stages of project life cycle (i.e.

tracking project cost during project execution and benefits realization only upon project completion).

The concept of KPI can also be applied to the other two components of the iron triangle where they could be defined in terms of “Progress KPIs” (that tracks if the project is delivering on time); and “Output KPIs” (that tracks if the project is churning out the deliverables according to specifications). Collectively, “Performance KPIs”, “Progress KPIs” and “Output KPIs” form the “Project KPIs” which are quantitative measures for the “Project Objectives”. In which case, the two levels of business project success would be more accurately reflected as (1) “meeting project objectives” which represent success in all 3 dimensions namely progress, output and performance; and (2) “meeting organization objectives” where performance of the project are expected to generate a more lasting effect at the programme’s and organization’s level.

As with core competencies required of a business project manager in ensuring project success, all 3 companies have identified 4 areas namely integration management, scope management, time management and communication management as the core project management competencies which pose a direct impact to business project success. Despite the common understanding in this variable, Co1 is the only case with successful project implementation; Co2 is still on a recovery path and Co3 has yet to progress beyond the planning stage one year after programme initiation. This difference in project outcome clearly reflects that project management competency alone does not guarantee business project success. The ability of the business project managers to deliver must have been either complemented or hindered by the two organizational factors.

For Co1, the tight integration between the project organization and the parent organization enabled by a highly empowered TMO and comprehensive project management framework have evidently provided the desired operating environment for the business transformation projects, especially since all their project managers are not even formally trained for project work. In addition, it has helped to ensure that the projects remain focused in delivering the desired impact at the organization level. Although Co2 has a similar set-up, its Transformer PMO was not effective in its role. Thus unlike Co1 projects which managed to leverage on the functional departments to assist in the non-core competency areas through the support of their PMO; Co2's Transformer Programme carried on as an independent projectized organization without filling these gaps. Since the corporate PMO was also not very effective in terms of controlling all the projects within the company, it was unable to put the Transformer Programme back on track when it became a runaway train. The current recovery is attributed to the change in the Transformer Programme's management. Thus although the programme appears to be moving towards the right direction, its success in delivering results which are aligned to the organizational objectives has yet to be seen. Co3's PMO on the other hand, merely does liaison work rather than driving the programme. As a result, the progress of the Strategic Agenda programme is hampered by the typical issue faced by most matrix organization, i.e. lack of focus and momentum. This loose relationship between the project organization and the parent organization due to the lack of advanced PMO support and involvement is evidently affecting the effectiveness of their well trained project managers in delivering results.

In view of the above, the integration between the project organization and the parent organization enabled by the PMO and its programme management effectiveness does pose a positive influence on the relationships between project management effectiveness and project success. In other words, it is a bonus if the business project manager is a highly trained project management professional; but general managers who are a good communicator with a good grasp of project management fundamentals may also be good enough for the job - IF they are supported by a presiding "integrated programme management" function that (1) oversees all project endeavours; (2) centrally collaborates, coordinates and integrates the support from the internal agencies on the non-core competency areas; (3) ensures consistent focus is placed on achieving organizational goals.

The need for this "integrated programme management" in turn, calls for the level of PMIS support to be elevated to the programme or organization level. While progress tracking are paramount at the project level, this information should be rolled up to the programme level to facilitate review of programme status. Tracking of project's cost and benefit performance on the other hand, will be more meaningful if it is monitored at a higher level since all projects contribute towards the same bottom line in the organization. Similarly, learning should be enabled at both project and programme /organization level. While content of issue log and change requests at the project level facilitates swift problem resolution of recurring issues, consolidation of lesson learned at the programme level facilitates better future corporate /programme /project planning and enables the desired close-loop organization learning. In retrospect, it is not that traditional PMIS is overly sophisticated for business project management but the functionalities demanded of it are different in nature. Focus of the traditional PMIS is to deliver technical capabilities in support of project fundamentals, but the PMIS requirement of business projects is to enable seamless information exchange between the projects, programmes and the parent organization throughout the project life cycle. This also explains why the preliminary analysis on PMIS support was inconclusive. Since the measure for the PMIS Support variable was based on the need for IT support at the project level, requirements beyond that scope have not been taken into considerations.

In summary, the case study findings support all 3 hypotheses on the causal relationships between the three independent /moderating variables on business project success in the following way:

1) The effective application of Project Management Competency does pose a direct positive impact on business project success at the project level. In addition, it is found that:

   - Business project is considered successful only if it meets both its project objectives and organization objectives;

   - Core business project management competencies are scope management, time management, communication management and integration management.

2) The extent of integration between the project organization and the parent organization place a determining positive impact on the effective application

of project management competency in delivering business project success, especially in terms of meeting the organizational objectives. In addition, it is found that the essential component that enables such integration is an integrated programme management function that fills up the gaps between the project, programme and the organization.

3) The comprehensiveness of the PMIS support does place an effect on the effective application of project management competency in delivering business project success. In addition, it is found that there is a need for a "specialized" PMIS to support business project management i.e. one which support the integrations demanded by (2) by enabling seamless information exchange between project, programme and organization throughout the project life cycle.

6.3 Essential BProjM components & the underlying BProjM theory

By singling out the mandatory attributes in each of the independent /moderating variables that contribute collectively towards a successful business project, the essential components of business project management are identified to be (1) Core business project management competency namely scope management, time management, integration management and communication management; (2) An integrated programme management function that connects project, programme and the parent organizations; and (3) A PMIS which is tailored to the needs of business project management.

The keyword here is 'integration', which reflects that business projects should be managed in close associations with its counterparts in the parent organization from all aspects. An initial theory that captures the essence of this underlying theme would be **Business projects should be managed as an integral part of a business enterprise.** Having said that, in support of the principle that business is a going concern, a longer term view should be adopted so that organizational considerations for projects beyond a 12 month period are also incorporated into the theory.

In view that business performance and business project performance is directly related (Barclay, 2008), continuous business growth and sustainability can theoretically be achieved by running business projects to effect organizational changes on an on-going basis. A smooth implementation of a pipeline of business projects would in turn call for:

1) An element of stability within the organization to ensure (1) on-going alignment between the project output and the organizational goal; (2) quality and consistency across all project executions; (3) continuity of the business change pipeline; (4) assimilation of the implemented changes into business as usual; and (5) continuous reflections and adjustments in future project planning based on lessons learned. What this suggests is that the integrated programme management function would have to be implemented as a permanent function in order to lead the on-going initiation, execution and completion of all programme and project efforts that are required to realize the organization's business strategies.

2) A more integrated approach in the use of IT where the PMIS is tightly coupled with the Enterprise Management System so that the elevated demand for seamless information exchange can be achieved in a more effective manner. In particular:

- During project initiation phase, mapping of the project objectives and deliverables to the programme objectives which in turn, links to the organizational objectives;

- During project planning & mobilisation phase, official deployment of existing resources to form the project teams and alignment of the reporting structure, performance appraisal etc. to that of the parent organization's;

- During project execution & control phrase, tracking of project status in terms of whether the project is progressing according to plan; whether the project is delivering the desired output per stakeholders' expectations; whether outstanding issues have been resolved; and whether change requests have been raised and implemented to address the issues;

- Also during project execution & control phrase, tracking of project performance by leveraging on the financial management functions enabled by the parent organization's enterprise management system in terms of whether the project has realized the business benefits; and whether the project cost incurred is still within budget.

- During project closure phrase, capturing of the project implementation as an event in the corporate memory in order to support future organization learning.

3) A constant flow of project human resources which are equipped with the required domain knowledge and business project management core competency to support the project deliveries. While industrial expertise can be brought in from outside, the ideal source of supply for the combination of business knowledge and working knowledge of the company is the existing operations workforce. In addition, since the core project management competencies are essentially general management skills, it should be possible to appoint project managers from within. What this suggests is that the organization should fine-tune its human resource management framework to support a formal full-time inter-deployment of project and operational personnel for better focus and effectiveness, as well as incorporating the training of core project management competencies as part of the overall staff development plan.

Based on these additional considerations, the initial theory has been improved to form a more comprehensive BProjM theory which states that **Business projects should be managed as an integral part of a business enterprise and given equal emphasis as the business as usual operations**.

6.4 BProjM Theoretical Framework

Based on the BProjM theory and the identified essential business project management components, the theoretical framework to kick start the domain modelling can now be developed by editing the components in the original conceptual framework. The resulting theoretical framework is as presented by Figure 6.1.

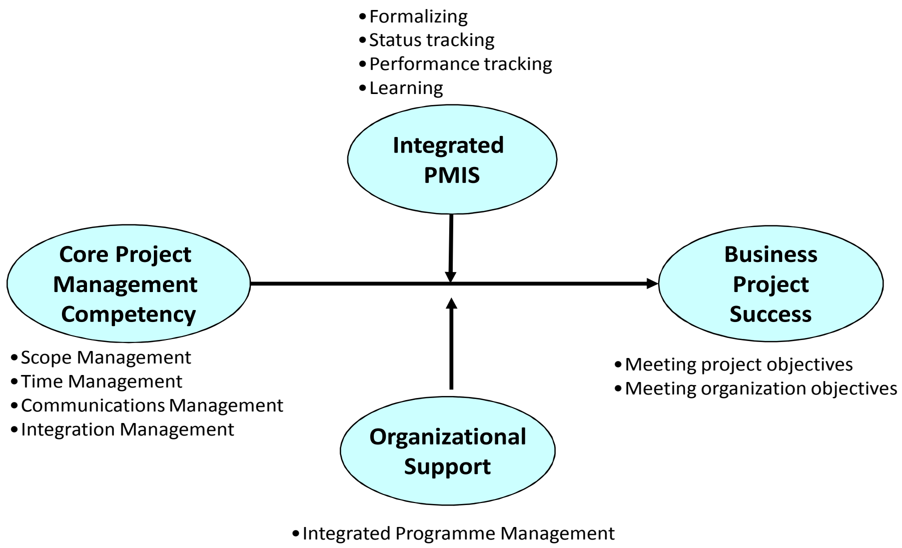

Figure 6.1 : Theoretical Framework

In essence, business project will stand a higher chance of success of meeting both project and organization objectives given the existence of:

1) Effective application of core project management competency namely scope management, time management, communication management, integration management;

2) An integrated programme management function in the parent organization that complements the exercise of project management core competency by centrally coordinating the support from the other functional departments; as well as to ensure that new business change programme/projects are consistently initiated, managed and delivered to meet organizational objectives;

3) An integrated PMIS that caters specially to the need of business projects and supports all project and programme management activities throughout their life cycles namely formalizing the project /programme during the initiation and planning stage; tracking the status and performance during the execution stage, consolidating the lesson learned during the closing stage as well as enabling its retrieval and reference as and when required.

CHAPTER 7 DEVELOPING THE DOMAIN MODEL

Given the theoretical framework, the research is now ready to develop its corresponding domain model. This section describes the detailed processes of developing the BProjM domain model which are introduced in chapter 4, methodology. To recap, a total of 4 steps are involved namely:

1) Defining the scope – this refers to setting the boundary for the modelling exercise; by expanding the essential business project management components into a list of supporting terms and their inter-relationships that must be captured by the domain model. The output of this step is the Specification Table which contains the exhaustive list of terms and their definitions; and the Key-relationships Diagram that presents an overview of the key relationships among them.

2) Reusing existing work – this refers to sourcing similar existing work done in the domain, evaluating their reusability for this modelling exercise and merging /integrating them into the predefined scope. The output of this step is the edited Specification Table and Key-relationship Diagram.

3) Building the domain model – this refers to mapping and translating the content in the Specification Table and Key-relationship Diagram into the UML diagrams which collectively forms the desired domain model. Both static and dynamic aspects of the domain model would be addressed where

Package Diagram and *Class Diagram* are used for the static specifications, whilst *State Machine Diagram* and *Communication Diagram* are used for the dynamic specifications.

4) Testing the domain model – this refers to testing the completeness of the resulting UML model against the content in the edited Specification Table and Key-relationship diagram. In addition, data collected during the anchor case study is used to instantiate the model in order to check on its validity and reliability in representing real-world scenarios.

These steps are to be executed sequentially with the exception of step 3 and 4 which are repeated back to back in multiple cycles until the desired completeness of the domain model is achieved.

7.1 Defining the Scope

The purpose of defining scope is to ensure that the modelling exercise is defined with a clear list of requirements to be fulfilled, based on which the completeness of the resulting model can be validated. The list of requirements in this case, refers to the list of terms that underline each of the essential business project components as laid out in the theoretical framework, as well as the inter-relationships among these terms.

The two important principles that guide the definition of these requirements are (1) only invariant aspects of the domain knowledge should be captured; (2) the knowledge must be specified in a manner which is more explicit than natural language. To achieve (1), the expansion of the essential business project components into its supporting terms must be based on the prevailing standards in the domain, failing which the credibility of the resulting model would become questionable. This may not always be possible since the social science research may introduce new concepts where there is no corresponding standard. Nonetheless, relevant standards must still be sourced and evaluated for adoption as much as possible. To achieve (2) i.e. the desired improvement in semantic precision, the supporting terms must at least be accompanied with clear definitions while they are captured into the Specification Table.

Capturing of inter-relationships on the other hand, is less straight forward. This is because the inter-relationships are often embedded in the definition of the terms or the narratives of the prevailing standards. Identifying and listing every one of these inter-relationships explicitly to provide a complete set of requirements is not only time consuming but a direct duplication of what will be represented in the UML model. Nonetheless, a balance must be struck in order to ease future maintenance of the domain model especially if the domain experts are UML illiterate. A compromise will be to provide an overview of only the key dependencies between the terms in the form of a diagram. Given this visual representation of the key relationships, the modeller would be able to (1) grasp the essences of what needs to be captured in the eventual UML model; (2) perform a high level validation if the scope has indeed been sufficiently covered; (3) divide the work into logical segments so that the model can be developed progressively in a systematic manner.

In relation to the above, the rest of this section presents the specifics of how these two steps were carried out for the BProjM domain model namely (1) developing the Specification Table; (2) developing the Key-relationships Diagram.

7.1.1 Developing the Specification Table

To develop the Specification Table, the detailed steps are (1) identify the suitable standards for expanding each component in the theoretical framework; (2) identify if a pattern exists within the chosen standards so that the component could be expanded in a consistent manner; (3) select the supporting terms in the prevailing standard and capture them into the Specification Table for each component; (4) combine the Specification Tables to form the consolidated Specification Table.

The first component to work on should be the "backbone" of the theoretical framework, i.e. the independent variable "Core business project management competency" and the dependent variable "Business project success".

For the "Core business project management competency" component, the adopted prevailing project management standard is PMBOK published by PMI since it has the largest member population. Furthermore, its 9 knowledge areas have already been used as measures for this variable by the first half of this research. The PMBOK guide is organized by knowledge area. Each of this knowledge area first presents an overview of the major processes involved followed by a detailed description for each major process. These details include the inputs, the outputs as well as tools & techniques applicable to the process. Since domain knowledge should consist of only invariant knowledge, tools and techniques have been excluded from further considerations. As a result, the basis for expanding the terms is narrowed down to just the input and the output components of each major process.

For the terms to be selected as a supporting term, it must be a significant representation of the high level concept. It is noticed that in PMBOK, the major processes within each knowledge area are chained in a sequential manner where output of a process is fed into the next process as input, and the output of the last process is typically a consolidation of all the input gathered along the way. For example in the case of "time management", project schedule is the final output and it captures the list of activity, resources required, project network diagrams etc. which are inputs of different intermediate processes. Secondly, it is found that each knowledge area has a control process that determines how related management activities and/or changes should be carried out based on their corresponding "control" document. Taking "time management" knowledge area as the example again, "schedule management plan" is the control document which dictates how changes to the project schedule should be managed.

Based on this uncovered "pattern" and the principle that the supporting terms must be of significance, it is sufficient to capture just the final output and the control document as the key supporting terms for each knowledge area. Thus the result of expanding "core project management competency" component is as presented in Table 7.1.

Table 7.1 : Specification Table for project management competency

Core project management competency	Definition	Key second level supporting terms
Scope Management	A subset of PM that includes processes to ensure that the project includes all the work required and only the work required, to complete the project successfully.	• Project charter • Scope management plan
Time Management	A subset of PM that includes processes to ensure timely completion of project.	• Project schedule • Schedule management plan

Core project management competency	Definition	Key second level supporting terms
Communications Management	A subset of PM that includes processes to ensure timely and appropriate generation, collection, dissemination, storage and ultimate disposition of project information.	• Communication management plan • Project records • Project reports
Integration Management	A subset of PM that includes processes to ensure that the various elements of the project are properly coordinated.	• Project plan • Work results

For the "business project success" component, key performance indicators (KPIs) would be used for the expansion, based on the principle that KPIs are quantitative measures of objectives. The "business project success" component after the expansion is as depicted by Table 7.2.

Table 7.2 : Specification Table for business project success

Business project success	Definition	Key second level supporting terms
Meeting project objectives	Meeting the list of objectives associated with the delivery of immediate output of the project.	• Project Objectives • Project Key Performance Indicators (KPIs)
Meeting organization objectives	Meeting the list of objectives associated with the attainment of project benefits at the organization level.	• Organizational Objectives • Organizational Key Performance Indicators (KPIs)

For the "Organizational Support" component, "Integrated Programme Management" is a new concept introduced by the research finding that highlights the importance of aligning all project efforts towards programme /organizational goals; but the concept of programme management itself is not new. As such, the prevailing standard which could be adopted for its expansion is the PMI's "The Standard of Program Management" and the result is demonstrated in Table 7.3. To maintain the consistency of expanding "objectives" to measureable KPIs as adopted by the "business project success" component, the term "Programme KPIs" is also added in support of "Programme Objectives".

Table 7.3 : Specification Table for integrated programme management

Organizational Support	Definition	Key second level supporting terms
Integrated Programme Management	An organizational practice that includes processes to enable on-going initiation, execution and completion of top-down driven business change programme which may consist of many sub-programmes defined with specific organizational objectives	• Programme • Programme Objectives • Programme KPIs • Programme Charter • Programme Plan

As for "Integrated PMIS", it is included as an essential business project management component due to the importance of enabling seamless information exchange throughout the project life cycle between project, programme and the parent organization. While "Integrated PMIS" may be a new concept, the types of information and the processes of generating, reviewing, approving and distributing them are generic across all types of projects and programmes. Hence the desired expansion can be achieved by cross referencing the relevant processes defined in the PMBOK guide and "The Standard of Program Management". The result of the expansion is as presented in Table 7.4.

Table 7.4 : Specification Table for integrated PMIS

Integrated PMIS	Definition	Key second level supporting terms
Formalizing	Processes that formalizes the initiation and planning of a project and maps the project objectives as well as KPIs to that of the programme's and organization's.	• Project Objective • Programme Objective • Organizational Objective • Project KPIs • Programme KPIs • Organizational KPIs • Project Charter • Programme Charter
Status Tracking	Processes that track where the project now stands in terms of progress and direct output / deliverables.	• Output • Progress
Performance Tracking	Processes that track if the project is meeting the organizational objectives namely the expected cost and benefits as set out in the business case.	• Performance
Learning	Processes that captures the project learning and enables their reusability at the appropriate junctures	• Issues • Change request • Lesson learned

Given that the components in the theoretical framework are inter-related, some of their supporting terms are expected to be common as correctly reflected in Table 7.1, 7.2, 7.3 and 7.4. As such, further rationalization was performed in order to remove the duplicates. In addition, it is noted that "integrated PMIS" is a technology component and thus, "formalizing", "status tracking", "performance tracking" and "learning" are essentially the expected functionalities of this desired PMIS. Given that domain model should be built independent from the system's point of view, these 4 high level terms have also be left out from the scope.

Last but not least, it is necessary to classify the resulting list of supporting terms into logical groups to reflect their relationships with the higher level concepts; as well as to form subgroups for terms of similar nature in order to ease reference. The proposal is to organize them according to the viewpoints of the prevailing standards so that the model is not a product of individual's preference or interpretation. The resulting groups developed for BProjM domain model based on these principles are (1) "Project Fundamentals" i.e. basic components of a project or programme; (2) "Core Business Project Management Functions" i.e. the essential management processes which must be performed to ensure success at the project level; (3) "Integrated Programme Management" i.e. the essential management process that must be performed to ensure that success at the organizational level; (4) "Project Results" i.e. the expected and actual results of the projects; (5) "Documentation" i.e. essential information and/or documents produced for/by the projects throughout its life cycle; and (6) "Change Management" i.e. components required to systematically manage change in various aspects of the projects.

The final output of this step is the consolidated Specification Table (Table 7.5) which lists all the terms that must be represented in the domain model.

Table 7.5 : Consolidated Specification Table

Key terms (consolidated)	Definition
Project Fundamentals	
PROJECT	A group of people working together in order to achieve specific objective(s), given limited time and resources.
PROGRAMME	A group of projects organized to meet a set of organizational objectives.
Core Business Project Management Functions	
SCOPE MANAGEMENT	A subset of PM that includes processes to ensure that the project includes all the work required and only the work required, to complete the project successfully.
TIME MANAGEMENT	A subset of PM that includes processes to ensure timely completion of project.
COMMUNICATIONS MANAGEMENT	A subset of PM that includes processes to ensure timely and appropriate generation, collection, dissemination, storage and ultimate disposition of project information.
INTEGRATION	A subset of PM that includes processes to ensure that the various

Key terms (consolidated)	Definition
MANAGEMENT	elements of the project are properly coordinated.
Integrated Programme Management	
INTEGRATED PROGRAMME MANAGEMENT	An organizational practice that includes processes to enable on-going initiation, execution and completion of top-down driven business change programme which may consist of many sub-programmes defined with specific organizational objectives.
Project Results	
PROJECT OBJECTIVE	Purposes or goals of the project, the aims to be achieved and the desired end results.
PROGRAMME OBJECTIVE	Purposes or goals of the programme, the aims to be achieved and the desired end results.
ORGANIZATIONAL OBJECTIVE	Purpose of goals of the organizations, the aims to be achieved and the desired end results.
PROJECT KPIS	Quantitative measures of the project objectives.
PROGRAMME KPIS	Quantitative measures of the programme objectives.
ORGANIZATIONAL KPIS	Quantitative measures of the organizational objectives.
PROGRESS	The completion of planned project activities.
OUTPUT (WORK RESULTS)	The direct output of project plan execution.
PERFORMANCE	The contribution of the project at the organizational level.
Documentation	
PROJECT CHARTER	A document issued by senior management that formally authorizes the existence of a project.
PROGRAMME CHARTER	A document issued by senior management that formally authorizes the existence of a Programme.
PROJECT SCHEDULE	The planned dates for performing activities and the planned dates for meeting milestones of the project.
PROJECT (INTEGRATED) PLAN	A formal, approved document used to guide both project execution and project control. The primary uses of the project plan are to document planning assumptions and decisions, facilitate communication among stakeholders and document approved scope, cost and schedule baselines.
PROGRAMME (INTEGRATED) PLAN	A formal, approved document used to guide both programme execution and programme control. The primary uses of the programme plan are to document planning assumptions and decisions, facilitate communication among stakeholders and document approved scope, cost and schedule baselines.

Key terms (consolidated)	Definition
PROJECT COMMUNICATION MANAGEMENT PLAN	A document that provides a collection and filing structure, a distribution structure, a description of the information to be distributed, production schedule for each type of communication, methods for accessing information between scheduled communications, a method for updating and refining the communication management plan as the project progresses and develops.
PROJECT SCOPE MANAGEMENT PLAN	A document that describes how project scope will be managed and how scope changes will be integrated into the project.
PROJECT SCHEDULE MANAGEMENT PLAN	A document that defines how changes to the schedule will be managed.
PROJECT RECORD	Project/programme record includes correspondence, memos, and documents describing the project/programme.
PROJECT REPORT	Formal report on project status including issues and change requests.
Change Management	
ISSUE	A point or matter of discussion, debate, or dispute which may or may not lead to the creation of change request.
CHANGE REQUEST	A document containing a call for an adjustment to one or more aspects of the project management.
LESSON LEARNED	The cause of issue and/or change request, the reasoning behind the preventive and/or corrective action.

7.1.2 Developing the Key relationships Diagram

To develop the Key-relationships Diagram, the detailed steps are (1) introduce only one term at a time into the diagram; (2) for every new term added, determines if it is related to the terms already captured in the diagram and if so, reflect their relationships accordingly; (3) repeat step 1 and 2 until all terms are included in the diagram; (4) evaluate if the scope depicted by the Key-relationships Diagram has sufficiently represented the research findings; otherwise expand the diagram with new terms and relationships accordingly.

The Key-relationships Diagram is a customized causal map, which has been modified to also represent structural information. For causal relationships, it is represented by lines with arrowheads. The link A→B for example, means A poses an effect on B. The representation of structural information on the other hand, is achieved by injecting elements of set diagram; where terms placed within a boundary are "subordinate" to the bounding term. This can be better illustrated by referring to Figure 7.1, which is the resulting Key-relationships Diagram.

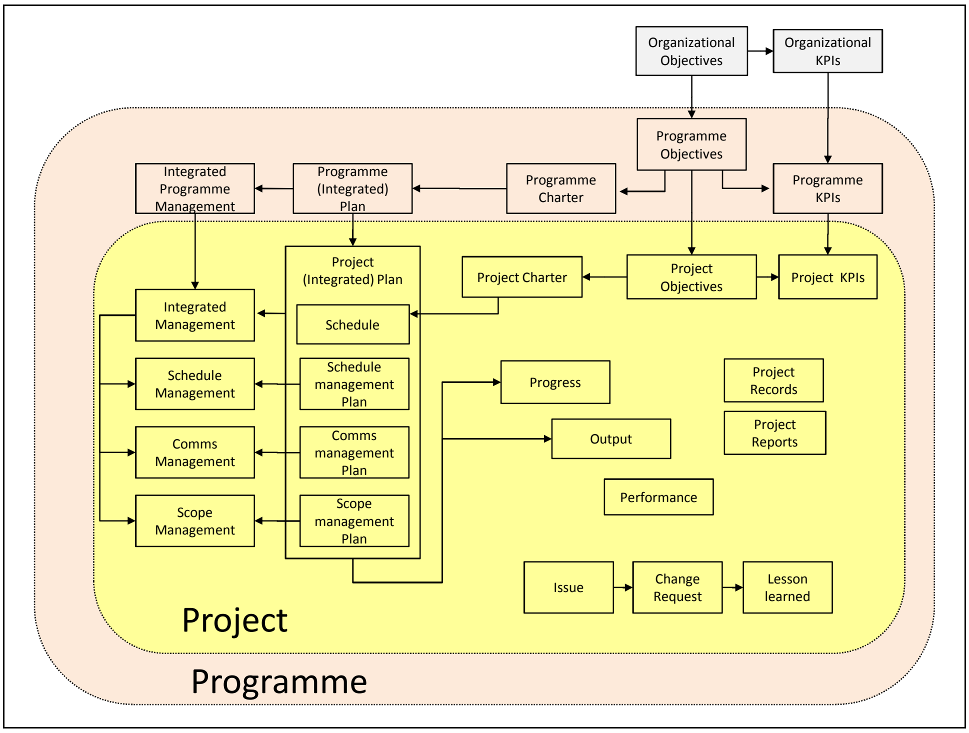

Figure 7.1 : Key-relationships Diagram

In terms of structural information, the Key-relationships Diagram shows that "Project (Integration) Plan" consists of "Schedule", "Schedule management Plan", "Communication Plan" and "Scope Management Plan". Another example would be "Programme" encompasses "Project", as well as all the other terms defined outside "Project" but within the boundary of "Programme". In terms of causal relationships, an example would be both "Project Objectives" and "Programme KPIs" pose an impact on how “Project KPIs” are defined. Another example would be execution of “Project (Integration) Plan” leads to delivery of “Progress” and “Output”.

At first glance, the key-relationships would appear to have covered the scope of both project management and programme management as suggested by the theoretical framework. Having said that, the essence of BProjM theory where “business projects should be managed as an integral part of the business enterprise and given equal emphasis as the business-as-usual operations” is still not reflective. It is also unclear at this point what impacts or contributes to project “Performance”; and where “Programme (Integrated) Plan” would draw the expertise to supplement the other 5 non-core project management competency areas. To address these missing links, other related terms at the organization level must also be included into the diagram to set the context. The result is the revised Key-relationships Diagram as depicted by Figure 7.2.

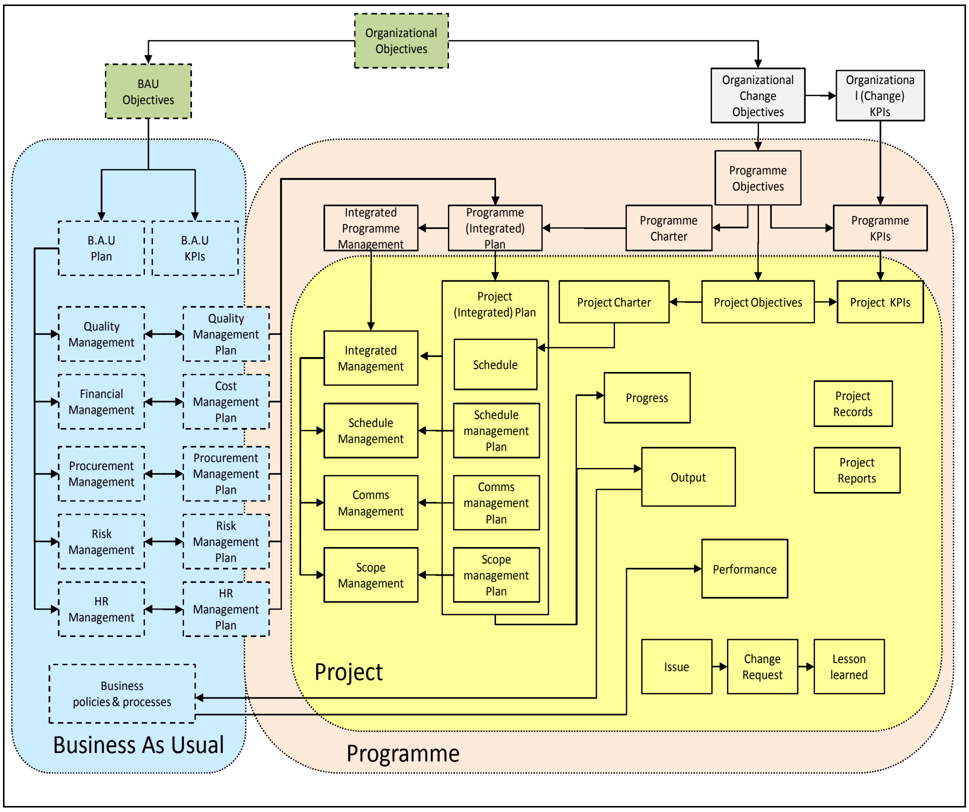

Figure 7.2 : Key-relationships Diagram (revised)

This time, it is clearly showed in the revised diagram that business project (on the right) is an integral part of a business enterprise which shares equal emphasis as the business-as-usual operations (on the left). In addition, project "Output" poses an impact (which is likely a change) on the existing "Business policies and processes" in the parent organization; and the execution of these revised "Business policies and processes" in turn bring about the desired project "Performance". The "Programme (Integrated) Plan" on the other hand, draws its input for the other 5 project management knowledge areas from the respective Business-As-Usual operations in the parent organization. With the exception of the 5 knowledge areas which are based on PMBOK standard, the other new terms are introduced based on common industry terminologies which are expected to be replaced with better recognised terms during the next modelling step of "Reusing existing work". Last but not least, the new terms are enclosed in dotted lines to indicate that they are technically out-of-scope but are included here so that the gist of the developed BProjM theory is not lost.

This Key-relationships Diagram is not ideal since the links do not carry any semantics. Without the accompanying narratives, it offers very little information for interpreting the causal relationships. Furthermore, only key relationships are reflective in the diagram. The rest of the relationships for example how “Change Request” relates to “Project Integrated Plan” during project execution stage and how “Project (Integrated) Plan” may be dependent on “Lesson Learned” during project planning stage etc. are not represented here. As incomplete as it may seem, the diagram has served its intended purpose of providing a visual overview of the key relationships so that the overall scope of the domain model is better comprehended.

With that, the scope definition of the domain model is now complete with the (1) Specification Table containing the list of terms; and (2) the Key-relationships Diagram depicting the key relationships among them. More importantly, through the process of developing the Specification Table and the Key-relationships Diagram, it is realized that the domain model must cover both (1) business project management related terms and relationships which forms the main scope of work; (2) their interfaces with related terms in the operating environment i.e. the parent organization or the business enterprise at large.

7.2 Reusing and Integrating Existing Work

The purpose of reusing existing work aside from expediting the modelling process is to promote collaborations and collective enrichment of the domain model. Guided by the defined scope, relevant work done by previous researchers would be sourced and assessed if they could be leveraged. The targeted reusable component in these existing works is the invariant aspects of the domain knowledge which they have captured. The basis of whether they will be adopted or rejected depends on the "comprehensiveness", "suitability" and "expandability" of its content. "Comprehensiveness" refers to the completeness of the work in describing the domain. "Suitability" refers to whether the context (i.e. the perspective of which the domain knowledge is interpreted) is aligned with the current modelling exercise. "Expandability" refers to the likelihood that the work will be expanded by its developer in the future, which is indicative by its level of popularity among the user community. The format of the existing work is not an important consideration because as long as the content can be translated into a list of terms and inter-relationships, they could be reused. As such, the types of existing work to be evaluated shall include both conceptual models and ontologies.

The ideal scenario would be where a similar domain model already existed, in which case, the task of the modelling exercise is just to identify the overlaps and extend the existing domain model with new terms and relationships. This may sound unlikely but it would be the exact scenario when the developed BProjM domain model is enriched with new findings in the future. If the potentially reusable work is not in a similar format as the domain model, the modelling exercise would have to extract the underlying list of terms and relationships accordingly. In any case, there are likely to be overlaps between the terms defined by the existing work and the content of the Specification Table. The key to resolving this "conflict" lies with the definition of the terms. If these reusable existing work are selected based on the 3 predefined criteria as described earlier, the differences are likely a matter of choice of words rather than conceptualization. Hence the recommended approach to resolving the “conflict” is to align the definition of the terms in the Specification Table to that of the adopted work. This is because the aim of this domain modelling is to capture knowledge and thus, efforts should be spent in enriching the model rather than debating the vocabularies. In addition, changing definition of existing terms may impact the integrity of the adopted work thus potentially jeopardising the stability and validity of the final model.

The rest of this section presents the details of how the above have been applied on the development of BProjM domain model namely (1) review and evaluate existing work; (2) identify reusable component in the existing work; (3) integrate them into the Specification Table and Key-relationships Diagram.

7.2.1 Reusing PROMONT for modelling project fundamentals

Based on the defined scope for the BProjM domain model, the types of existing work to be sourced should be those related to business project management (the main scope of work) and business enterprise (its operating environment).

For sourcing of related work in the domain of business project management, it is extended to include general project and project management related works. This is because business project management is still not a very well defined subject matter and thus, there may not be a great deal of existing work in this area. To date, the search did not find any reusable conceptual models; and only a handful of related project ontologies and project management ontologies are found. The following sections detail the evaluation of these project ontologies and project management ontologies; and how the conclusion on reusing PROMONT is derived.

Project Ontologies

Project ontologies refer to ontologies that describe projects and three existing project ontologies were found namely DOAP, POP and WebODE. DOAP (Description of a Project) is an RDF schema and XML vocabulary that describes open-source software projects (Dumbill, 2004). It captures basic information such as name and description of the software project, its developer, the programme language and operating system used for its development, the location where this software could be found etc. POP (Product, Organization, Process) is a project ontology introduced to promote collaboration & virtual design of building projects (Garcia et al, 2003). It captures the functional requirements, designed forms, predicted and observed behaviours of the product, organization and process of the building projects. ODESeW (Semantic Web Portal based on WebODE) project ontology is the underlying ontology of a project portal developed using ODESeW framework to manage the EU R&D projects (Gómez-Pérez et al, 2006b). It contains five project description ontologies (documentation, event, organization, person, and project), a user-role ontology (for managing different user profiles within the project), and a project management ontology (for managing R&D projects).

Project Management Ontologies

Project management ontology describes project management concepts, constructs and dynamics. The work in this area is notably scarce and the ontologies found are mostly light weight ontology or glossary of terms. The most well-known glossary is Wideman's "glossary of common Project Management terms" which has been acknowledged as the most significant and complete glossary of Project Management terms in existence to date. Developed by R. Max Wideman in 2002, it is now in its 4th version with 4500 entries (Wideman, 2005).

The only other work found is PROject Management ONTology (PROMONT) which offers a formal approach to define relationships and conditions between different common project management terms. This ontology was developed to facilitate communication and integration management of distributed virtual projects where project can be structured into independent sub-projects coordinated via "Events". In addition, it shows how individual objectives can be defined, communicated and compared with actual results (Abels et al, 2006). Using PMBOK knowledge areas as the basis, PROMONT's core concepts and relationships as listed in Table 7.6 and Table 7.7 are developed by extending DIN69901's data model (German national standards for Project Management Systems) with semantic information.

Table 7.6: PROMONT's core concepts (Abels et al, 2006)

Concept	Definition
Initiative	Any intention or endeavour, super ordinate concept for project, task and processes.
Project	A project is a structured approach to deliver a certain result. It consists of an amount of time, budget and resource restrictions and conditions and is usually divided into a set of tasks.
Task	Project-specific initiative. May be divided into sub-tasks. May be implemented by the application of a process.
Activity	Task that has been assigned to a specific resource. The assignment determines duration and costs of task execution.
Phase	Subdivision of Project timing with specific objective. Often ends with a gate
Resource	Consumable or not-consumable good or entity. Resources are necessary to execute an initiative
Employee	Person working for an organizational unit. Subset of Resource.
Machine	A non-consumable, non-human Resource.
Calendar	A timetable showing the availability and workload of a resource during a period. Also used for a project overview calendar.
Skill	Property and potential of a resource to satisfy a requirement for a task.
Event	Occurrence of an action at a specific point in time. Has zero duration and may trigger tasks.
Milestone	Event with significant meaning for project status.
Gate	Milestone ending a phase. Usually associated with a formal review task.

Concept	Definition
Risk	Possible source of shortcomings or failure in the project. Might be sanctioned.
Objective	Desired outcome of an Initiative. Can be a physical product, a service or a document
Result	Actual outcome of an Initiative. Can be a physical product, a service or a document.

Table 7.7 : PROMONT's core relations (Abels et al, 2006)

category	definition / examples
attends	Shows, that the subject instance. For example, a worker is responsible for a certain machine. Usually requires with a certain ability of the subject.
depends on	Shows the logical dependency of the target instance from the subject instance. Works usually depending on status, for example, makes the start of a certain activity dependant on the conclusion of another. Inverse relations are implies and supplies.
implies	Models the logical consequence of the target instance from the start instance. The use of a resource implies certain costs, for example. Often inverse relation to depend on.
part of	The subject instance is a member, content or a component of the target instance. A human resource, for example, is a member of an organizational unit.
supplies	The subject instance offers a property of ability for the target instance, e. g. a Human Resource supplies his knowledge of engineering to a task. Inverse relation to depend on.
startsWith	Relation between initiatives and events to illustrate that an event triggers an initative
endsWith	Relation between initiatives and events to illustrate that an event is triggered by an initative.

To ease comparison, the project ontologies and project management ontologies which have just been described are summarized into Table 7.8 according to their types and coverage.

Table 7.8 : Existing work related to business project management

Targeted Domain / Context of which it was built for		Type	
		Conceptual Model	Ontology
Project	Open source system projects		DOAP
	R&D Projects		ODESeW's R&D project ontology
	Building projects		POP project ontology
Project Management	General		Wideman's glossary of project management terms
	Product development projects		PROMONT

Among the three project ontologies listed in the table, ODESeW's project ontology is the most comprehensive since its ontology also contains some project management terms. Nonetheless, it failed the suitability criterion as it is designed specifically for R&D projects. For the project management ontologies, Wideman's glossary of terms may be more comprehensive in terms of provision of terms but PROMONT is richer in its representation of the domain knowledge by providing both terms and their inter-relationships. Although PROMONT is designed for product development project, a closer examination reveals that its core concepts and relationships cover no more than project fundamentals. This is likely attributed to its use of PMBOK as the basis. The use of PMBOK also satisfies the expandability criteria given the generic nature, popularity and continuous improvement of PMI's standards. As such, PROMONT has been adopted and reused by this modelling exercise to capture project fundamentals.

7.2.2 Reusing OMG Standards for modelling project environment

As mentioned in earlier section, the domain model will have to cover key concepts and relationships of the business enterprise in order to reflect the interfaces between business project management and its parent organization. This translates to the need of sourcing and evaluating existing enterprise models and enterprise ontologies. This section details how OMG standards namely BMM, BPDM and OSM are eventually adopted as the basis for modelling the project environment.

Unlike the small number of existing business project management related work, there is an extensive amount of work in this area especially in terms of enterprise modelling (Petit & Doumeingts, 2002). The suitability criterion comes in handy in this case to help shortlist the existing work. Guided by the definition of domain model that it should contain only invariants in the domain knowledge, the reusable work should be an enterprise model or enterprise ontology that describes how business enterprise works, independent from any system considerations. Based on this principle, enterprise models that approach the subject matter from the architecture point of view such as Zachman's Framework for Enterprise Architecture, ISO 15704 **G**eneralised **E**nterprise **R**eference **A**rchitecture and **M**ethodology (GERAM) and ISO/CEN 19439 Framework for Enterprise Modelling (Martin & Robertson, 2003) are deemed unsuitable for reuse. This is because these standards define the framework for enterprise modelling rather than the actual terms and relationships of the enterprise domain. The potentially reusable work in which case, are narrowed down to enterprise models, enterprise ontologies as well as related data exchange standards (which may be considered as light weight ontologies) that describe enterprise fundamentals.

This resulting list of existing work shortlisted for further evaluation can be classified into 3 categories namely (1) business model ontologies; (2) enterprise ontologies (3) generic enterprise models. For business model ontologies, REA (Resource-Event-Agent) ontology, e3-value ontology and e-Business Model Ontology (e-BMO) are prominent examples which focuses on the concepts of creation and transfer of economic value (Gailly & Poel, 2007). For enterprise ontologies, represented works are TOVE, EO and Leppänen's Contextual enterprise ontology which place emphasis on organizational structure, activities and management. Lastly for the generic enterprise models, the closest found are ISO/CEN 19440 Construct for enterprise modelling (Shorter, 2005) and OMG's standards for defining CIM for enterprise namely BMM, BPDM, OSM. Standards such as IS 15531 Manufacturing Data Exchange for resources usage management, ISO16100 Manufacturing Software Capability Profiling for interoperability, IEC/ISO 62264 Enterprise Control Systems Integration (Kosanke, 2007) have been ruled out because although they could be applied across organizations, they address only a specific segment within the enterprise (such as manufacturing), thus failing the comprehensive criteria. Table 7.9 below summarises these shortlisted work by category.

Table 7.9 : Existing work related to enterprise (project environment)

Category of existing work found	Type	
	Conceptual Model	Ontology
Business Model Ontologies		• REA ontology • e3-value ontology • e-Business Model • Ontology (e-BMO)
Enterprise Ontologies		• TOVE • Enterprise Ontology (EO) • Leppänen's Contextual enterprise ontology
Generic Enterprise Models	• ISO/CEN 19440 Construct for enterprise modelling • OMG's BMM, BPDM, OSM	

Comparatively between business model ontologies and enterprise ontologies, enterprise ontologies would be a better fit for describing the project environment given its coverage on organizational structure, activities and management. As such, only the enterprise ontologies and domain models were assessed further for reuse.

TOVE

TOVE is a product of the "TOronto Virtual Enterprise (TOVE) Project" led by Mark S. Fox of University of Toronto, Canada in 1992. The goal of the TOVE project was to create the next generation Common Sense Enterprise Model that has the ability to deduce answers to queries that require relatively shallow knowledge of the domain. The developed ontology represents the organization as a group of agents playing roles in which they are acting to achieve specific goals according to various constraints or "rule of the games" (Fox et al., 1997). Implemented in a set of PROLOG axioms, TOVE ontology can be organized in 3 dimensions as illustrated by Figure 7.3.

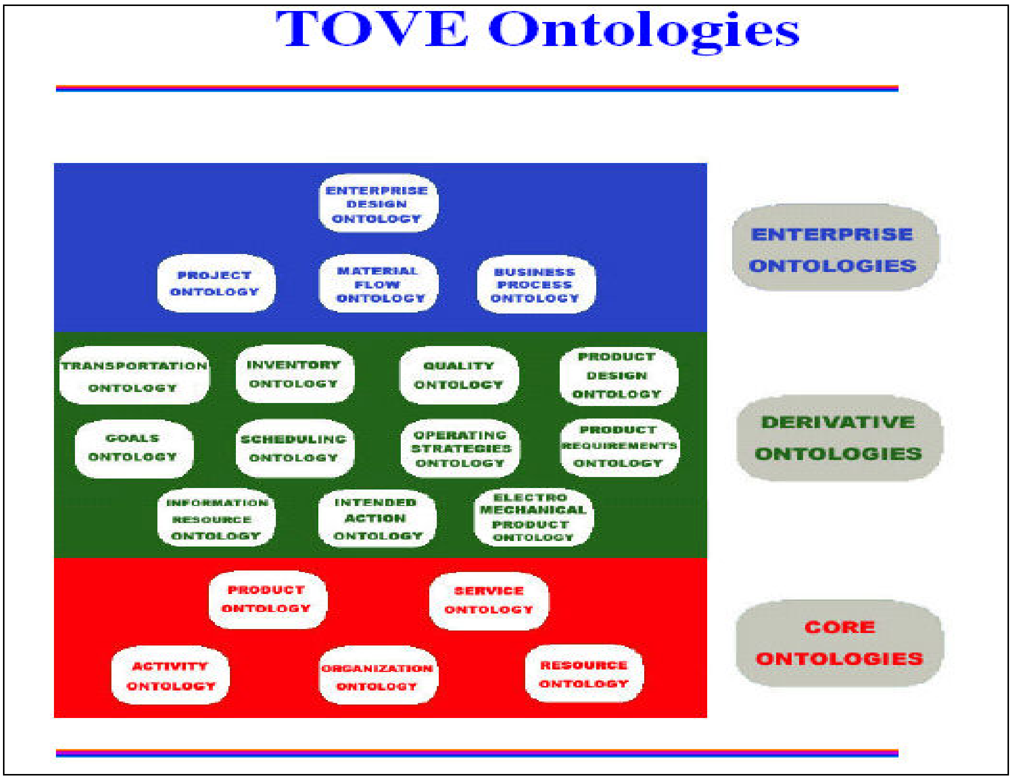

Figure 7.3 : TOVE ontology (TOVE Ontology Project, 2002)

Enterprise Ontology (EO)

EO is the product of the "Enterprise Project" led by Mike Uschold of Artificial Intelligence Applications Institute (AIAI), University of Edinburgh in 1995. The goal of the Enterprise Project is to provide an environment for integration methods & tools for capturing and analyzing key aspects of business. The resulting Enterprise Ontology (EO) is a glossary of terms expressed in a restricted and structured form of natural language supplemented with formal axioms. It contains a small set of Meta-ontology or top level Classes which are organized into (1) Meta-ontology: Entity, Relationship, Role, Actor, State Of Affairs; (2) Activity and processes : Activity, resource, Plan and

Capability; (3) Organization : Organization unit, Legal Entity, Management, Ownership (4) Strategy : Purpose, Strategy, Help to Achieve, Assumptions); (5) Marketing : Product, Vendor, Customer, Market (Uschold et al, 1995, 1996 &1998; Fox & Gruninger, 1998). The full list of terms in each of these groups is summarized in Table 7.10.

Table 7.10 : Enterprise ontology (Uschold et al, 1996)

ACTIVITY etc.	*ORGANISATION*	*STRATEGY*	*MARKETING*	*TIME*
Activity	Person	Purpose	Sale	Time Line
Activity Specification	Machine	Hold Purpose	Potential Sale	Time Point
Execute	Corporation	Intended Purpose	For Sale	Calendar Date
Executed Activity Specification	Partnership	Purpose-Holder	Sale Offer	Relative Time Point
T-Begin	Partner	Strategic Purpose	Vendor	Duration
T-End	Legal Entity	Objective	Actual Customer	Duration Bounds
Pre-Condition	Organisational Unit	Vision	Potential Customer	Time Interval
Effect	Manage	Mission	Customer	Before
Doer	Delegate	Goal	Reseller	Same or Before
Sub-Activity	Management Link	Help Achieve	Product	After
Authority	Legal Ownership	Strategy	Asking Price	Same or After
Activity Owner	Non-Legal Ownership	Strategic Planning	Sale Price	Distance
Event	Ownership	Strategic Action	Market	Earliest Start Time
Plan	Owner	Decision	Segmentation Variable	Latest Start Time
Sub-Plan	Asset	Assumption	Market Segment	Earliest End Time
Planning	Stakeholder	Critical Assumption	Market Research	Latest End Time
Process Specification	Employment Contract	Non-Critical Assumption	Brand	Interval Before
Capability	Share	Influence Factor	Image	Interval During
Skill	Shareholder	Critical Influence Factor	Feature	Interval Overlaps
Resource		Non-Critical Influence Factor	Need	Interval Disjoint
Resource Allocation		Critical Success Factor	Market Need	
Resource Substitute		Risk	Promotion	
			Competitor	

Contextual Enterprise Ontology

Leppänen (2007) approaches Enterprise Ontology in a slightly different angle by incorporating the element of context. The Contextual Enterprise Ontology as illustrated by Figure 7.4, is a top level ontology comprising a list of domains which conceives, structures and represents the nature, purposes and meaning of things in the enterprise within context, and/or as context (Leppänen, 2007).

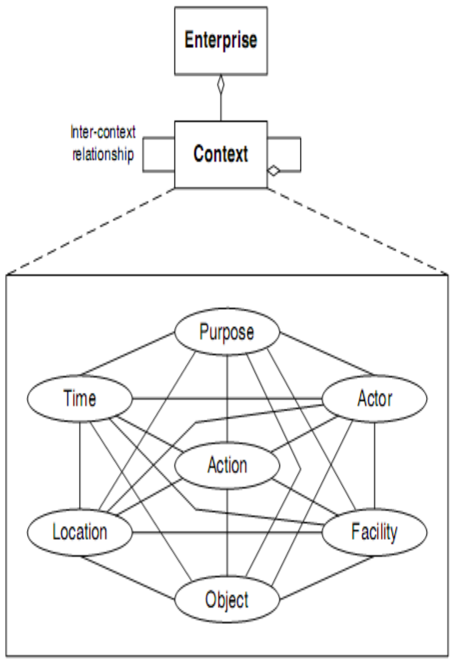

Figure 7.4 : Contextual enterprise ontology (Leppänen, 2007)

The nature of "context" is similar to that of the TOVE's derivative ontologies. Each business functions within the organization such as sales, procurement etc. could be defined as a different context, whilst cross-functional operations could either be captured as another context or reflected through inter-context relationship at a higher level. Similar contextual ontology approach has also been employed by the Enterprise Information System Contextual Ontology (EISCO) project which is dedicated to describing a rich conceptual model based on ontologies (Rifaieh et al, 2004), motivated by the need to see the same concept from different perspectives. For example, the same product needs to be marketed but each enterprise has its own representation which varies in properties and possibly structure from other representations. Its key characteristic is that these various viewpoints can be captured without constructing a global ontology but inter-related with each other through mapping.

The context-based approach appears logical but its practicality has yet to be tested. Firstly, not all relationships in an organization could be expressed in terms of seven S's scheme where "For Some purpose, Somebody does Something for Someone, with Some means, Sometimes and Somewhere". The focus is clearly the behavioural aspect of the enterprise and the provision for describing plain structural relationships among objects in an organization is unclear. Secondly, the use of context essentially creates an additional layer and thus, may introduce unnecessary complications as all concepts must first be expressed in contexts before the inter-context relationships are added on. In addition, since the inter-context relationships are defined in a lateral fashion, the hierarchical relationship between the contexts will either be lost or inadequately represented. Last but not least, the ontology would become very difficult to comprehend once all the inter-context relationships in the organization are fully captured.

ISO/CEN 19440

ISO/CEN 19440 is technically not an enterprise model but a set of definitions and descriptions of the core constructs necessary for computer-supported modelling of enterprises. Having said that, an overview of these constructs and their relationships is presented in an UML meta-model graphical representation (CIMOSA, 2007). It has 14 language constructs such as Enterprise Activity, Event, Enterprise Object, Product, Order, Resource, Capability, Organizational Unit; which are classified into 4 basic model views namely function, information, resource and organisation (Zelm & Konsake, 2007).

OMG's Standards

The OMG standards of interest to this research are its specifications for domain, which is where Business Motivation Model (BMM) is classified and found. BMM contains a set of built-in concepts that define the elements of business plans. It claims that in association with standards for "business process" (i.e.BPDM), "organization unit" (i.e. OSM), as well as concepts in 'asset & liability' (which BMM referred to as "BMM Place Holders"), it provides the related concepts needed for detailed business modelling (BMM 2008). Business Process Definition Meta-Model (BPDM) is a framework for understanding and specifying the processes of a community or organization (BPDM, 2008) whilst Organization Structure Meta-Model (OSM) provides the concepts behind the organization to serve as the basis for exchanging organizational models. Since OSM has not been finalised at the time of this research, its RFP submission is adopted as the basis (OSM, 2006) to support the modelling work.

Comparison between Enterprise Ontologies & Conceptual Models

Based on the above findings, it is clear that there is no universally accepted enterprise ontology and as pointed out by Khoury et al (2005), nor are there standards for enterprise models, enterprise modelling or enterprise modelling languages. It is also found that the coverage of the enterprise ontologies and the enterprise models are similar; and these enterprise ontologies and enterprise models are comprehensive in their own perspectives. In which case, the adoption of conceptual models already expressed in the form of UML would be favourable and the 3rd criterion of expandability becomes the determining factor. This narrows down the choices to ISO/CEN 19440 and OMG's which are both international standards that are continuously enhanced and maintained by professional bodies. Nonetheless in view that the key motivation of adopting domain model as the specification format is to be able to leverage on the MDA approach, it would be sensible to also adopt OMG's suite of enterprise meta-Classes.

7.2.3 Integrating existing work with the Specification Table

The last activity to be performed within the step of "reusing existing work" is to integrate the reusable work into the Specification Table and Key-relationships Diagram. This section describes how this is done and the result is the edited Specification Table and Key-relationships Diagrams that kick start the actual development of the UML model.

The guiding principle for the integration is to add new terms and relationships into what is already recognized as a standard. In addition, rather than integrating the content of the Specification Table with more than one piece of existing work, the recommended approach is to first integrate all the existing work to form a base, and then integrate the base with the Specifications Table.

Since OMG standards are already well established, all existing terms in the BMM, BPDM and OSM shall be adopted without change. The next step is to align and connect PROMONT's terms with that of OMG's, followed by a similar exercise to integrate the combined results with the terms in the Specification Table. A systematic way to approach this would be to review each term in the "non-standard" or "new-comer" list against those in the existing standards and perform the following:

a) For overlapping terms, review and change the definition of the "non-standard" or "new-comer" term and adjust its relationships with the rest of the terms as necessary.

b) For related terms, define new relationship(s) between them

Table 7.11 lists the PROMONT terms which overlap with OMG's, alongside the adjustments made to resolve the "conflict", as well as the new relationships that should be introduced to integrate the two pieces of work.

Table 7.11 : Overlapping terms between OMG standards and PROMONT

PROMONT terms	Original definition of PROMONT term	Corresponding terms in OMG's BMM/BPDM/OSM standards	Modified definition of PROMONT term	New relationships to be introduced between PROMONT and OMG terms
INITIATIVE	Any intention or endeavour, super ordinate concept for project, task and processes.			INITIATIVE *is a form of* BMM's TACTICAL, which in turn *is a form of* BMM's COURSE OF ACTION
ACTIVITY	Task that has been assigned to a specific resource. The assignment determines duration and costs of task execution.	Defined as meta-Class in the activity model in BPDM: An ACTIVITY is a kind of BEHAVIOUR STEP that activates a BEHAVIOR (it operates over time) in the context of a PROCESS [BPDM].	The two terms are not of the same level. PROMONT's ACTIVITY is a term defined at the M1 level whilst BPDM's a meta-metaClass at the M3 level.	
RESOURCE	Consumable or not-consumable good or entity. Resources are necessary to execute an initiative.	Defined by BMM under placeholder as: Asset that is consumed in the operations of the enterprise and	PROMONT term will be renamed to INPUT as a composite term that refers to all types of resources that is required to	INPUT *is an allocation of* BMM's Place Holder's ASSETS

PROMONT terms	Original definition of PROMONT term	Corresponding terms in OMG's BMM/BPDM/OSM standards	Modified definition of PROMONT term	New relationships to be introduced between PROMONT and OMG terms
		replenished.	execute an INITIATVE which includes BMM's RESOURCE as well as FIXED ASSETS.	
EMPLOYEE	Person working for an organizational unit. Subset of Resource.			EMPLOYEE *fills* OSM's POSITIONS EMPLOYEE *is a form* of OSM's PERSON
MACHINE	A non-consumable, non-human Resource.			MACHINE *is a form of* BMM Place Holder's FIXED ASSET
SKILL	Property and potential of a resource to satisfy a requirement for a task.			SKILL is *satisfied by* OSM's POSITION
RISK	Possible source of shortcomings or failure in the project. Might be sanctioned.	Defined in BMM as: Potential impact that indicates the possibility of loss, injury, disadvantage, or destruction.	PROMONT term will be renamed to PROJECT RISK as a special form of BMM's RISK. Having said that, Risk management has been identified as a non-core competency knowledge area in business project management. In which case, the terms should be treated in the same way as the other 4 knowledge areas i.e. by leaving it out of the modelling scope.	
OBJECTIVE	Desired outcome of an Initiative. Can be a physical product, a service or a document.	Defined in BMM as: End that is a specific time-targeted, measurable, attainable target that	PROMONT term will be renamed to PROJECT OBJECTIVE as a special form of BMM's	PROJECT OBJECTIVE *is a form of* BMM's OBJECTIVE

PROMONT terms	Original definition of PROMONT term	Corresponding terms in OMG's BMM/BPDM/OSM standards	Modified definition of PROMONT term	New relationships to be introduced between PROMONT and OMG terms
		an enterprise seeks to meet in order to achieve its goals.	OBJECTIVE.	

In general, for terms with the same name but are used in different context, prefix is added to denote that it is a special form of its more generic counterpart. For example, the term OBJECTIVE exists in both BMM and PROMONT. Since PROMONT's OBJECTIVE is defined in the context of a project, it is renamed to PROJECT OBJECTIVE and to denote this specialization, a new relationship where "PROJECT OBJECTIVE is a special form of OBJECTIVE" is introduced.

By deploying the same method, overlapping /conflicting terms between the Specification Table and the combined base of existing work were tackled accordingly. The only point to note is that while OMG terms are considered standards and must not be changed, PROMONT is not a standard and thus further deliberation may take place while resolving the "conflicts" with the PROMONT's terms. A good example to illustrate this is the integration of the term OUTPUT from the Specification Table and the term RESULT from PROMONT. As described in Table 7.12 which presents the final list of "conflicts", the term will still be named OUTPUT in order to be in line with the use of the term INPUT; but it will adopt the more refined definition of RESULT.

Table 7.12 : Overlapping terms between existing work and Specification Table

Terms in Specification Table	Original definition of term in the Specification table	Corresponding terms in the integrated base of existing work	Modified definition of terms in the Specification Table	New relationships to be introduced between terms in existing work and Specification Table
INITIATIVE		Any intention or endeavour, super ordinate concept of project, tasks and activities.	This existing definition from PROMONT's is no longer appropriate when it is placed in the context of a business enterprise; and thus it is modified to "Any intention or endeavour, super ordinate concept of project and programme".	
PROJECT	A group of people working together in order to achieve specific objective(s), given limited time and resources.	A project is a structured approach to deliver a certain result. It consists of an amount of time, budget and resource restrictions and conditions and is usually divided into a set of tasks.	Both definitions are similar in meaning except difference in wordings. As such, the more concise definition in the specification table will be adopted.	PROJECT *is a form of* INITIATIVE
OUTPUT	The direct output of project plan execution.	Defined by PROMONT as RESULT with the definition of "Actual outcome of an Initiative. Can be a physical product, a service or a document".	Both definitions are similar in meaning except difference in wordings, thus definition in PROMONT can be adopted. Having said that, the term RESULT may also be interpreted as meeting objectives in addition to producing concrete deliverables thus creating unnecessary confusions. Furthermore, the term OUTPUT aligns	

Terms in Specification Table	Original definition of term in the Specification table	Corresponding terms in the integrated base of existing work	Modified definition of terms in the Specification Table	New relationships to be introduced between terms in existing work and Specification Table
			well with the use of INPUT which describes all types of project input. As such, the term OUTPUT rather than RESULT is chosen to carry the definition.	
PROGRAMME	A group of projects organized to meet a set of organizational objectives.			PROGRAMME *is a form of* INITIATIVE
PROGRAMME OBJECTIVE	Purposes or goals of the programme, the aims to be achieved and the desired end results.			PROGRAMME OBJECTIVE *is a form of* OBJECTIVE
INTEGRATED PROGRAMME MANAGEMENT	An organizational practice that includes processes to enable on-going initiation, execution and completion of top-down driven business change programme which may consist of many sub-programmes defined with specific organizational objectives.			INTEGRATED PROGRAMME MANAGEMENT *is a form of* BPDM's BUSINESS PROCESS
SCOPE MANAGEMENT	A subset of PM that includes processes to ensure that the project includes all the work required and only the work required, to complete the project successfully.			SCOPE MANAGEMENT *is a form of* BPDM's BUSINESS PROCESS
TIME MANAGEMENT	A subset of PM that includes processes to ensure timely completion of project.			TIME MANAGEMENT *is a form of* BPDM's BUSINESS PROCESS
INTEGRATION MANAGEMENT	A subset of PM that includes processes to ensure that the various elements of the project are properly coordinated.			INTEGRATED MANAGEMENT *is a form of* BPDM's BUSINESS PROCESS

Terms in Specification Table	Original definition of term in the Specification table	Corresponding terms in the integrated base of existing work	Modified definition of terms in the Specification Table	New relationships to be introduced between terms in existing work and Specification Table
COMMUNICATIONS MANAGEMENT	A subset of PM that includes processes to ensure timely and appropriate generation, collection, dissemination, storage and ultimate disposition of project information.			COMMUNICATIONS MANAGEMENT *is a form of* BPDM's BUSINESS PROCESS

With that, the full list of terms to be captured by the domain model is now revised and presented in Table 7.13. The column in which the term is parked denotes its origin.

Table 7.13 : List of terms to be captured by the BProjM domain model

BProjM Terms		Enterprise Fundamentals		
BProjM terms in the original Specification Table	Project Fundamentals from PROMONT	BMM	BPDM	OSM
Overlapping terms and the adopted terms upon resolving “conflicts”				
	PROJECT			
	PROJECT OBJECTIVE	OBJECTIVE		
OUTPUT				
	INPUT	RESOURCE		
Unique terms from BProjM and each of the existing work				
PROGRAMME	INITIATIVE	MEANS	BUSINESS PROCESS	ORGANIZATION
SCOPE MANAGEMENT	TASK	MISSION		ORGANIZATION UNIT
TIME MANAGEMENT	ACTIVITY	COURSE OF ACTION		ORGANIZATION ROLE
INTEGRATION MANAGEMENT	PHASE	STRATEGY		ORGANIZATION TYPE
COMMUNICATIONS MANAGEMENT	EMPLOYEE	TACTIC		PERSON
INTEGRATED PROGRAMME MANAGEMENT	MACHINE	DIRECTIVE		POSITION
PROJECT CHARTER	CALENDAR	BUSINESS POLICY		CONTRACTOR
PROGRAMME CHARTER	SKILL	BUSINESS RULES		
PROJECT SCHEDULE	GATE	END		
PROJECT (INTEGRATED) PLAN	EVENT	VISION		
PROJECT SCHEDULE MANAGEMENT PLAN	MILESTONE	DESIRED RESULTS		
PROJECT (INTEGRATED) PLAN		GOAL		
PROGRAMME (INTEGRATED) PLAN		INFLUENCER		
PROJECT COMMUNICATION MANAGEMENT PLAN		EXTERNAL INFLUENCER		
PROJECT SCOPE MANAGEMENT PLAN		INTERNAL INFLUENCER		
PROJECT RECORD		POTENTIAL IMPACT		
PROJECT REPORT		POTENTIAL REWARDS		
ISSUE		ASSESSMENT		
CHANGE REQUEST				
LESSON LEARNED				
PROGRAMME				

BProjM Terms		Enterprise Fundamentals		
BProjM terms in the original Specification Table	Project Fundamentals from PROMONT	BMM	BPDM	OSM
OBJECTIVE				
ORGANIZATIONAL KPIS				
PROJECT KPIS				
PROGRAMME KPIS				
PERFORMANCE				
PROGRESS				

A review on the list of new relationships introduced to resolve the "conflicts" shows that they are mostly specialization in nature. These relationships would enrich the comprehensiveness of the model but they are not key relationships that would change the landscape of the original scope. Thus no changes are required in the original Key-relationships Diagram.

The definition of scope for the domain model is now complete with (1) the edited Specification Table; (2) original Key-relationships Diagram.

7.3 Building the BProjM Domain model

This section details the steps involved in building the domain model using UML based on the edited Specification Table, Key-relationships Diagram and the underlying prevailing standards. Two aspects of model must be addressed namely the structural and the behavioural aspects. The structural aspect or static view emphasizes the static structure of the domain using *Objects*, *Attributes*, *Constraints, Operations* and *Associations*. The behavioural aspect or dynamic view emphasizes the dynamic behaviour of the domain by showing collaborations among objects and changes to the internal states of objects. The UML diagrams used to represent the structural aspect of the model are *Package Diagram* and *Class Diagram*; whilst *State Machine Diagram* and *Communication Diagram* are used to represent the behavioural aspect.

Since it would be too lengthy to explain the entire model in the main body of this thesis, this section uses only the extracts from the fully developed domain model to illustrate on the development process. Please refer to Appendix B for the details and documentation of the complete BProjM domain model.

The UML tool used to develop UML diagrams is Objecteering version 6.1, executing on Windows Vista Business platform.

7.3.1 Structural aspect of the model

This refers to developing the *Package Diagram* and the *Class Diagram*. The key activities are (1) create *Packages* and *Classes*; (2) reflect relationships among *Classes* within and across *Packages*; (3) Substantiate each *Class* with *Attributes, Operations* and *Constraints*.

Creating the Packages and Classes

Creation of *Package Diagram* is the starting point so that a macro view containing all the logical groups can be captured as well as to guide subsequent work. It can be built by defining a *Package* for each group of terms based on their origins namely BMM (note that a separate Package was defined for BMM Place Holder to contain Asset & Liability related Classes in accordance with OMG's BMM specification), BPDM, OSM, and "BProjM" which contains all the business project management related terms. Within each *Package*, sub-*Packages* can be defined for the finer logical grouping of the terms. Taking "BProjM" *Package* as an example, each logical group in the Specification Table can be translated to a corresponding sub-Package namely "Basic", "Core BProjM Functions", "Project Results", "Change Management", "Documentation". Creation of the *Class Diagram* is next and this can be achieved by filling each *Package* with *Classes*, where each *Class* is a direct translation of a term in the Specification Table.

Figure 7.5 presents the resulting *Class Diagram* which shows all the *Packages* in the BProjM domain model. At the top are the OMG Packages namely BMM, BPDM, OSM and BMM Placeholder. The focal point of the diagram is the "BProjM" *Package* where both its sub-*Packages* and *Classes* are showed. With reference to the defined scope, "BProjM" *Package* is the main scope of work where it contains all the terms which are direct related to business project management.

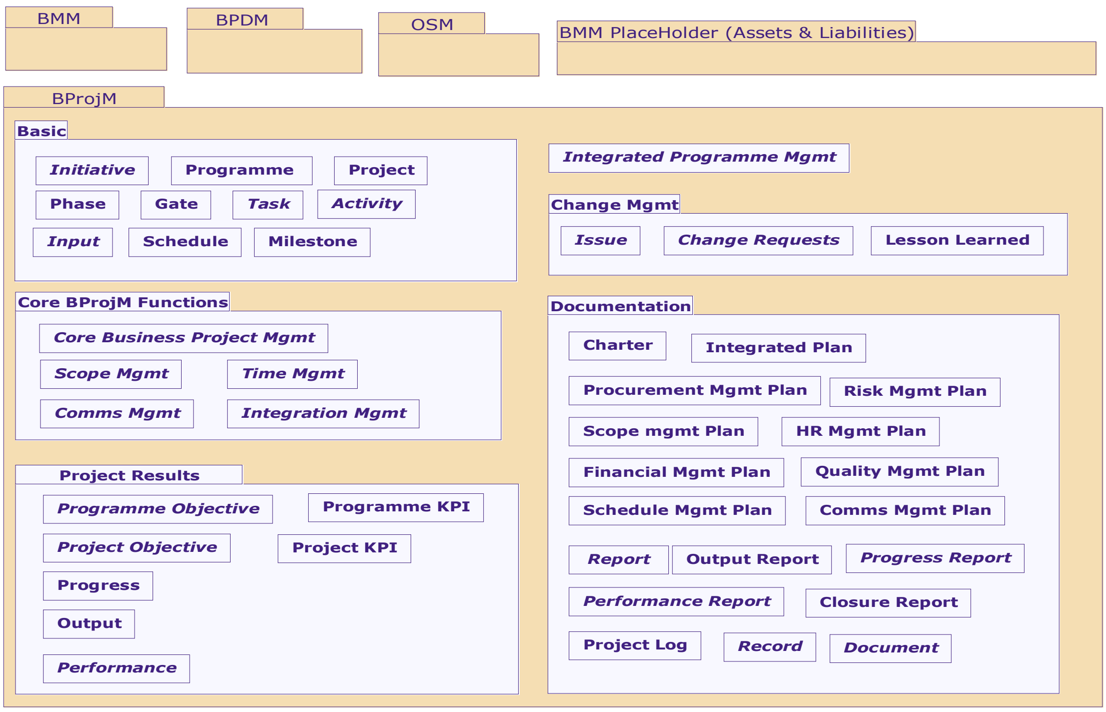

Figure 7.5 : Package and Class Diagram

Reflecting relationships among Classes within and across Packages

Having listed all the *Classes* in each *Package*, the next step is to reflect the inter-relationships among the *Classes* which justify their logical groupings. As illustrated by Figure 7.6, the "Basic" sub-*Package* is now defined with different types of relationships among its *Classes*.

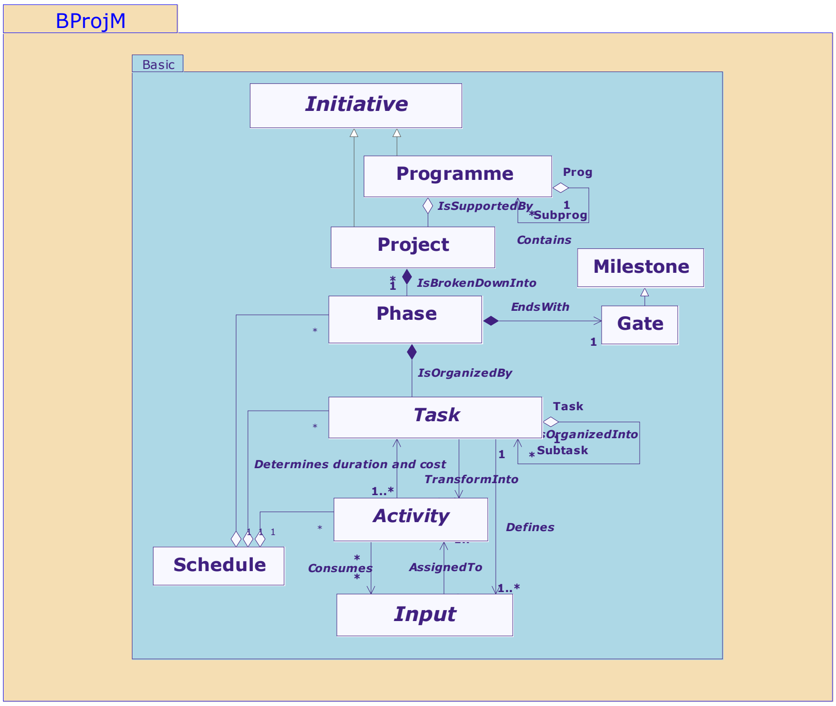

Figure 7.6 : Reflecting relationships within Package

This "Basic" sub-*Package* comprises primarily the project fundamental terms adopted from PROMONT and contains all four types of *Associations* namely *Inheritances, Composition, Aggregation* and the standard *Associations*. In conjunctions with the defined multiplicity, the relationships can now be explicitly interpreted. For example:

- INITIATIVE is a generalization of PROGRAMME and PROJECT, denoting that project and programme share the same fundamentals.

- PROGRAMME is an aggregation of PROJECT, reflecting that programme is made up of multiple projects.

- PROJECT is a composition of PHASE, indicating that a project phase cannot exist on its own without a project; and a project is consisted of multiple phases.

- SCHEDULE is an aggregation of PHASE, TASK and ACTIVITY, denoting that a schedule is created by putting phase, task and activity together.

- TASK is related to ACTIVITY by two *Associations*, one reflects that task are transformed into activities; while the other denotes that activities in turn determine the duration and cost of performing the task.

In a similar way, relationships among *Classes* across *Packages* can be built by establishing *Associations* with one other Package at a time. Technically, it does not make any difference which *Packages* are worked on first but for a better flow of thoughts, it is recommended that an inside-out approach be adopted. Taking the same example of "Basic" sub-*Package*, this means it should first establish the relationships with its "fellow" sub-*Packages* within the "BProjM" *Package* before connecting with the OMG's related *Packages*.

Figure 7.7 presents the result after the *Classes* in the "Basic" sub-*Package* are connected to the "Project Results" sub-*Package*. Their inter-relationships are now clearly depicted, for example, PROGRAMME and PROJECT are to be guided by

PROGRAMME OBJECTIVE and PROJECT OBJECTIVE respectively; a TASK is expected to produce one or more OUTPUT; and completion of ACTIVITY delivers PROGRESS.

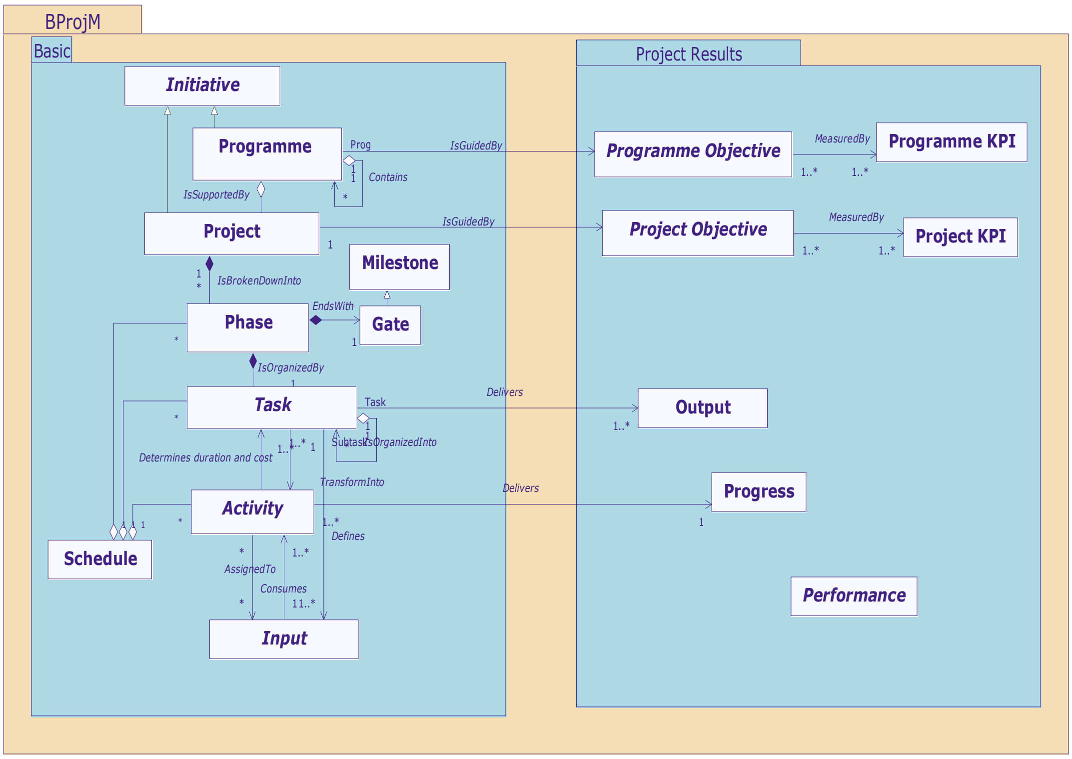

Figure 7.7 : Reflecting relationships between Basic and Project Results

Using “Basic” sub-*Package* as the focal point, the series of diagrams below present its relationships with each of the other sub-Packages within the “BProjM” *Package*. The purpose of doing this is to elaborate how the activities of establishing *Associations* across *Packages* are carried out, as well as to provide more details on the resulting “BProjM” *Package*.

Figure 7.8 denotes that the only relationship between "Basic" and "Core BProjM Function" sub-*Packages* is CORE BUSINESS PROJECT MGMT *Manages* PROJECT; which clearly reflects the role and influences of the core business project management competencies at the project level.

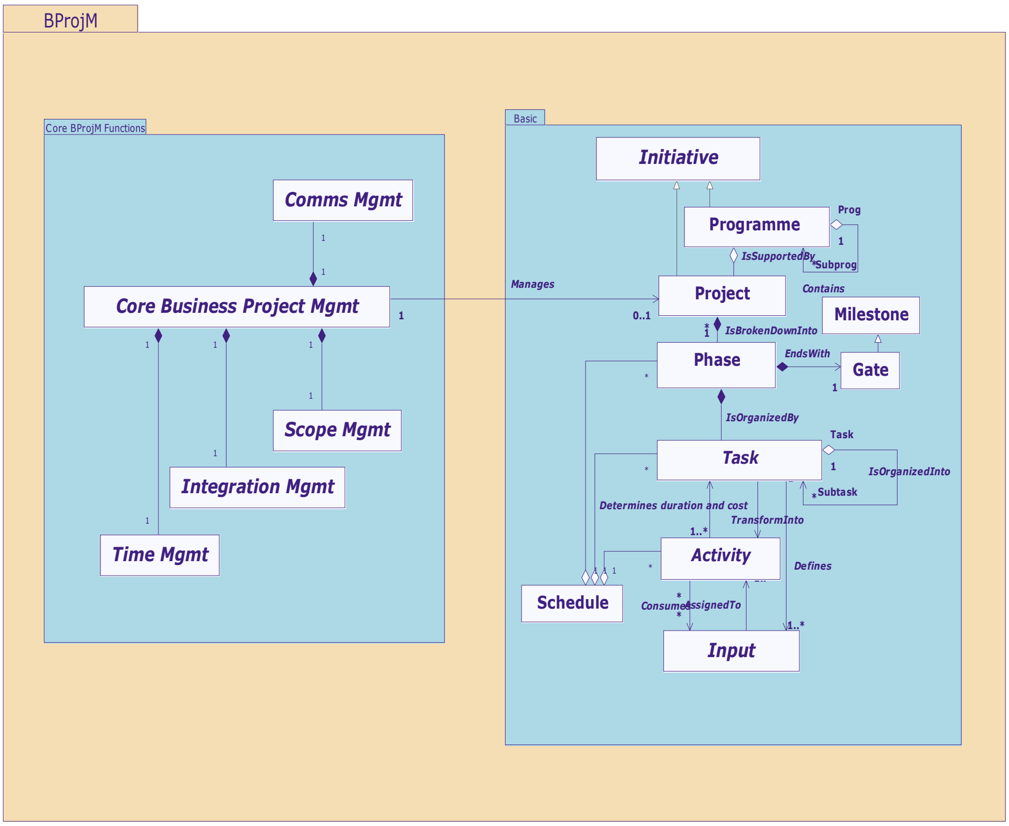

Figure 7.8 : Reflecting relationships between Basic and Core BProjM Functions

Figure 7.9 denotes that the only relationship between "Basic" and "Integrated Programme Management" is INTEGRATED PROGRAMME MANAGEMENT *Manages* PROGRAMME; which clearly reflects the role and influences of integrated programme management at the programme level.

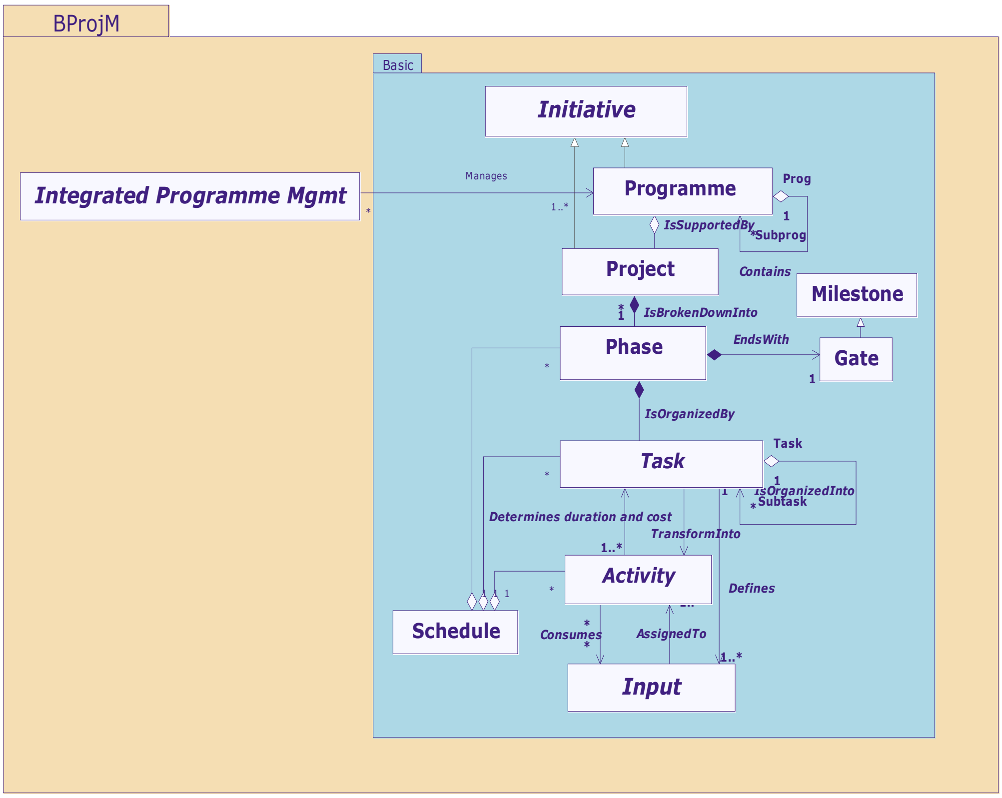

Figure 7.9 : Reflecting relationships between Basic & Integrated PM

Figure 7.10 denotes that the only relationship between "Basic" and "Documentation" is that SCHEDULE is a component in the INTEGRATED PLAN. This shows that documentation is not directly related to project fundamentals, but merely a supporting mechanism.

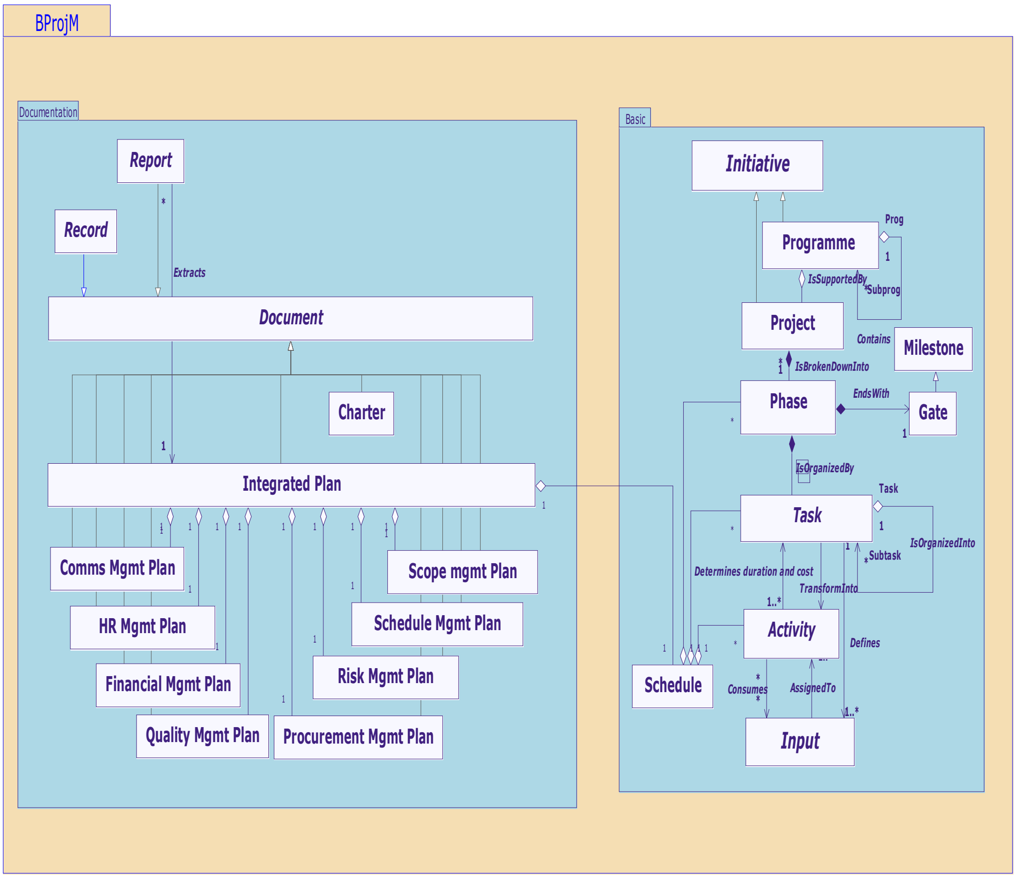

Figure 7.10 : Reflecting relationships between Basic & Documentation

Figure 7.11 denotes that the relationship between “Basic” and “Change Management” is CHANGE REQUEST *Updates* INITIATIVE in response to an issue; and LESSON LEARNED *Guides* INITIATIVE by learning from the past.

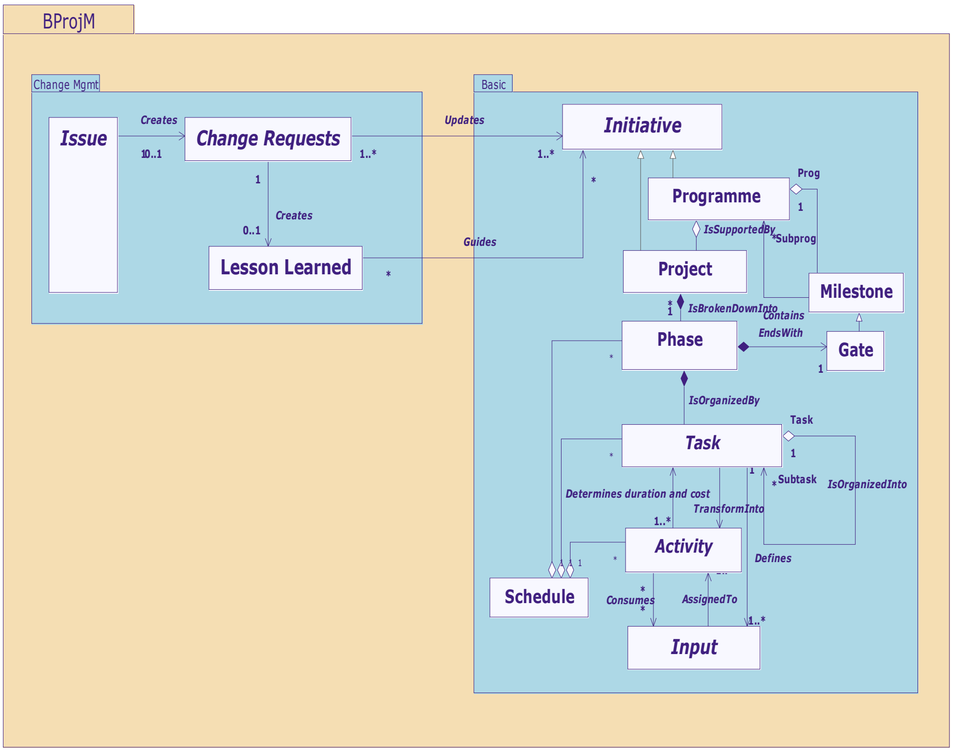

Figure 7.11 : Reflecting relationships between Basic & Change Management

At this point, the model looks simple with straight forward *Associations* across *Packages* because it is just the beginning. This same process of taking centre stage of linking itself with the other *Packages* is to be performed by each sub-*Package* in the “BProjM” *Package* until all the required *Associations* among them are established. If “Change Management” sub-*Package* is to take centre stage next, its *Associations* with the other sub-*Packages* namely “Core BProjM Functions”, “Documentation”, “Project Results” and “Integrated Programme Management” would be established in the similar way.

Upon completion of establishing *Associations* across all sub-*Packages* within "BProjM" *Package,* the last step of reflecting relationships would be to weave this "BProjM" *Package* and the OMG *Packages* together. In the context of the BProjM theory, this refers to integrating business project management into the project environment i.e. the parent organization. Figure 7.12 presents the result which is an extracted view of the model where only *Classes* defined with cross-*Package Associations* are reflected.

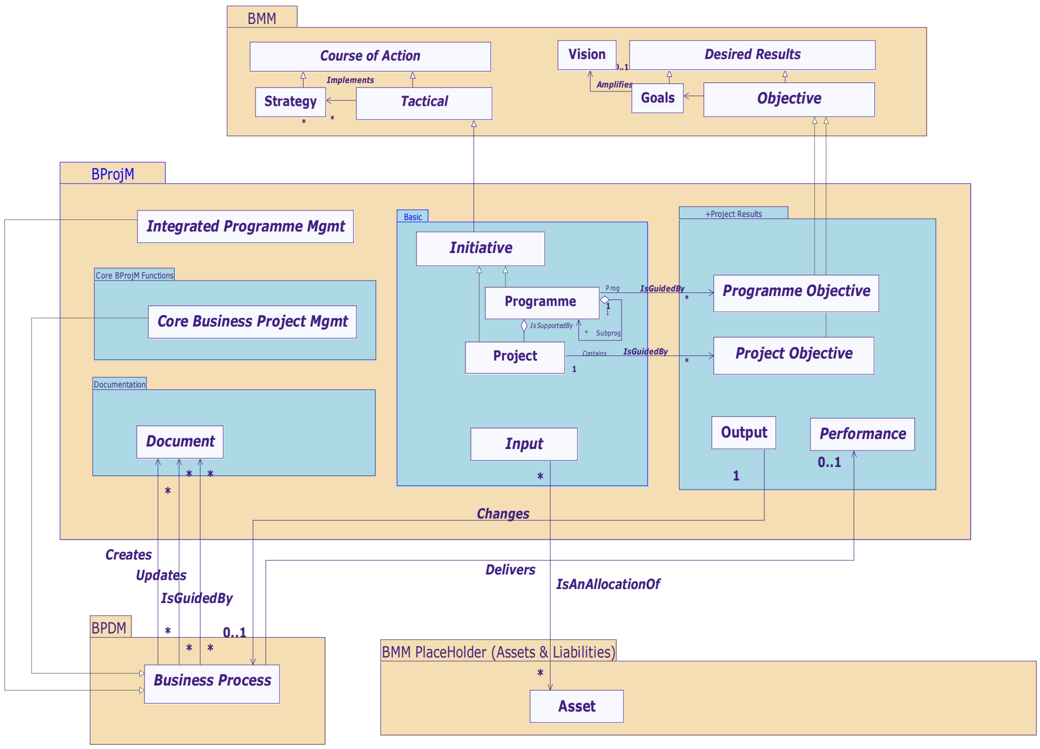

Figure 7.12 : Reflecting relationships between BProjM and OMG Packages

With reference to the diagram, the following relationships between business project management and its parent organization are now explicitly defined:

- INITIATIVE is tied to TACTICAL in BMM through an inheritance link, reflecting its nature as a special type of tactical COURSE OF ACTION.

- PROGRAMME OBJECTIVE and PROJECT OBJECTIVE are denoted as special types of BMM's OBJECTIVE;

- Project's INPUT "*IsAnAllocationOf*" ASSET in the BMM PlaceHolder *Package* (which can come in many forms such as materials, equipment or human resources);

- Both INTEGRATED PROGRAMME MANAGEMENT and CORE BUSINESS PROJECT MANAGEMENT are special types of BPDM's BUSINESS PROCESS ;

- Project's OUTPUT changes BPDM's BUSINESS PROCESS;

- BPDM's BUSINESS PROCESS delivers project's PERFORMANCE;

- BPDM's BUSINESS PROCESS creates and updates DOCUMENTS; but the executions of BUSINESS PROCESS can also be guided by DOCUMENTS.

Figure 7.13 shows the fully completed *Class Diagram* detailing all *Package*s, *Classes* and *Associations*. The purpose of presenting this diagram is to give an impression of the comprehensiveness of the developed model and it is not intended for all the details to be read. In summary, a total of 58 Classes (excluding the BMM, BPDM and OSM *Classes*) are captured in the model.

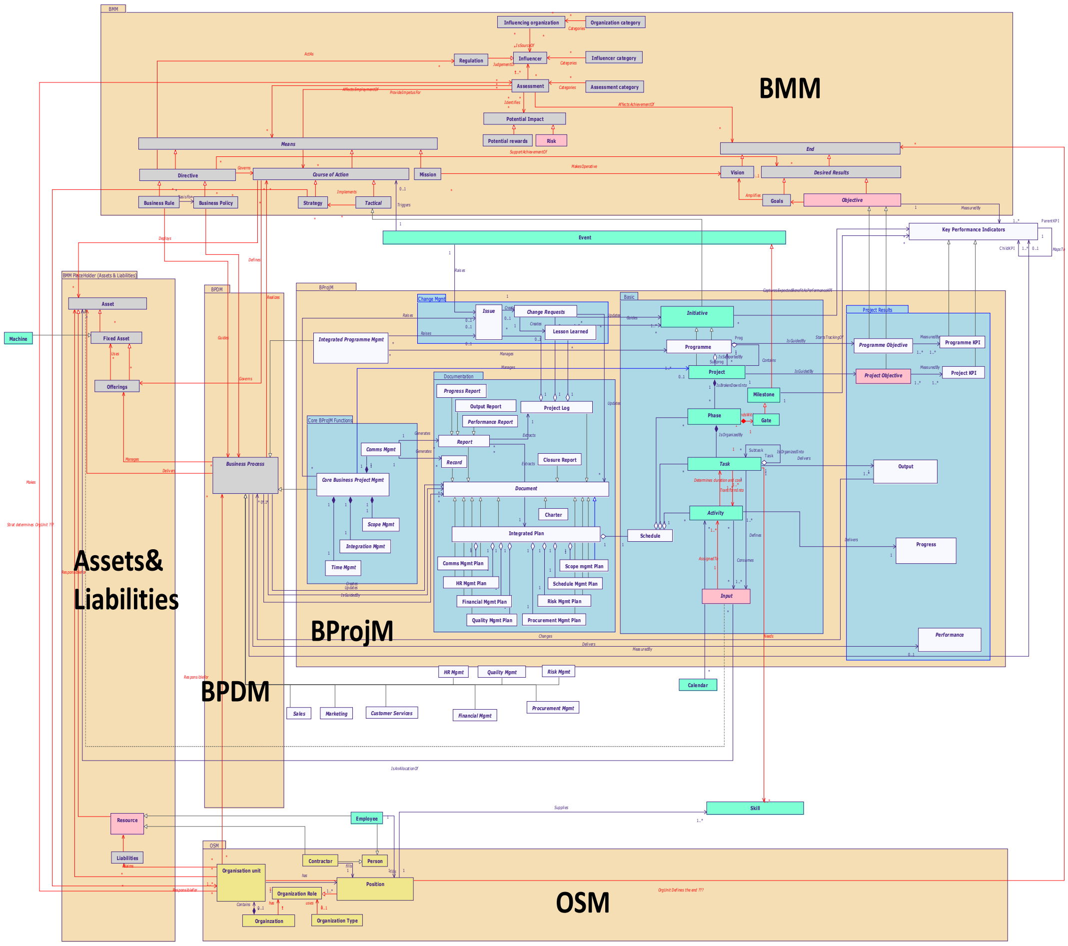

Figure 7.13 : Complete Package and Class Diagram for BProjM domain model

With reference to the diagram, right in the middle of the domain model is the "BProjM" *Package* which is the main scope of work. The *Package*s that surround it are BMM on the top; Assets & Liabilities and BPDM on the left; and OSM at the bottom. Collectively BMM, BPDM and OSM describe the project environment or the parent organization.

It is also worth noting in the diagram at this juncture, that some *Classes* are positioned outside of the *Package*s namely EVENT, KEY PERFORMANCE INDICATORS, EMPLOYEE, SKILL, MACHINE, CALENDAR, SALES, MARKETING, CUSTOMER SERVICES, HR MANAGEMENT, FINANCIAL MANAGEMENT, QUALITY MANAGEMENT, PROCUREMENT MANAGEMENT AND RISK MANAGEMENT. These *Classes* are found to be either out-of-place or introduced only during the development of the model when the predetermined list of terms is found to be inadequate in representing the research findings. The details of how and why they are introduced will be described in greater details in section 7.5 on "Findings & Discussions".

Substantiating each Class with Attributes Operations and Constraints

The final step of building the structural aspect of the model is to substantiate the defined *Classes* and *Associations* with even more explicitness by defining *Attributes, Constraints* and *Operations.*

To ensure that this step is performed in a proper and consistent fashion, guidelines if not rules should be developed to map ontologically derived concepts to the object-oriented language constructs (Evermann & Wand, 2005). Some of these guidelines which have already been applied are the translation of terms into *Classes* and their inter-relationships in terms of *Inheritances, Aggregation, Composition* or standard *Associations*.

An "*Attribute*" is a specification that defines a property of an object, element, or file. In other words, it refers to defining the characteristics of the supporting terms. An

"*Operation*" is a method or function that can be performed by an instance of a Class or interface. This translates to defining the processes that could be initiated by the underlying concept represented by the *Class*. A "*Constraint*" is a form of rules that refines the definition of both the structural and behavioural aspects of the model. By applying *Constraints* in the *Class* definition, the description of the underlying concept becomes more explicit and this can be achieved by use of either natural language or Object Constraint Language (OCL, 2006). Since this is the first attempt of defining a domain model of this nature, the intent is to keep the model basic and simple. As such, a *Constraint* will only be introduced if it is necessary, i.e. if the standard specifications for *Classes* and *Associations* in the *Class Diagram* failed to represent an important aspect of the domain. The following section details how these guidelines are applied by presenting the *Attributes*, O*perations* and *Constraints* of a complex *Class* in each of the "BProjM" sub-*Packages*.

For the "Basic" sub-*Package*, INITIATIVE is a good example as it is the "ruling" *Class* of the model. This means INITITAVE dictates the interactions of the other *Classes* depending on what state it is in. This can be comprehended from the angle of an initiative's life cycle. Whether an initiative embarked by the organization is a project or programme, it goes through 4 states namely (1) initiation (2) planning (3) execution & control (4) closing (PMBOK Guide 2008; A Standard of Programme Management, 2008).

Table 7.14 presents the *Attributes*, *Operations* and *Constraints* defined for INITIATIVE where *Attributes* represent the fundamental properties of an initiative namely the planned and actual of its duration, cost and benefits as well as the current state /status of which it is in; *Operations* list the processes that an initiative may execute in support of the transition of its state; and *Constraints* specify simple validation rules for some of the *Attributes*.

Table 7.14 : Attributes/Operations/Constraints for INITIATIVE

Attributes	Operations	Constraints
Name	CreateIntiative()	
Description	UpdateInitiative()	
CostEstimated	KickOffInitiative()	
CostActual	UpdateInitiativeStatus()	
BenefitEstimated	CloseInitiative()	
BenefitActual		
StartDatePlanned		
EndDatePlanned		Planned end date must not be earlier than the planned start date
StartDateActual		
EndDateActual		Actual end date must not be earlier than actual start date
Owner		
Status		Type of status must correspond to the states defined in the state machine diagram

For the "Project Results" sub-*Package*, OUTPUT is a good example since it is a complex Class which could take on the state of either "Planned", "In Progress", "Rework", "Cancelled", "Completed" or "Accepted"; depicting the stages of which the deliverable of a project has to go through before it is finally accepted by the designated reviewer. Other than the processes which are required to support the transition of its state, this *Class* holds the key to reporting current status of each project output at any given time. Based on this understanding, the *Attributes* and *Operations* for this *Class* are developed as presented in Table 7.15. No value-adding *Constraints* are identified in this case.

Table 7.15 : Attributes/Operations/Constraints for OUTPUT

Attributes	Operations	Constraints
Name	DefineOutput()	
Description	UpdateOutput()	
Reviewer	ReviewOutput()	
ReviewDate	UpdateOutputStatus()	
ReviewFindings	GetOutputStatus()	
Status		

For the "Core BProjM Functions" Sub-*Package*, INTEGRATION MANAGEMENT is a good example as other than ensuring proper integration of all related areas, it is responsible of tracking the progress and delivery of output for the entire project. To enforce good project management practice as suggested in PMBOK, *Constraints* are introduced to ensure that progress tracking and output tracking shall not begin until the integration plan has been approved. Table 7.16 presents the *Attributes*, *Operations* and *Constraints* defined for this *Class*.

Table 7.16 : Attributes/Operations/Constraints for INTEGRATION MANAGEMENT

Attributes	Operations	Constraints
Name	DefineIntegrationPlan()	
Description	UpdateIntegrationPlan()	
Reviewer	ManageIntegration()	
ReviewDate	TrackProgress()	TrackProgress() must not be activated until the Integration Plan has been approved
ReviewFindings	TrackOutput()	TrackOutput() must not be activated until Integration Plan has been approved

For INTEGRATED PROGRAMME MANAGEMENT which belongs directly to the "BProjM" *Package*, it is responsible of integrating the project dynamics at the organization level. Thus as illustrated by Table 7.17, the *Operations* are defined in reflection of (1) its role in securing and managing continuous support from the functional departments on the non-core project management knowledge areas; as well as (2) tracking performance of the projects and programmes.

Table 7.17 : Attributes/Operations/Constraints for INTEGRATED PM

Attributes	Operations	Constraints
Name	ManageDeptSupport()	
Description	TrackPerformance()	
Reviewer		
ReviewDate		
ReviewFindings		

For the "Documentation" sub-*Package*, DOCUMENT is a good example since it is the generalization of all the *Classes* in this *Package*. In addition, it is a complex *Class* that describes the states which a document must go through before it is finally published and distributed. Table 7.18 presents the *Attributes*, *Operations* and *Constraints* defined for this *Class*.

Table 7.18 : Attributes/Operations/Constraints for DOCUMENT

Attributes	Operations	Constraints
Name	CreateDoc()	
Description	UpdateDoc()	
Version	ReviewDoc()	
CreationDate	ApproveDoc()	
RevisedDate	DistributeDoc()	Revised date must not be earlier than creation

Attributes	Operations	Constraints
		date
ApprovedDate	UpdateDocStatus()	Approved date must not be earlier than creation date
DistributionDate	GetDocStatus()	Distribution date must not be earlier than approved date
DistributionList		
Status		

Lastly for the "Change Management" *Package*, ISSUE is a good example as its instantiation kicks off the change management processes. It is also a complex *Class* since an issue is expected go through multiple states before it can be closed. Table 7.19 presents the *Attributes*, *Operations* and *Constraints* defined for this *Class*.

Table 7.19 : Attributes/Operations/Constraints for ISSUE

Attributes	Operations	Constraints
Name	RaiseIssue()	
Description	PerformImpactAnalysis()	
Impact	UpdateIssueStatus()	
Severity		
Resolutions		
Status		State must not be "closed" if "resolutions" has not been captured

It would appear at this point, that the *Class Diagram* is already quite comprehensive in representing the business project management domain. Nonetheless, it describes only the static aspect and offers no insight for the business project management dynamics. This is the aspect which will be addressed by the behavioural specifications.

7.3.2 Behavioural aspect of the model

To represent the dynamic aspect of the model, *State Machine Diagram* is used to define the different states which the model could be in; and for each of these states, *Communication Diagram* is used to depict the interactions among the *Classes*.

The starting point is to identify the "ruling" *Class* of the model. As mentioned in the earlier section, the dynamism of the BProjM domain model is stimulated by the transition of states in the project life cycle and thus, the "ruling" *Class* is INITIATIVE, i.e. the generalization *Class* of both PROGRAMME and PROJECT. Based on this understanding, the "Initiative Life Cycle*"* *State Machine Diagram* is developed (as illustrated by Figure 7.14), stating how INITIATIVE can advance from one state to another; as well as the conditions that govern the transition.

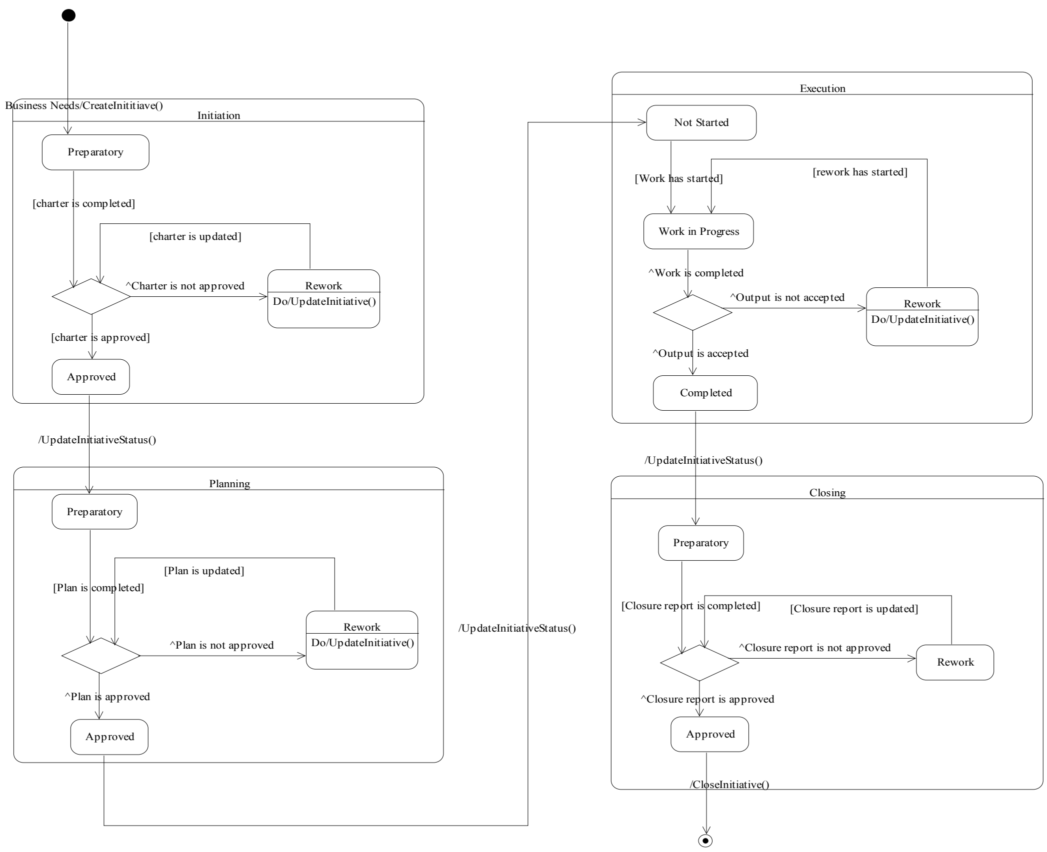

Figure 7.14 : State Machine Diagram for INITIATIVE

With reference to the diagram, business needs trigger the launch of a change initiative and assumes the first state of "Initiation". The initiative only transits into the next state of "Planning" if the initiative's Charter has been approved by the stakeholders. Similarly, it will only take on the "Execution" state if its Plan has been approved. Finally, only upon completion of all activities and acceptance of its output by the stakeholders will the initiative be closed. *State Machine Diagram* is also used to elaborate on the more sophisticated *Classes* namely PHASE, TASK, ACTIVITY in the "Basic" sub-*Package*; OUTPUT, PROGRESS, PERFORMANCE in the "Project Results" Sub-*Package*; DOCUMENT in the "Documentation" Sub-*Package*; ISSUE and CHANGE REQUEST in the "Change Management" sub-*Package*.

Given the INITIATIVE's *State Machine Diagram, Communication Diagram(s)* are created to illustrate each of its state by demonstrating the various aspects of interactions among the *Classes* as well as the sequence of their occurrences through invoking the predefined *Operations*. In addition, dependencies among these *Classes* can be indicated. An important point to note here is technically, *Communication Diagram* deals with *Objects* rather than *Classes*. Since the purpose of this research to produce a general specification of the domain knowledge, the *Communication Diagrams* are developed using generic *Object* defined for each *Class.*

Figure 7.15 is the *Communication Diagram* for INITIATIVE's "Initiation" state. With reference to the numbering, the Integrated Programme Management function is the starting point which launches a change programme by firstly, sourcing if there is lesson learned in the past that should be taken into consideration. After that, it proceeds to define the programme objectives, translate the programme benefits into expected performance as well as supporting KPIs; and finally maps the KPIs to those at the organization level. A Programme Charter is then put together to guide the initiation of the supporting projects; and a series of similar initiation activities for the projects are kicked off. The final output of this state is the Project Charter for each project.

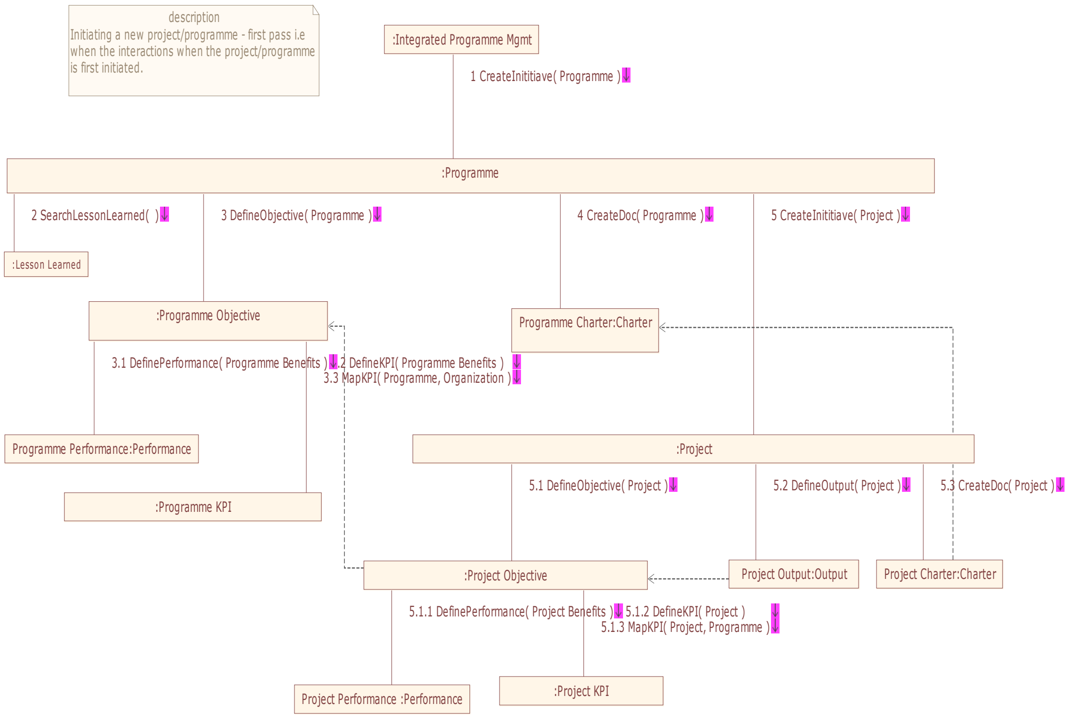

Figure 7.15 : Communication Diagram for INITIATIVE's "Initiation" state

The next figure is Figure 7.16, which is the *Communication Diagram* for INITIATIVE's "Planning" State. The dynamics in this state is again initiated by the Integrated Programme Management. At the project level on the left, the focus is on the core business project management areas i.e. to define scope, schedule, communication requirements and the control documents to guide the eventual execution of each area. At the programme level on the right, the focus is on the development of control document for the other 5 project management knowledge areas (where the expertises come from the corresponding functional departments) namely risk management, quality management, procurement management, human resources management, financial management. These programme-level control documents will then become the common reference for the supporting projects to create their respective integration plans; and the overall programme plan will be consolidated at the end. The key point to note here is that cost and benefit analysis would require both the project and the programme management teams to work closely with the financial management team in order to produce the financial management plan.

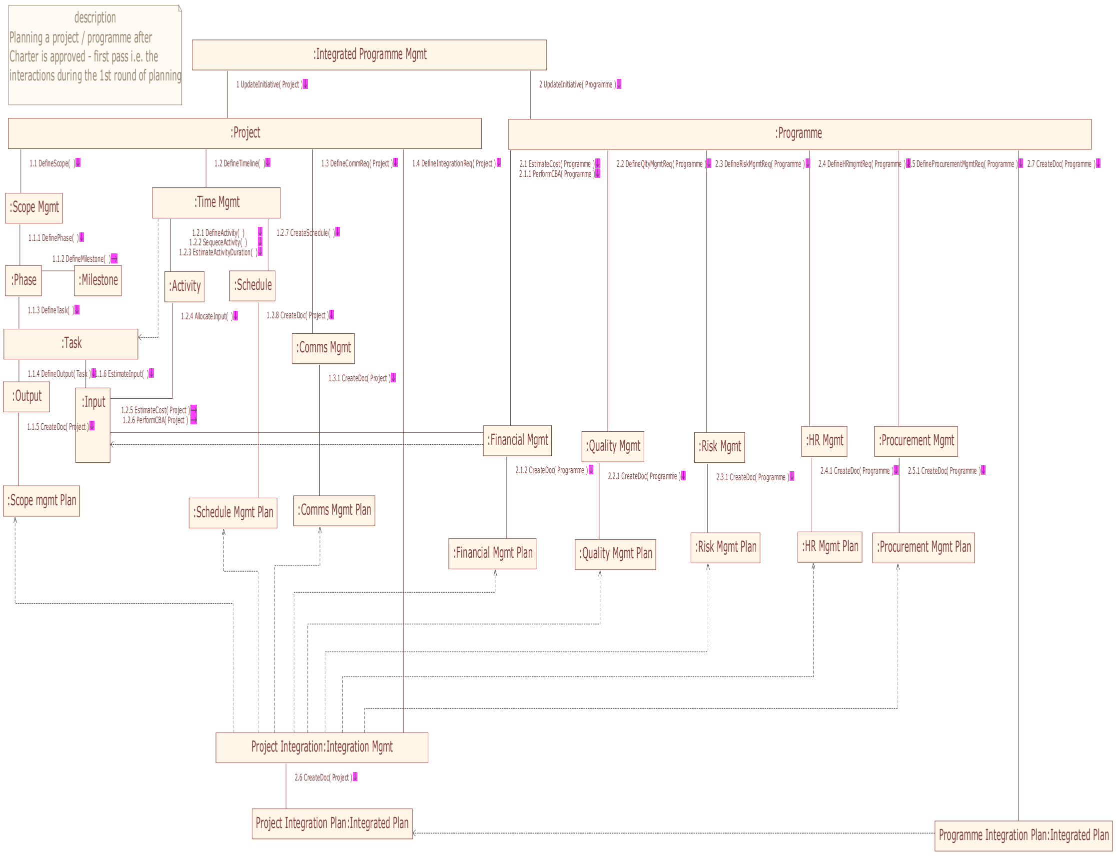

Figure 7.16 : Communication Diagram for INITIATIVE's "Planning" state

For the state of "Execution", there are 3 aspects of interactions namely (1) Status update and monitoring (2) Change Management and (3) Reporting. For the purpose of illustration, only the *Communication Diagram* for Status update and monitoring is presented (Figure 7.17).

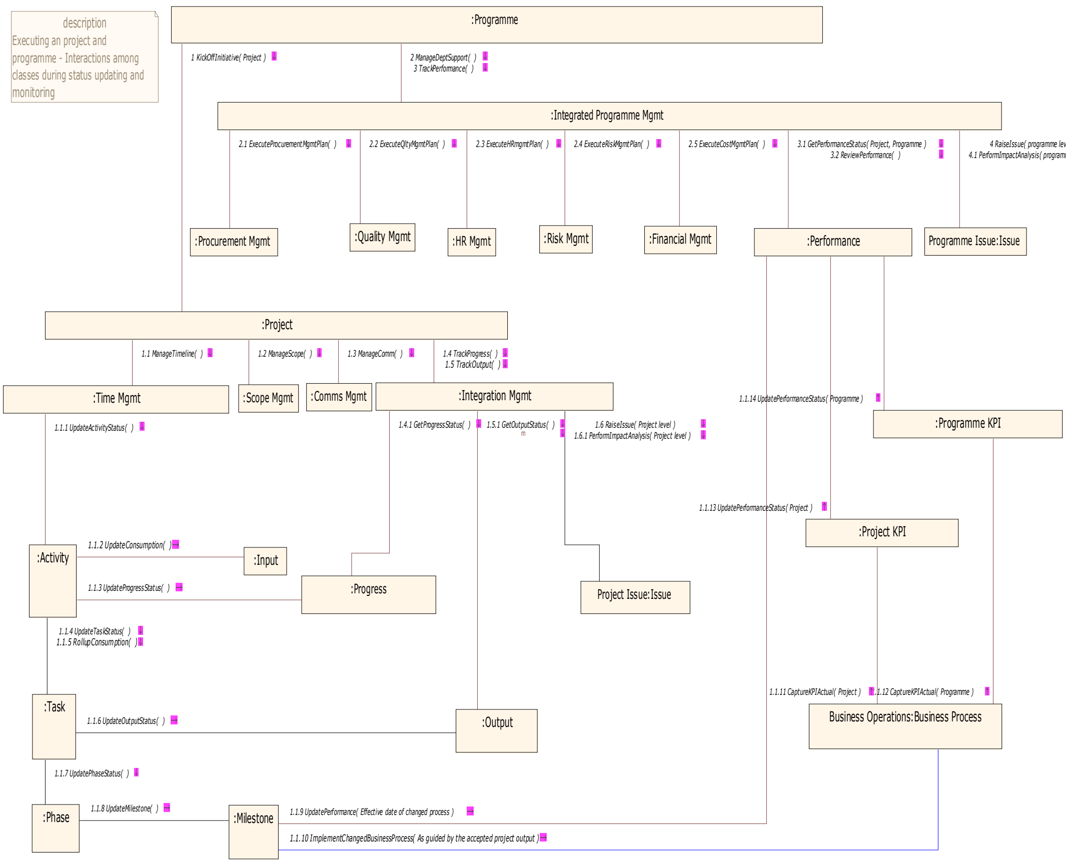

Figure 7.17 : Communication Diagram for INITIATIVE's "Execution" state

The key message here is that project execution is monitored at two levels. At the project level in the lower half of the diagram, it is shown that update of activity status triggers the status update of other related *Classes* namely TASK, PHASE, INPUT and PROGRESS. Of particular importance is the update of progress status which will indicate if the project is on time, behind schedule or ahead of schedule. The update of task status on the other hand, triggers an update of the output status to reflect if the output of this task is in progress, completed, cancelled, reworked or accepted. Similarly, update of phase status triggers an update of milestone status. If this happens to be the juncture where a milestone is hit, the actual benefit realization date in PERFORMANCE will be updated accordingly. It is also worth noting that “Integration Management” is the last checkpoint at the project level where the overall progress of the project and the status of the output are reviewed. Issues if any will be raised and by doing so, the project transits into the “change management” mode in the “Executing” state. In the last segment on the right, integrated programme management reviews the performance of the projects as well as the programmes; and may also initiate the transition into the “change management” mode by raising cross-projects or programme level issues.

Last but not least, Figure 7.18 shows the interactions among *Classes* for the INITIATIVE’s “Closing” state. Comparatively, this *Communication Diagram* is relatively straightforward where it depicts that upon completion of all tasks and acceptance of all output (i.e. condition of transiting into the “Closing” state), a final report on the progress, output and performance of the project must first be generated, followed by the preparation of the project closure report. In relation to the earlier research findings, a project is considered successful only it has a final progress status which is either “on time” or “ahead of schedule”; a final output status which is “accepted”; and a final performance status which says “met”. Closure at the programme level highlights similar interactions among *Classes*, except for the additional step of consolidating lesson learned; and the dependency that programme can only be closed if all its supporting projects are closed.

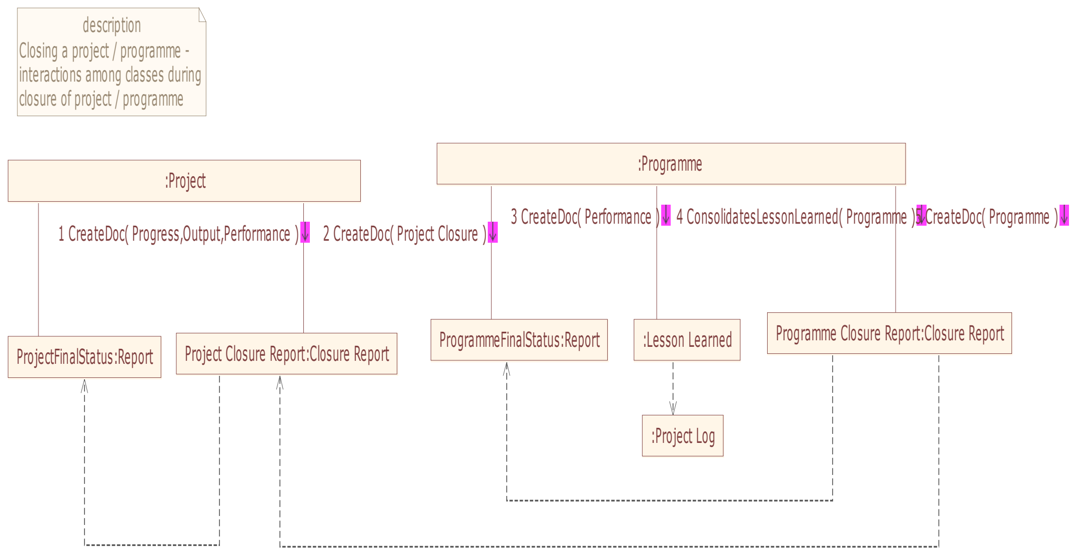

Figure 7.18 : Communication Diagram for INITIATIVE's "Closing" state

In summary, a total of 10 *State Machine Diagrams* and 6 *Communication Diagrams* are captured in the domain model.

7.4 Testing the Developed Domain Model for Completeness

This section details the steps involved in testing the model for completeness. The main advantage of performing domain modelling using a UML tool is the ability to automatically check the technical integrity of the model as it is being built. Since the BProjM domain model is built using Objecteering, first level validation on the model has already been carried out by the software's audit function.

From the content perspective, two types of testing were conducted. Firstly, the model must be complete in terms of addressing the predefined scope; Secondly, the model must be able to represent real-life scenarios.

The first aspect of testing was achieved by checking the resulting model against the list of terms in the Specifications Table and relationships defined in the Key-relationships Diagram. If a term or relationship is found missing or misrepresented, changes were made in *Class Diagram* first followed by the *State Machine Diagram* and the *Communication Diagram*. In retrospect, the structural aspect of the model was already tested in an implicit way as the behavioural aspect of the model was being built. This is because as mentioned in earlier section, *Operations* must be predefined so that the *Communication Diagram* merely selects the appropriate entry in the dialog box while defining the interactions among *Classes*. By adhering strictly to this rule, not only is the integrity between the structural and behavioural specifications are maintained, the completeness of the *Class* specification is checked and updated along the way.

The second aspect of the testing was achieved by instantiating the *Classes* using *Object Diagram* based on the details gathered during the case study. Since Co1 is the most comprehensive case, its EBP Programme (which the researcher is personally involved for 1.5 years) is used as the basis to validate the model. Using the *Class Diagram* as the base reference, the *Object Diagram* was developed by instantiating one *Class* at a time starting with the ruling *Class* INITIATIVE. The *Classes* to instantiate next were PROGRAMME and PROJECT; i.e. the *Classes* which are directly associated with INITIATIVE and so on.

As a miss-out in the model is uncovered, details were recorded and changes were not applied to the model immediately. The affected UML diagrams were corrected only at the end of the validation exercise in one go so that the versioning of the model can be properly managed. Furthermore, some of the miss-outs are related to each other and thus, further rationalization was performed before the model is altered. The steps of instantiations and corrections are carried out repeatedly until the model is proven capable of producing a corresponding *Object Diagram* that well represents the EBP programme. Figure 7.19 presents a segment of the *Object Diagram* which is created using the data from Co1's EBP programme. Please refer to Appendix B for an enlarged version of the diagram for more details.

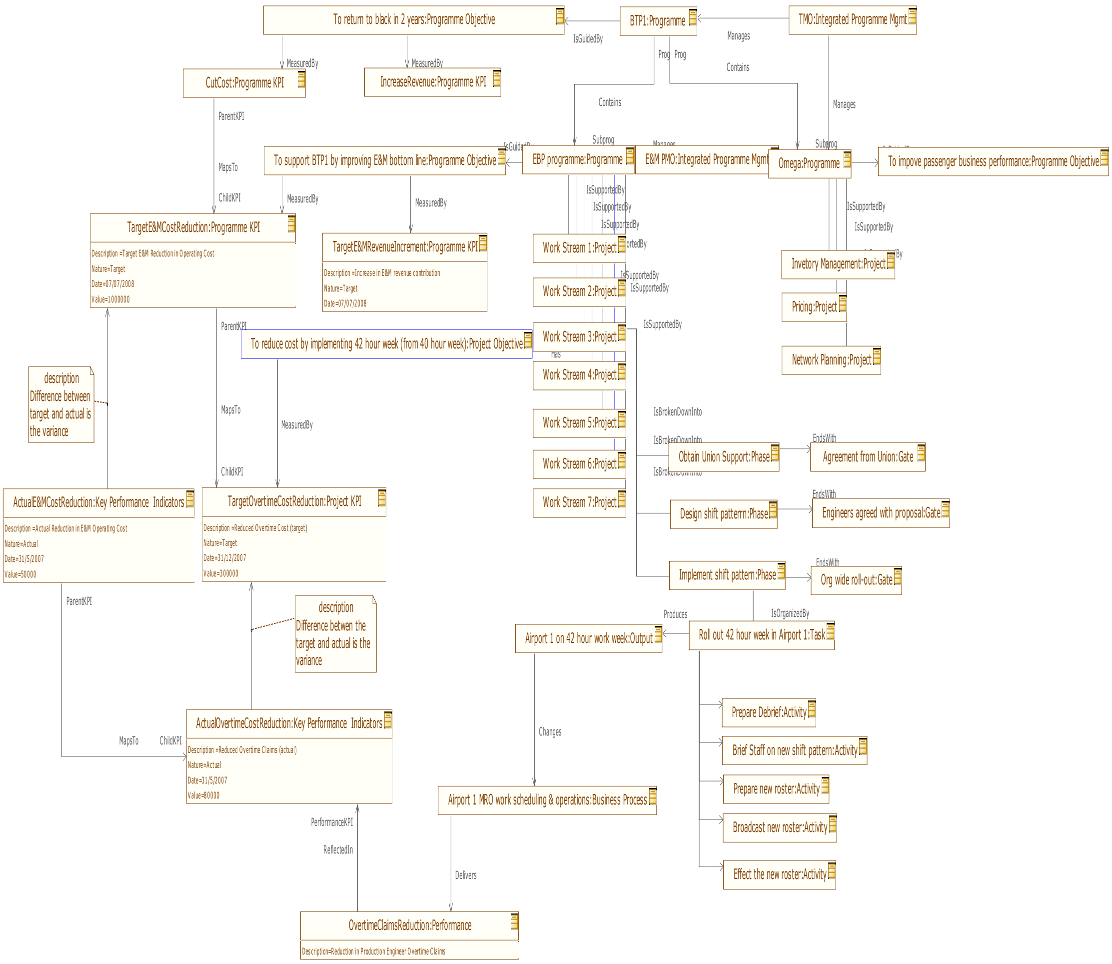

Figure 7.19 : Object Diagram for EBP programme for Co1 case study

With reference to the diagram, it is indicated that the EBP Programme is subordinate to the "BTP 1" Programme at the organization level. The EBP Programme itself is supported by 7 projects which are named "Work Stream" from 1 to 7. Each of these work streams has their own objectives which are aligned to that of the EBP's. Taking work stream 3 as an example, it is defined with a specific objective of reducing cost by implementing 42 hours work week (from the current 40 hours work week). The work stream /project is organized into phases namely (1) obtaining the union's consent to proceed, (2) designing the shift pattern based on the agreement, and finally (3) implementing the shift pattern. Taking the implementation phase as an example, it is further broken down into two tasks i.e. to roll-out the changed shift patterns at the two airports. Taking the rollout to airport 1 as an example, the task is translated into activities related to "managing" the change i.e. preparing and debriefing the staff of the upcoming change; and activities related to "making" the change i.e. creating, broadcasting and effecting the new rosters. The output of the task on the other hand, is the implementation of a new roster which will place an impact on the existing operations of the Maintenance & Repair Operations (MRO) in the airport. This change is expected to deliver a performance which is equivalent to a reduction of up to 2 hours per person per week in overtime claims. Whether the changed airport operations deliver the expected result will be measured by the project KPIs which are mapped to the corresponding organizational KPIs. The variance between the target and actual project KPIs in turn, determines whether the work stream's performance should be reflected as "met" or "not met".

Below are some examples of the discrepancies which were uncovered during the creation of this *Object Diagram*:

1) Before: PROGRAMME may be an Aggregation of PROJECTS

Findings: Programme may be an "Aggregation" of projects and sub-programmes. E.g. BTP1 Programme is supported by EBP Programme and the Project Omega Programme.

Amendments: Add a new *Association* to PROGRAMME which points to itself.

2) Before: INITIATIVE *produces* OUTPUT, based on the PROMONT definition that OUTPUT is an outcome of an INITIATIVE, which can be a physical product, a service or a document.

Findings: The outcome of an initiative may comprise multiple products, services or documents which are produced throughout the project rather than right at the end. This is especially true in the case of staged implementation, for example, work stream 3 implementation of a 42 hour work week for all the airports in stages.

Amendments: the relationship "INITIATIVE *produces* OUTPUT" is replaced by "TASK *produces* OUTPUT".

3) Before: TASK is specified without ability to create Subtask.

Findings: The 2nd findings triggered a check at the TASK's definition in the Specification Table where it is realized that Task could also be defined with Subtasks.

Amendments: Add a new *Association* to TASK which points to itself.

The current version of the BProjM domain model is the result after all the identified miss-outs have been corrected.

7.5 Findings & Discussions

This section details the key findings of the modelling exercise, in particular, the confirmation that the domain model is a better representation of the business project management knowledge and given the graphical representation, potential gaps in knowledge could be spotted by visually inspecting the UML diagrams. In addition, it presents the other findings which may be of interest to future modelling efforts namely (1) difficulties in developing the *Communication Diagrams*; (2) potential areas of improvements in the OMG standards; and (3) potential of expanding the domain model to describe Business-As-Usual (BAU) operations in the business enterprise.

7.5.1 A better representation of domain knowledge

The key objective of the modelling exercise is to capture the domain knowledge in a format which is more explicit than natural language descriptions. To see if this objective has been met, a segment of the resulting model that paraphrases the relationships among the components in the theoretical framework is extracted and presented in Figure 7.20.

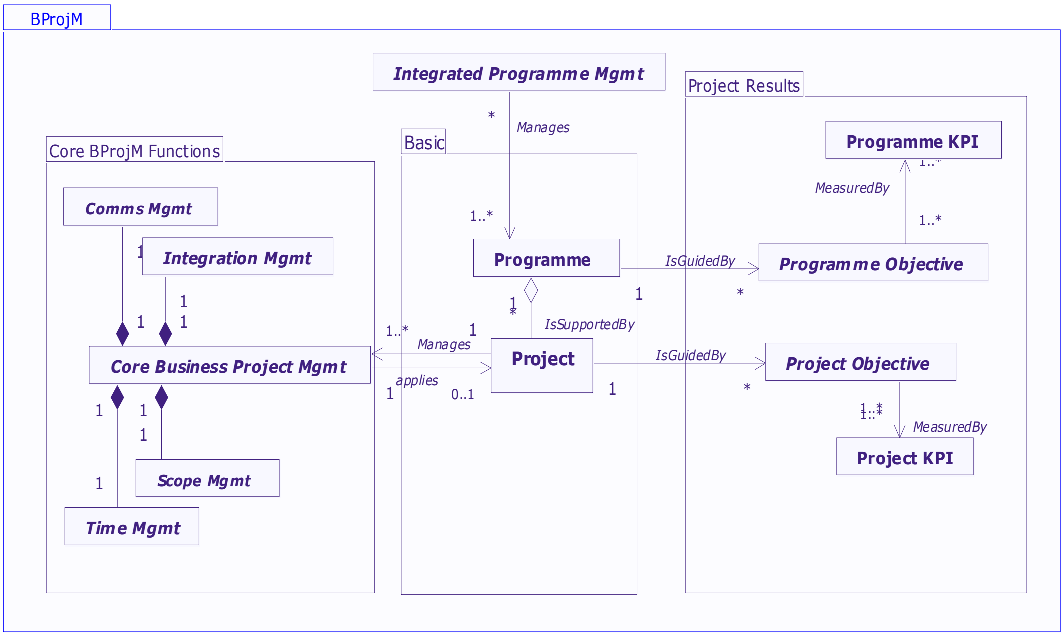

Figure 7.20 : BProjM domain model – reflecting the theoretical framework

On the left, the "Core BProjM Functions" *Package* represents the "Core Business Project Management Competency" component in the theoretical framework, where the 4 key business project management competencies are now translated explicitly into mandatory management functions that must be performed by the project managers. In addition, each of them is defined with O*perations* to reflect the key processes that must be carried out as illustrated by Table 7.20.

Table 7.20 : Operations in Core BProjM Functions Classes

Time Management	Scope Management	Integration Management	Communication Management
• Define Timeline • Update Timeline • Manage Timeline	• Define Scope • Update Scope • Manage Scope	• Define Integration Req • Update Integration Req • Manage Integration • Track Output • Track Progress	• Define Comms Plan • Update Comms Plan • Manage Comms • Generate Reports

On the right, “Project Results” *Package* represents the “Business Project Success” component in the theoretical framework, where success is now translated into meeting PROJECT OBJECTIVE at the project level and meeting PROGRAMME OBJECTIVE at the organizational level. Whether these objectives are met will be determined by whether their respective KPI targets have been achieved.

Linking the two in the middle is the project fundamentals which clearly demonstrate that for business project to be successful, two level of management is required namely BUSINESS PROJECT MANAGEMENT at the project level and INTEGRATED PROGRAMME MANAGEMENT at the organization level. The expectation of what comprises the integrated programme management function on the other hand, is explicitly spelt out in terms of *Operations* namely *“TrackPerformance”* and *“ManageDeptSupport”.*

By revealing more details especially the links between “BProjM” *Package* and the OMG *Packages,* the close relationships between business project management and its operating environment (which is formerly not well reflected in the theoretical framework) is also clearly represented in the UML model as depicted by Figure 7.21.

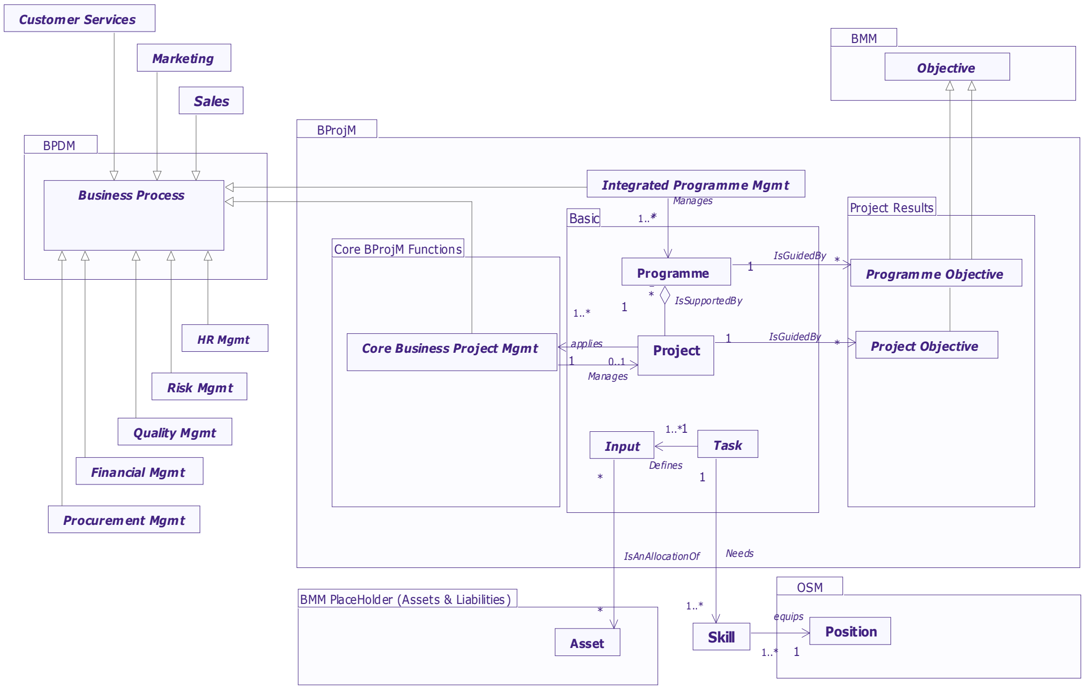

Figure 7.21 : BProjM domain model – reflecting the BProjM theory

In view of the above, it is evident that the BProjM domain model has successfully specified the business project management knowledge with better clarity and explicitness. Furthermore, since it is developed using a UML tool with audit function that enforces compliance to UML modelling rules, the resulting domain model is a robust model with consistent internal structure.

In addition to the above, it is realized that the ability to "visualize" domain knowledge could lead to discovery of "hidden messages" in the domain model. Using Figure 7.21 as an example, it is noted from the properly laid-out *Classes* and inter-relationships that business project management is a function deployed to meet some aspects of the organizational objectives (top right hand corner) by executing tasks which requires an allocation of the organization assets (lower segment of the diagram) and skills that must be possessed by selected positions in the organization structure (bottom right hand corner). In other words, there is no fundamental difference between the nature of business project management and the typical functional departments such as Customer Services, Marketing, Sales, HR, Risk Management etc. (as depicted on the left hand side of the diagram). In fact, the effect of integrated programme management function on business project management is the same as the general management function performed by the functional manager in the functional department. In view of the above, there is really no strong foundation as to why business project management should be organized differently; or deprived from receiving the same level of management attention & resources commitment as the business-as-usual operations. Coincidentally, this discovery supports the BProjM theory which states that "business projects should be an integral part of business enterprise and given equal emphasis as the business-as-usual operations". In which case, the domain model actually strengthens the validity of the research findings.

The other uncovered "hidden message" is the emphasis of documentation in business project management practice. This discovery is a result of examining just the details within the "BProjM" *Package* (as illustrated by Figure 7.22), without considering their relationships with the operating environment.

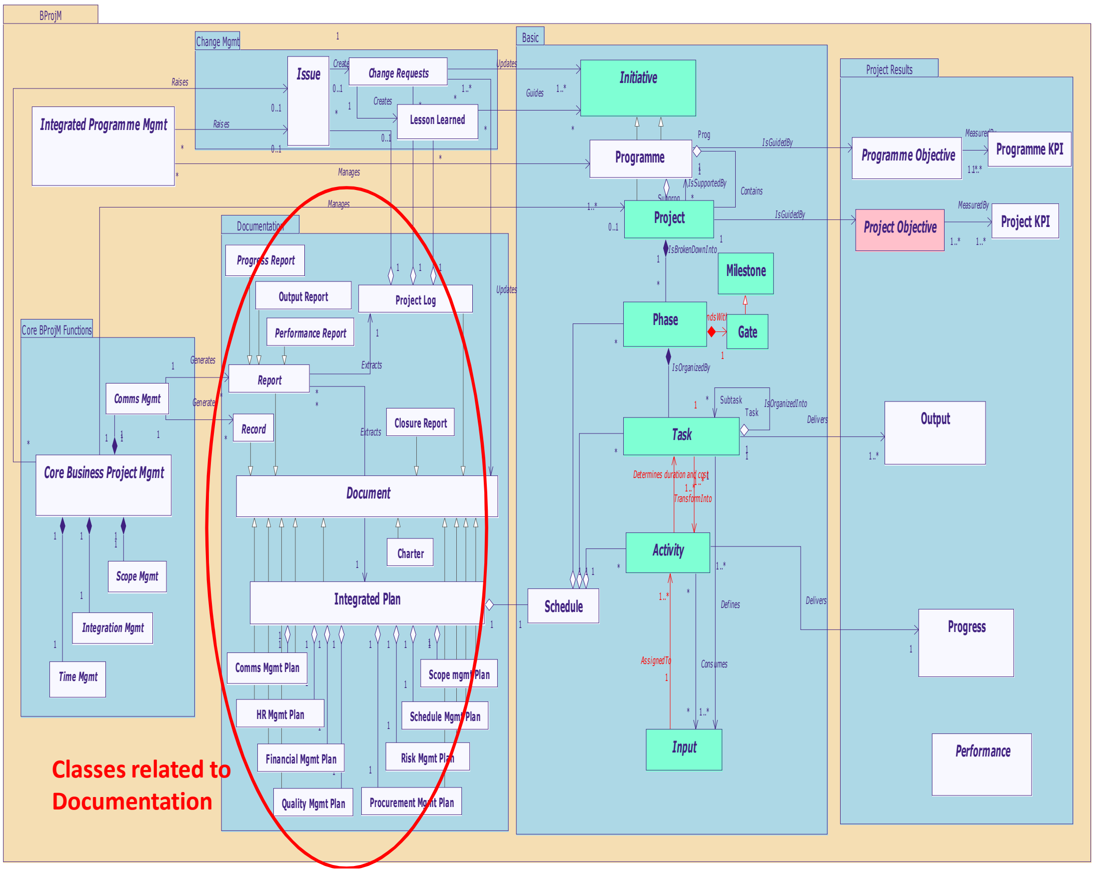

Figure 7.22 : BProjM domain model – Overview of BProjM Package

As highlighted in Figure 7.22, there is a lot of documentation related *Classes*. Since these are supporting terms expanded based on prevailing standards, it shows that the recommended business project management practice today is very documentation-centric especially in terms of producing control documents. Also noted from the diagram is that documentation has limited direct relationships with project fundamentals as well as project results. This discovery as such, prompts the question of whether such heavy emphasis should be reviewed and/or how the current practice can be improved so that more efforts are channelled to the right places.

In summary, not only has the domain model successfully represented the business project management knowledge with more clarity and explicitness, the adopted UML format has allowed (1) knowledge to be analyzed from various perspectives, as well as (2) new areas of investigation to be visually spotted.

7.5.2 Significance of Communication Diagrams

Development of the *Communication Diagram* was the most difficult aspect of the modelling exercise. While the structural specification of the model is a value-adding "translation" of the predefined terms and relationships, the development of the behavioural aspect of the model especially the construction of C*ommunication Diagram*s, is a "transformation" of implicit knowledge embedded in the prevailing standards.

In the case of this research, it is further complicated by the existence of moderating variables. For example, in order to describe interactions among *Classes* throughout a project life cycle, effect of the organization support (i.e. integrated programme management function) must first be incorporated into the standard project management processes in relation to the 4 core project management competencies. This poses a challenge as PMBOK and "A standard for Programme Management" are two separate standards which cross-reference to each other rather than a unified standard which applies the two together. Thus, the required behavioural information to build the model is not readily available for extraction; and its specifications can only be developed by the original researcher and/or the domain experts who understand the dynamics between the two standards in the context of the research findings. In addition, once this information is formulated, they could not be adequately expressed by an intermediate format such as the use of Specification Table. As such, the developed *Communication Diagram* is truly an explicit specification of conceptualizations which have not been clearly documented in any other form; and the development of *Communication Diagram*s is a perfect demonstration of the merits of this domain modelling approach.

Last but not least, this also means that the effort required to develop *Communication Diagram* must not be underestimated and the domain modelling should ideally be performed by management researchers who are proficient in UML.

7.5.3 Potential areas of improvement in OMG standards

The OMG standards namely BMM, BPDM and OSM define only the concepts essential to forming the organization framework; and made no provision for describing the actual outcome or output produced by the organization. An example to illustrate this would be BMM which describe only what the organization plans to achieve e.g. OBJECTIVES, DESIRED RESULTS with no provision of meta-concepts to represent actual results such as OUTPUT or PERFORMANCE. This poses a challenge during the modelling exercise as the consistent element in every project management knowledge area is to track and control by comparing actual against planned. As a result, new meta-*Classes* at the organization level has to be added and in order not to disrupt the existing nature and integrity of the OMG terms, they are introduced outside the OMG's *Packages*. The new meta-*Class* introduced under this circumstance is KEY PERFORMANCE INDICATOR (as a measure for OBJECTIVE) which captures both target and actual KPIs as illustrated by Figure 7.23.

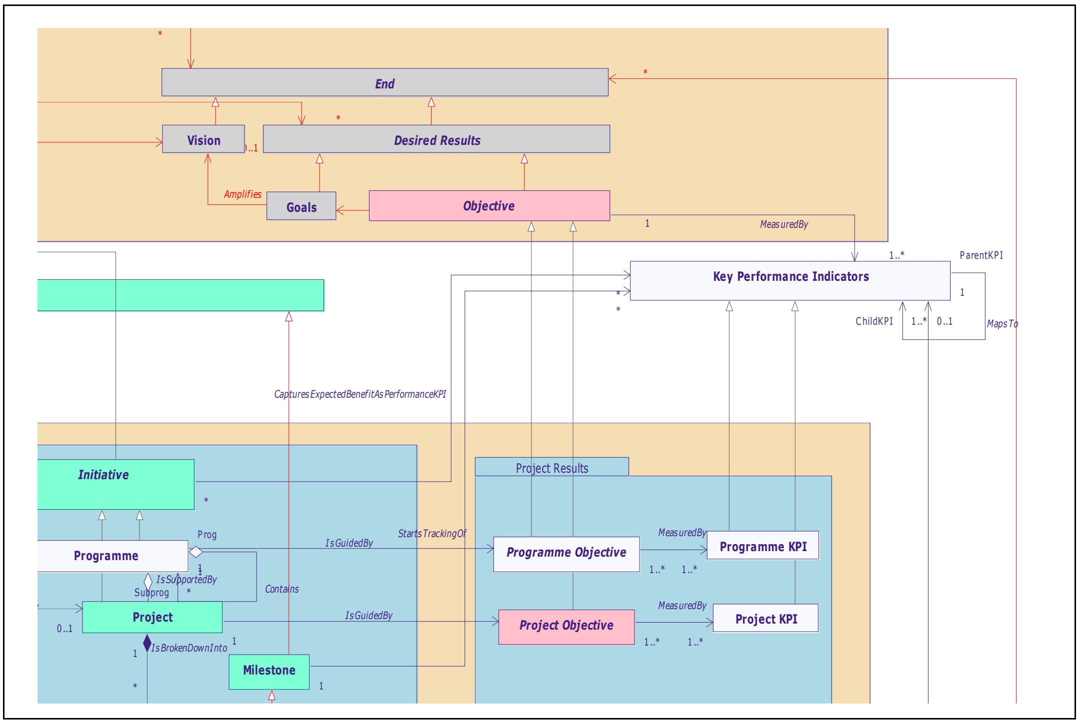

Figure 7.23 : Introducing KEY PERFORMANCE INDICATOR

Secondly, in relations to Zachman's Framework for Enterprise Architecture as presented in Figure 7.24, BMM addresses only the sixth aspect of the business model (i.e., the "Motivation" or "Why" column); BPDM describes the framework required to build the second aspect (i.e., the "Function" or "How" column); whilst OSM details the framework required to build the fourth aspect (i.e., the "People" or "Who" column).

Figure 7.24 : Zachman Enterprise Architecture (Zachman, 2009)

This means "Time" or 'When' aspect that describes the dynamics of the organization as a single integrated entity is also missing from the OMG standards. In the BProjM domain model, INITIATIVE is the "ruling" class and its transition of states dictates the behaviour and interactions of other related *Classes* within BProjM. Similarly, there should be a "ruling" *Class* in the parent organization that kicks off the instantiations and interactions of other *Classes* at different junctions. This is an important aspect which must be addressed failing which BMM, BPDM, OSM and "BProjM" *Packages* are just disparate groups of *Classes* with no trigger that brings out the dynamics among them. Under this same scenario, "BProjM" *Package* will also be an isolated group of self-contained terms if their behavioural specifications are not connected to that of the organization's. Based on the underlying concept of REMORA that real world system behaviour can be described in a causal way where events trigger operations that modify the state of objects (Rolland, 1988), a potential "ruling" *Class* at the organization level would be EVENT. Incidentally, this *Class* has already been introduced by PROMONT and thus one way to address this is to take this *Class* out of the BProjM scope and "lift" it to the organization level. By doing so, EVENT which is defined as "a significant occurrence or happening", allows the following linkages to be established at the organization level (as illustrated by Figure 7.25):

- EVENT may trigger a COURSE OF ACTION which takes the form of an INITIATIVE;

- EVENT may lead to ISSUE which impacts existing INITIATIVEs in the form of PROJECT and/or PROGRAMME;

- An INITIATIVE's MILESTONE is a form of EVENT, given its significance of implementing change in the organization.

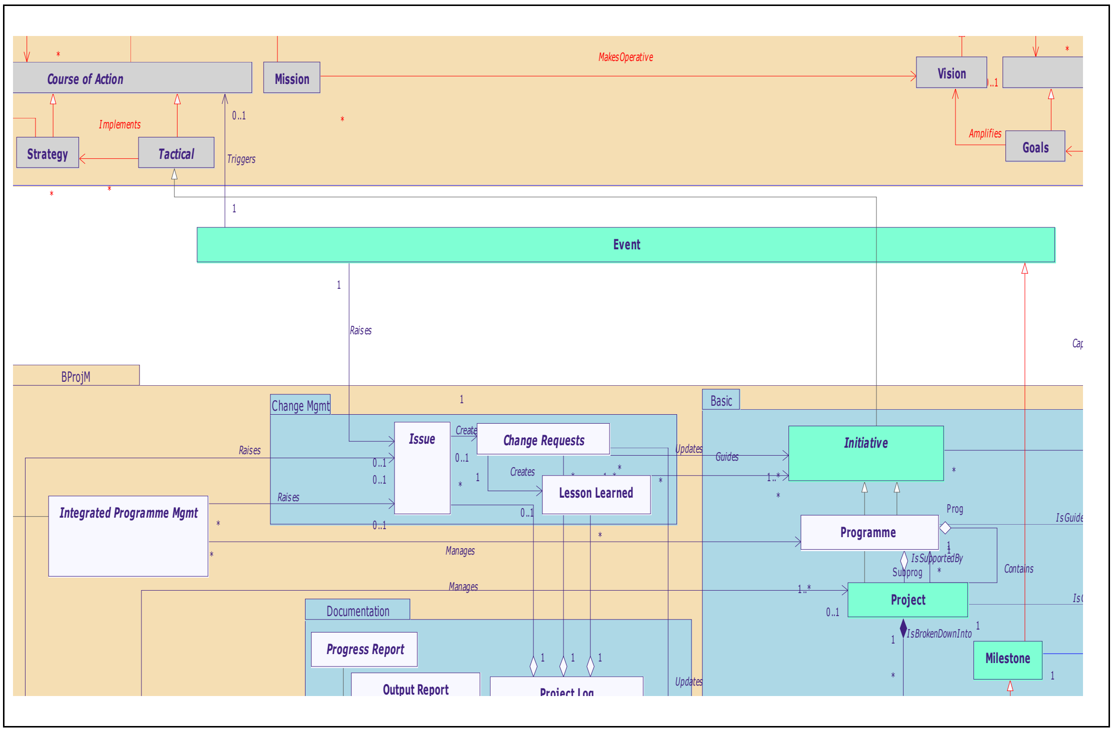

Figure 7.25 : Introducing EVENT at the organization level

In a similar context, CALENDAR which is another *Class* originated from PROMONT has a similar super-ordinate nature as EVENT which belongs to the “Time” or “When” aspect in the Zachman’s framework. As such, it is also parked outside of all the *Packages* to denote its applicability at the organization level. In fact, it has the potential of becoming the second ruling *Class* for the enterprise domain model since standard business activities such as budgeting and statutory reporting etc. are triggered by calendar dates. Bringing this discussion a step further; EVENT, CALENDAR and other time related meta-concepts could perhaps be grouped together to form a new “Time” meta-model *Package* to supplement BMM, BPDM and OSM.

Thirdly, it is realized that some of the BProjM terms (mostly those adopted from PROMONT) should rightfully be included in the OMG standards, as these are meta-

Classes which are applicable not only to the context of business project management but the enterprise in general:

- EMPLOYEE, CONTRACTOR – these two terms should be incorporated into OSM since they are the two special forms of OSM's PERSON with differing engagement terms and conditions;

- SKILL -- this term should be incorporated into OSM since it refers to the work proficiency supplied by OSM's PERSON;

- MACHINE – this term should incorporated into BMM's Assets & Liabilities since it is a special form of ASSET

Last but not least, some of the sub-*Packages* in "BProjM" *Package* namely "Documentation" and "Change Management*"* *Packages* are applicable to the enterprise at large but there are no suitable meta-*Classes* in BMM, BPDM or OSM today which they could relate to.

It would be useful if OMG can look into improving these 4 areas in order to provide a more comprehensive base for enterprise domain modelling.

7.5.4 Potential expansion to describe BAU operations

In order to present how business project management is positioned within a business enterprise in relation to the Business-As-Usual (BAU) operations, the model has included a high level definition of all the key business functions in an organization namely Sales, Marketing, Financial Management, Customer Services, Human Resources Management, Quality Management, Procurement Management and Risk Management. Each of them is represented by a *Class*.

A closer examination reveals that the approach of defining BProjM domain by organizing the knowledge into *Basic, Functions, Results, Documentation, Change Management* components or sub-*Packages* may also be applicable to these key business functions. "Sales" function for example, may have its core concepts defined and grouped under a "Basic" sub-*Package,* sales related processes defined under the "Functions" sub-*Package*, expected sales results and measurements defined under the "Results" sub-*Package*, paper work and records defined under "Documentation" sub-*Package*; and key concepts that govern the change management processes defined under the "Change Management" sub-*Package*.

By adopting the same "pattern" and the same domain modelling approach, each of these "BAU" *Classes* can be replaced by a *Package* with similar constructs to represent the respective domain knowledge based on existing academic literatures. The result is a comprehensive enterprise domain model with a consistent and vigorous internal structure.

CHAPTER 8 USING THE DOMAIN MODEL

Given the developed BProjM domain model, the challenge now is to examine how it can be effectively used to help the development of solution(s) that could improve the chances of business project success. Since it is designed to be a common semantic foundation based on which ontologies and conceptual model of software solutions can be built, it could be used as:

1) A foundation for an integrated PMIS that caters for the special needs of business projects;

2) A foundation for project knowledge ontology where lesson learned from the past could be leveraged for smoother project executions and better future project planning.

In the course of the modelling, it is realized that since the model contains the essential business project management components, it can also be used in its raw form as a "BProjM Practice Assessment Tool". This is achieved by using the *Class Diagram* as the base reference to identify missing components in an existing business project management practice. Theoretically speaking, projects should stand a better chance of success once the identified gaps are closed.

Each of the above applications is explained in the following sections by using UML's *Use Case Diagram* as applicable. Further details of the *Use Cases* can be found in Appendix B.

8.1 Foundation for an Integrated PMIS

This section describes how the developed domain model can be used in the requirement specifications of the integrated PMIS which is essential in enabling business project success.

Leveraging on the *Classes, Objects, Operations* etc. already defined in the domain model, the conceptual model of a specialized PMIS catering specifically for the need of business project management can be easily developed by expanding the original model with (a) *Use Case Diagram* to describe the requirements of the different stakeholders and to provide an overview of the required system functionalities in fulfilment of those requirements; (b) *Sequence Diagram* to denote the series of actions that must be carried out in order to fulfil the stated requirements. Part (b) is where *Communication Diagrams* with predefined interactions among *Classes* can be reused and added with more features and processing logics as necessary.

Figure 8.1 is the *Use Case Diagram* which presents a usage scenario during the "Executing" state of the project, where the integrated PMIS allows project team members to retrieve their work assignment and capture the work status upon completion of a day's work. From there, the system derives the corresponding status for the task, output, phase and milestones automatically (based on their relationships defined in the model); and finally format the information according to the requirements of different stakeholders namely the Project manager (who reviews project status), Programme manager (who reviews project performance) and senior management (who reviews programme dashboard).

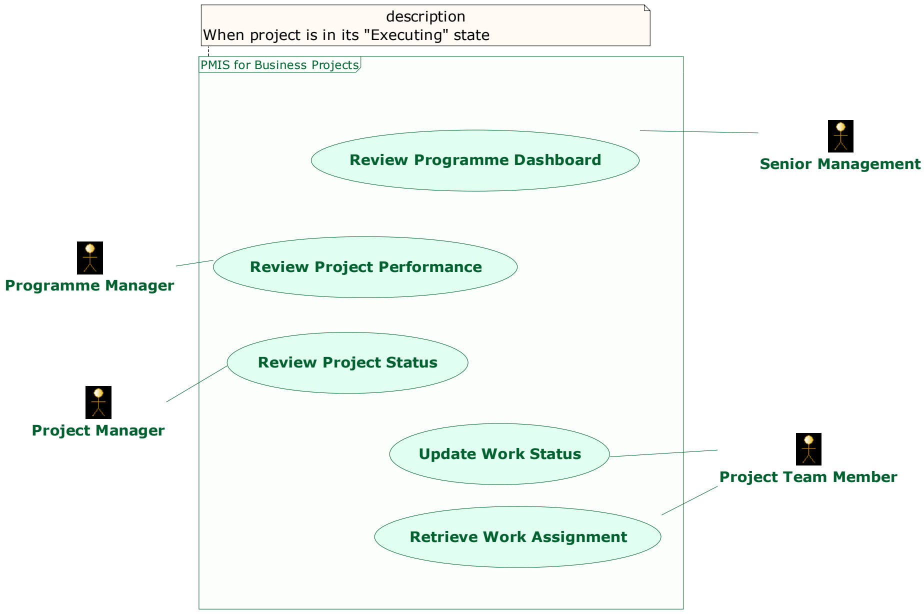

Figure 8.1 : Use Case Diagram for PMIS – during project execution

Each of the *Use Case* (ellipse shape) is accompanied by a *Sequence Diagram* that details the requirements of the system functionality to be fulfilled by the desired PMIS system.

Using "Update Work Status" as an example, Figure 8.2 is the resulting *Sequence Diagram* which describes both user-defined requirements and the domain-imposed requirements (Rolland, 2006). Since the key objective here is to demonstrate how the domain model can be leveraged during the requirement study stage, only the domain-imposed requirements are specified as a sequence of actions whilst the user-defined requirements are simply described using a note. The rationale of doing this is for the diagram to remain compact and readable.

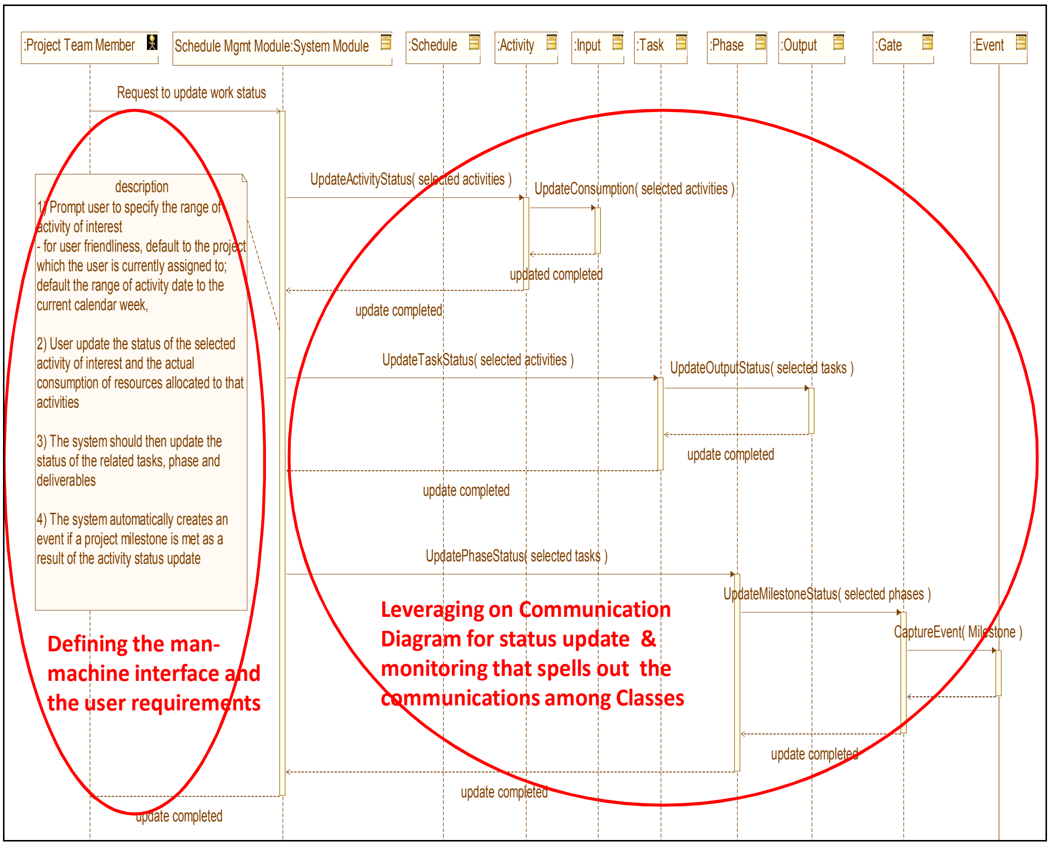

Figure 8.2 : Sequence Diagram for PMIS - during 'Update work status'

The circle on the left denotes the user-defined requirements which reflect users' goal, intention and wishes. The circle on the right denotes the domain-imposed requirements which describe the domain "laws" independently of any user's need or wishes. While user-defined requirements must be gathered from the users, the domain model can be leveraged for specifying the domain-imposed requirements. In this particular case, the domain-imposed requirements stated in the *Sequence Diagram* are essentially a transcript of the *Communication Diagram* for "Status Update and Monitoring". Since the domain model contains the invariant aspect of the domain knowledge, any fundamental differences between the two would imply that the captured domain-imposed requirement is a deviation from the standard practices.

In a typical requirement study scenario, the software engineer will depend solely on the users and/or domain experts for both types of requirements; and the full system requirements can only be determined after gathering and analyzing inputs from various stakeholders. Taking the same *Use Case* as an example, the requirement for "Update work status" obtained from project team members may be superficial and creates a false impression that it is a simple function that only retrieves and updates activity status. Assuming the software engineer is unfamiliar with the domain of project management, the need to also update status of the corresponding tasks, phases, output and milestones may not be uncovered until the requirement of management reporting is discussed with the project manager.

Given the domain model, the software engineer can use it to get a preview of the fundamental concepts in the domain before the requirement study exercise, validate the information received during the exercise, check the completeness of the gathered requirements after the exercise; and lastly as illustrated earlier, leverage on the *Communication Diagrams* already defined in the domain model to specify the requirements using *Sequence Diagram*. In any case, not only does the requirements study exercise become more effective and productive, the quality of the specification is better assured.

In addition, the use of domain model helps to inject standards and best practices into the software solutions. To further illustrate this point, Figure 8.3 which is the *Sequence Diagram* for "Review project status" *Use Case* is also included here for reference. Similar to the "Update work status" *Use Case*, it is developed based on the

Communication Diagram for "Reporting" which is already available in the domain model.

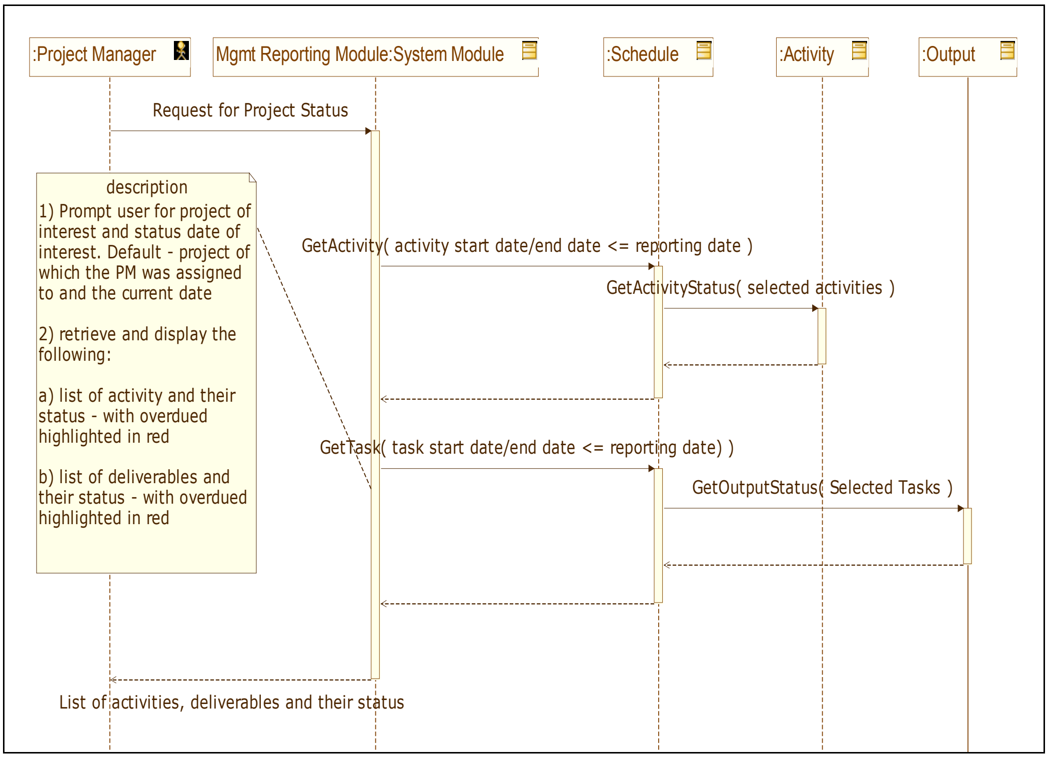

Figure 8.3 : Sequence Diagram for PMIS – during 'Review project status'

If both *Use Cases* of "Update work status" and "Review project status" as described above are implemented by the desired PMIS and the project team members are disciplined in their updating of activity status on a daily basis, the productivity level of project manager in preparing management reports would be improved tremendously.

As uncovered by the case study, project manager typically obtains activity status formally during status review meeting or informally by approaching the responsible individuals. In any case, the project manager is often the one who performs the actual update in the project schedule. So the larger is the project, the more unproductive is the task. Although the root cause of this issue is not entirely technical in nature, the implementation of such a PMIS would help to enforce the embedded best practices of timely status update at source by the team members.

Lastly, in order to provide a more complete view of how the domain model can be used to support all the functionalities expected of the integrated PMIS, a total of 20 *Use Cases* have been defined in the model. Table 8.1 shows the mapping between these *Use Cases*, the states in the initiative's life cycle and the four mandatory functions of the integrated PMIS. The detailed specifications of these *Use Cases* can be found in Appendix B.

Table 8.1 : List of Use Cases created for PMIS

Initiative Life Cycle phase	Use Cases	Required functionalities of an Integrated PMIS as reflected in the theoretical framework
Initiation	• Initiate new programme • Initiate new project • Generate project charter • Review and approve project charter • Generate programme charter • Review and approve programme charter	• Formalizing • Learning
Planning	• Initiate programme planning • Develop project plan • Review and approve project plan • Complete programme plan • Review and approve programme plan	• Learning
Execution	• Retrieve work assignment • Update work status • Review project status • Review project benefits • Review programme dashboard	• Status Tracking • Performance Tracking • Learning
Closing	• Prepare project closure report • Review and close project • Prepare programme closure report • Review and close programme	• Learning

As indicated in the table, "Learning" is required by all states /stages of an initiative's life cycle. This means learning related functionalities can potentially be implemented as an independent subsystem which is activated as and when required. In addition, different software development principles and techniques may be more appropriate and effective in representing, organizing and searching of "knowledge" related information. All this calls for an implementation of an ontology based application system which will be described in details in the next section.

8.2 Foundation for Project Knowledge Ontology

Ontology based application system has been developed for use in business enterprises and a good example is the development of "corporate yellow pages" (Santos et al, 2004). The "yellow pages" keeps information about the competence profile for each professional of the organization and provide the facility to search and allocate human resources with the adequate skills to be assigned to software development projects. In a similar way, extracts of the BProjM model can be used to implement Project Knowledge Ontologies to allow more effective learning. By applying the current technique of translating UML *Class Diagram* into OWL ontology, a project knowledge ontology comprising EVENT, ISSUE, CHANGE REQUEST, LESSON LEARNED and INITIATIVE can be generated accordingly.

With reference to Figure 8.4 which is an extract of the related *Classes* in the BProjM domain model, an EVENT at the organization level may trigger the creation of a new INITIATIVE as a TACTICAL COURSE OF ACTION. This same EVENT may also create ISSUEs for existing INITIATIVEs. The ISSUE in turn, may cause some aspects of the initiative to be changed through implementation of CHANGE REQUESTS and lastly, the LESSONs LEARNED from this episode are captured for future reference.

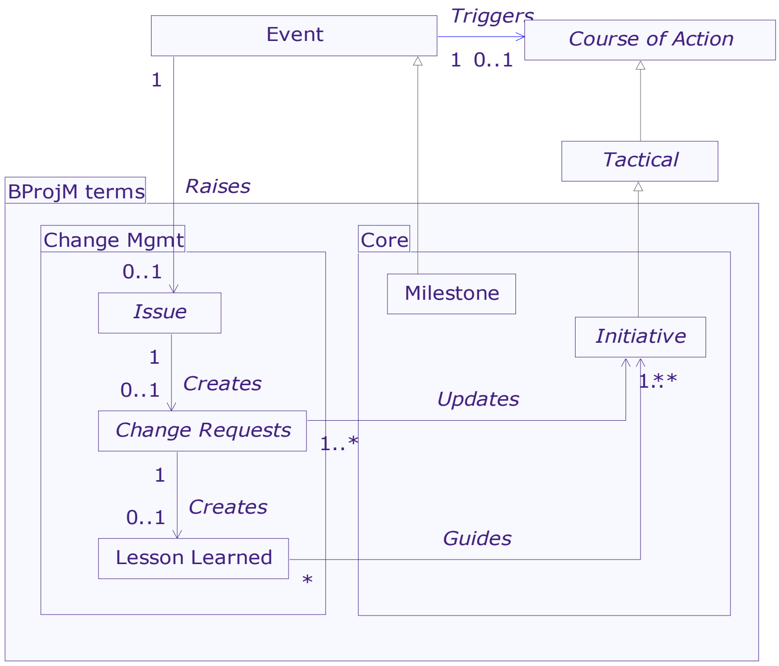

Figure 8.4 : BProjM domain model as foundation for project knowledge ontology

Given the availability of this information in the form of ontologies, future projects could learn from previous mistakes by incorporating counter measures as early as the project initiation and planning phases. Some examples of the types of questions which could be answered by querying the resulting project knowledge ontology would be:

1) What are the lessons learned from the same type of projects in the past and what were the triggering issues?

2) What were the change requests from the same type of projects in the past that incur more than RM10,000 additional cost?

3) What were some of the post implementation issues after the project went live?

At the programme level, the likely types of questions which could potentially be answered are:

1) What were the events in the past that created issues as well as impacted project work with change requests?

2) What were the organization's responses to a previous attack from a competitor (recorded as an event) and what were the lessons learned?

Likewise, problem solving for the current projects could also benefit from retrieving readily available answers for issues which have already been encountered in the past.

The implementation of this project knowledge ontology however, would require transformation of object's instances into ontology's individuals. Although this is less straight forward than the transformation of UML specifications, it can still be correctly achieved through various techniques of transforming relational tuples into RDF triples (Melnik et al, 2007). Alternatively, the transformation can be performed at the application level, where SPARQL queries are transformed to OQL queries (Hillairet et al, 2009) based on the mapping between the objects and the OWL concepts (Hillairet et al, 2008).

8.3 Business Project Management Practice Assessment Tool

By virtue that the developed domain model captures the essential components of business project management, a failure in instantiating the *Classes* and *Associations* in the model is an indication that something is amiss with the business project management practice. Based on this principle, Figure 8.5 is the *Use Case Diagram* that describes a straight forward scenario of an assessment exercise where an assessor (who could either be an external consultant or an internal QA officer) performs an assessment on an existing business project management practice. This may be initiated due to high project failure rates or an on-going effort of improving management processes. Upon completion of the exercise, the Chief Project Officer (or a position empowered to improve project management practice in the organization) acts on the findings and recommendations by putting the missing components in place.

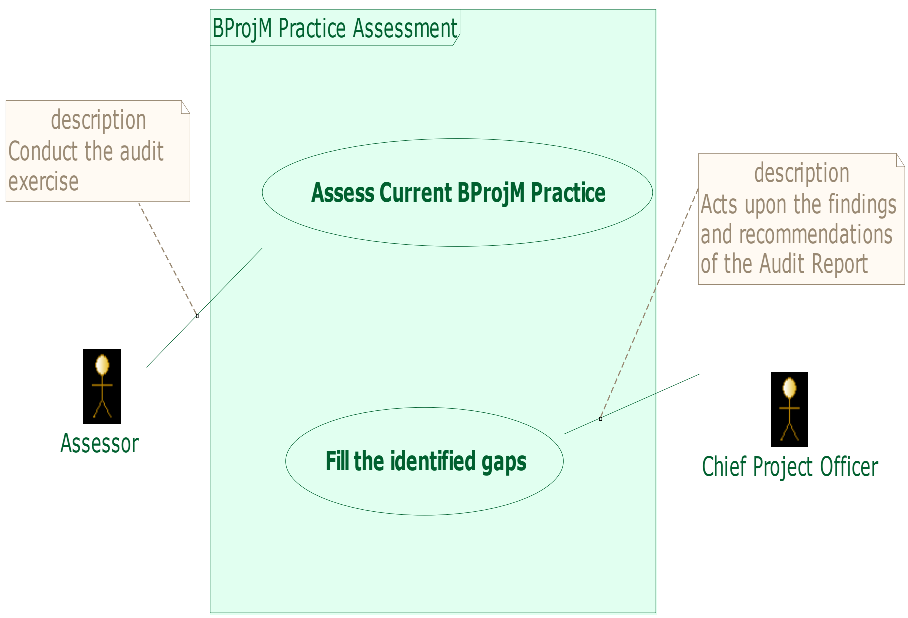

Figure 8.5 : BProjM domain model as a practice assessment tool

This assessment can be performed by using the domain model in a way very similar to how the model was tested for completeness during the development stage, i.e. by creating an *Object Diagram* and attempting to instantiate the *Classes* with real-life data. Taking Co2 Case study as an example, Figure 8.6 is its *Object Diagram* after instantiating the *Classes* in the domain model based on the data collected from the Transformer Programme which is still on-going; and information about their corporate PMO which is given the task to integrate all programmes and projects within the organization.

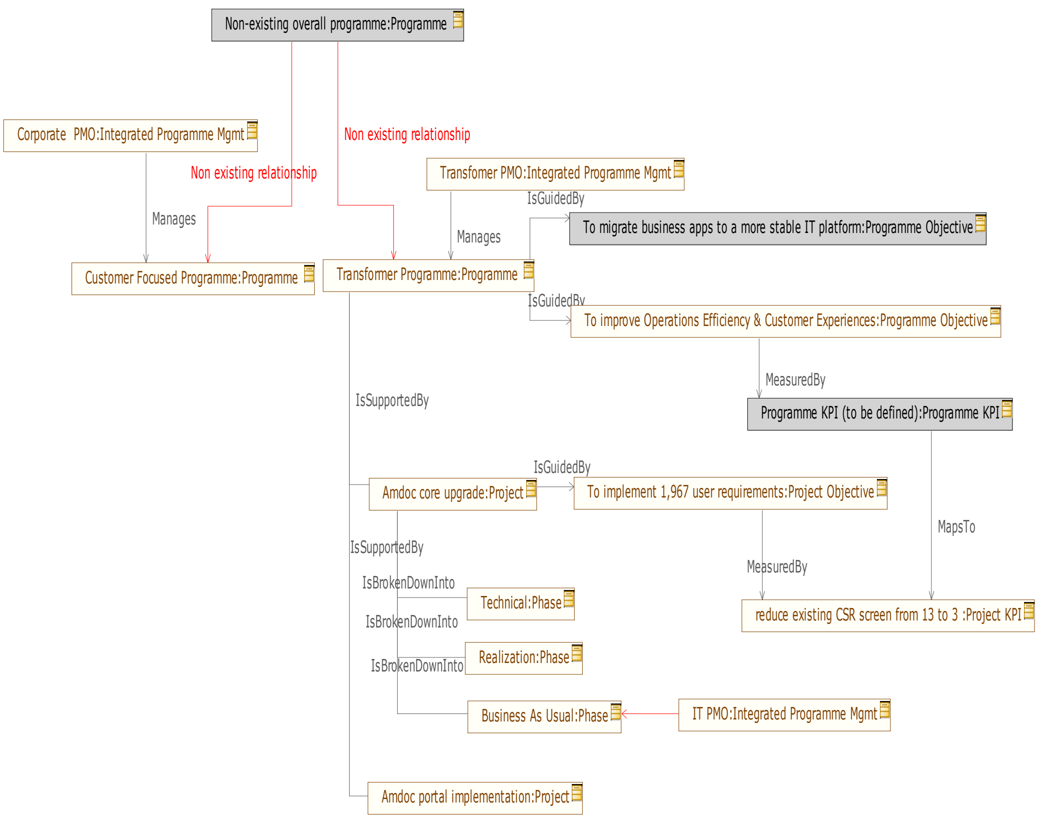

Figure 8.6 : Object Diagram of Co2

The gaps in Co2's business project management practice were found to be as follows:

1) There is no overall Change programme where all the programmes and projects can converge at the organizational level.

Without the shaded object labelled "Non-existing overall programme" and the 2 lines labelled "non existing relationships" at the top of the diagram, it is clear that Transformer Programme is operating independently from the other programmes which are managed by the Corporate PMO. Without a well defined overall programme at the organization level, the scope of work for the Corporate PMO is essentially undefined. This explains the different levels of endorsement for Corporate PMO's work and consequently, they are leveraged mainly for advices on how to run projects more effectively but not recognized as a central agency that drives programmes and projects towards success. The responsibility of executing the approved programme /projects are still shouldered by the respective business owners and as such, the worthiness of Corporate PMO in the organization is doubted by some, especially those who are already proficient in project and programme management.

2) There is a mismatch between the Transformer Programme's programme level KPIs and project level KPIs

At the programme level, the objectives are (1) to migrate the business application systems to a more stable platform (i.e. the first shaded object on the right), and (2) to improve operations efficiencies and customer experiences. Only the second programme objective is supported at the project level with "implementation of 1,967 user requirements"; while no attention has been paid to the first programme objective. In addition, the programme level KPIs have not been properly defined (i.e. the second shaded object on the right). Placing primary focus on user requirements is a very common mindset of the Information System projects, where it is often assumed that as long as these requirements are fulfilled by the system, the original problem which initiates its implementation would naturally be resolved as a result. In the case of Transformer Programme, the current issue with the infrastructure is high maintenance cost and system instability caused by heavy customization. Thus the first objective of the project should have been "to migrate the Amdocs system to a new version with minimal customization". Since this objective is not stated, the system may once again end up with undesirable amount of customizations which are required to implement the long list of functional requirements.

The recommendations to close these gaps as guided by the domain model would be:

1) To consolidate all existing programmes and projects which are cross-functional in nature into a single big programme; and give the corporate PMO a clear mandate to drive it forward.

2) To review the Amdoc upgrade project objectives and ensures that they are in line with the programme objectives. Their corresponding KPIs should also be clearly defined and mapped so that the performance of the project can be measured.

The model can also be used at more detailed level where the comprehensiveness of the schedule (in terms of defining tasks, output and activity) could also be assessed in a similar way.

Thus unlike conventional project maturity assessment methods which base their analysis on derived scores from completed questionnaires, this BProjM practice assessment tool identifies the gaps by injecting project data and facts directly into the model. The result is the delivery of more objective and explicit findings.

Last but not least, the domain model can also be used as a guide for setting up a new business project management practice.

CHAPTER 9 CONCLUSIONS

This section summarises the findings & conclusion of the research, highlights the potential implications brought about by the results and suggests next steps.

9.1 Summary & Conclusions

It is concluded that organizational factors do pose a significant moderating effect on attainment of business project success in all 3 cases studies, specifically (1) type of organization structure – where the tighter is the relationships between the project and its parent organization, the more effective is the application of project management competencies given the organization support. This in turn, contributes towards higher chances of project success; (2) level of PMIS support – where the more advanced and comprehensive is the PMIS support, the more productive and effective is the execution of project management competencies which in turn, contributes towards higher chances of project success.

It is also found that business project success should be measured at 2 levels namely meeting the project objectives and the organizational objectives. Based on this perspective, the essential business project management components were identified to be (1) core project management competencies (comprising only 4 out of the 9 PMI knowledge areas) which focuses at delivering success at the project level; (2) an integrated programme function that closes all the gaps between the project and the parent organizations in order to steer project towards success at the organization level; and (3) a specialized PMIS that supports the seamless communications between the project and parent organizations. Moreover, the single theme that weaves these essential components together is “integration”.

This shows that unlike traditional projects where it is a temporary organization positioned “beside” the parent organization, business projects should be placed “inside” the parent organization. As such, business projects are likely to fail if it is not managed as an integral part of the business enterprise. The anchor case study on Co1 is a fine example of how such integration could help to turnaround a sizable enterprise within a short span of time; case study of Co2 demonstrated how such disconnect can be disastrous; whilst case study of Co3 reflects that the industry is beginning to acknowledge this need to integrate. This also explains why previous inquiries into business project failure from a restricted project point of view without considering the significance of organization factors have not been able to offer satisfactory answers. The deficiencies such as lack of top management support, insufficient resources, no clear goals /objectives etc. are not the root causes but the consequences of the mis-positioning of business projects in business organization which are felt only by the project and no other parties. As a result, the prescribed critical success factors are treating the symptoms rather than curing the actual illness.

Taking the discussion to the next level, if the business enterprise wishes to reap maximum value from running business projects to effect on-going organizational changes; a more balanced amount of management attention and distribution of resources between business projects and daily business operations must be struck. Based on this principle, this firm-based research had answered the call to develop “theory for practice” (Winter et al, 2006) with the “Business Project Management theory” which states that “business projects should be managed as an integral part of a business enterprise, and given equal emphasis as the business-as-usual operations”.

It is also concluded that the resulting domain model has successfully specified the new gained BProjM knowledge in a more explicit and comprehensive manner. Each business project management concept is now clearly defined with *Attributes*, *Operations*, *Constraints* as well as *Associations* with the other related concepts. In addition, both structural and behavioural aspects of business project management as a field of interest are now clearly specified by a series of inter-related *Class Diagrams, Package Diagrams, State Machine Diagrams* and *Communication Diagrams*. Last but not least, the current format of specification allows the knowledge to be visualized and analyzed from various perspectives; as a result, facilitates identification of potential areas for future research.

The successful creation of the domain model on the other hand, is a demonstration that the 4-step domain modelling approach which took the middle path between conceptual system modelling and ontology modelling is workable and effective. As illustrated by the research, the resulting domain model is a common semantic foundation which could be used directly in both the development of the desired PMIS for business projects as well as the construction of project knowledge ontologies. It is hoped that upon implementation of these systems, the business project management practice in the adopting organizations would become system led; and consequently the gap between theory and practice would be closed and the embedded domain wisdom in the system would help to improve chances of business project success.

It is also gathered from the domain modelling exercise that OMG's BMM, BPDM, OSM standards form a good basis for defining enterprise framework although there is still room for improvement in their coverage of meta-concepts. UML on the other hand, is easy to learn and thus a viable modelling language to be promoted among non-technical domain experts. Lastly, Objecteering is a very user friendly tool with good design considerations but the provision of a more intelligent auto-layout function would be helpful in reducing the model's development time.

Last but not least, since the step of reusing existing work has been built in, the same modelling steps could be applied to capture new inputs into the model, facilitating the desired knowledge expansion. This resulting domain model as such, is a foundation of which business project management research findings could be cumulated; and serves as a consolidated domain reference for project management researchers, practitioners and software developers.

9.2 Implications & Recommendations

Organizational change is becoming a rule rather than an exception given the increasingly fluid, complex, and global business environment. As demand for business projects to implement these organizational changes increases, the overhead incurred due to initiation and dismissal of temporary project organizations are also expected to grow accordingly.

In view of this phenomenon and the need to integrate project and parent organizations in order to obtain project success, the way business projects are organized today needs to be reviewed and elements of permanence should be injected. One solution would be the establishment of a "business project department" to take up all the business projects related responsibilities. This department will have a skeletal number of key personnel with integrated programme management responsibilities; and a group of renewable full time project personnel who represent their originating departments in all project works throughout their secondment tenure. This differs from the typical PO/PMO or a corporate planning department as the scope of work for this department covers both the former's focus on execution as well as the latter's emphasis on planning for the future. In other words, the creation of this department is formalizing and centralizing how on-going organizational changes would be initiated, managed and implemented in the company. Since this also means some degrees of authorities and control would be drawn away from existing stakeholders (including the role as integrator within the CEO), the impact of this new form of organization structure which combines both permanent and temporary elements has to be assessed further before it is implemented.

Similarly, the current use of information technology in support of business project management deserves a relook. The need for project related information and interactions can only grow with the increasingly importance role of business projects in business enterprises. In which case, use of isolated application systems or different tools to handle different stages of the project life cycles are unlikely to sustain in the long run. Although the integrated PMIS suggested by the research findings may not be available in the market today, intermediate solution that gears towards that direction can be put in place. This can be achieved by adjusting current policies and procedure as well as extending the functionalities of the existing enterprise management systems. For example, the use of Ms-Project by the project manager to update timeline can be extended to support timely project status update by the team members; and the use of

Ms-Excel spreadsheet and/or Ms-Project to track utilization of project resources could be taken over by the existing human resources management system and financial management system. It will also be worthwhile to assess if the integrated PMIS should be built as an extension of an integrated enterprise management system; rather than an independent module which will be integrated with the enterprise management systems later.

The identification of the 4 core business project management competencies on the other hand, implies that not all PMBOK knowledge areas are of equal importance and relevance to business project management. In addition, the nature of integration management, scope management, time management and communication management is related more to the general management skills demanded of an integrator, rather than technical competencies required of a traditional project manager in charge of a construction or engineering project. As such, it may be more appropriate to approach the study of business project management as an extension of the management discipline, rather than an application of alien technical concepts in business management. What this also suggests is that a clear distinction between business project management and traditional project management should perhaps be made; and fundamentals of projects and project management should perhaps be taught in undergraduate management schools to produce better prepared candidates for the workforce.

Last but not least, the placement of equal emphasis on project and operations as suggested by the BProjM theory implies that the same level of expectation on results would also be imposed on projects. In other words, projects and programmes would have to be planned in such a way that benefits can be realized in alignment with the financial year calendar on a quarterly or half-yearly basis.

On the computer science front, the domain modelling can theoretically be applied to other management subject of interest, as long as the findings can be expressed in the form of theoretical framework and the components can be expanded using prevailing standards. In which case, consistent application of this methodology over time would contribute towards the development of a multi-facet enterprise domain model. This could potentially change the landscape of software engineering as given the enterprise domain model; enterprise systems can now be built based on predefined knowledge specification which is a direct reflection of basic research findings, rather than consolidation of user requirements which are more subjective and problem solving in nature. When this scenario becomes a reality, the ability to fulfil domain-imposed requirements will no longer be a differentiator and software systems would compete primarily in terms of quality and how well they meet the non-functionality requirements (Sawyer et al, 2007).

Similarly as demonstrated by Figure 9.1, corporate memory ontologies can be developed based on the resulting enterprise domain model. Consequently, enterprise of the future may no longer be solely dependent on its human capital for knowledge and lesson learned from the past.

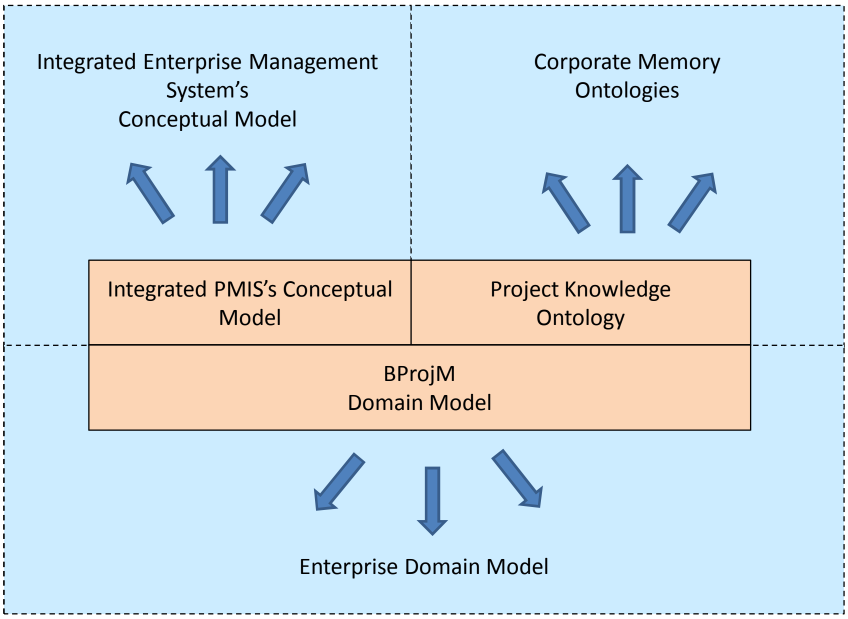

Figure 9.1 : Expanding BProjM domain model to Enterprise domain model

The creation of this enterprise domain model however, would need support from a central agency to host the convergence of all related management research efforts. OMG would be in the best position to play that role since the domain model is built using its BMM, BPDM and OSM standards which also need to be improved with more meta-concepts. The central agency will also play an important role in providing the forum to resolve semantic conflicts between new and existing *Classes*, which are expected to become regular with the expansion of the domain model.

The other concern would be the lack of UML knowledge and understanding of the object oriented concepts among the management scholars which could potentially impede the acceptance of this modelling approach. Thus until unification of modelling standards across disciplines is achieved, close collaborations in the form of joint research must continue to be encouraged and promoted.

As an immediate next step, more case studies can be conducted to enhance the domain model with more *Attribute, Constraints, Operations* as well as *Associations*. The study can also be followed by a survey to generalize the findings at a later stage. Lastly, project management professionals can start using the domain model in its current form to identify missing essential business project components in existing business establishments in order to improve chances of business project success.

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