Université de Montréal

MANAGED CLAIMS PROCUREMENT STRATEGY (MCPS): A COMPARATIVE STUDY OF THE PERFORMANCE OF ALTERNATE BUILDING PROCUREMENT STRATEGIES

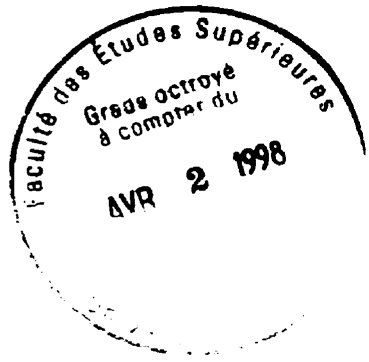
par

Tarek Ahmed Abdel Meguid

Faculté de l'Aménagement

Thèse présentée à la Faculté des études supérieures
en vue de l'obtention du grade de
Philosophiæ Doctor (Ph.D.)
en Aménagement

Décembre 1997



Université de Montréal

Faculté des études supérieures

Cette thèse intitulée :

**MANAGED CLAIMS PROCUREMENT STRATEGY (MCPS) :
A COMPARATIVE STUDY OF THE PERFORMANCE
OF ALTERNATE BUILDING PROCUREMENT STRATEGIES**

présentée par :

Tarek Ahmed Abdel Meguid

a été évaluée par un jury composé des personnes suivantes :

..... président-rapporteur
Marie Lessard

..... directeur de recherche
Colin H. Davidson

..... co-directeur de recherche
Sabah Alkass

..... membre du jury
Jean-Jacques Lipp remplacé par Iskandar Gabbour

..... examinateur externe
David Haviland

..... représentant du doyen
Georges Michaud

Thèse accepté le : 20 février 1998

The procurement strategy:

The framework within which construction is brought about, acquired or obtained.

"CIB W92 - Procurement Systems"

La maîtrise d'ouvrage:

Structure qui soutient l'acte de bâtir depuis la conception jusqu'à la livraison de l'ouvrage.

"CIB W92 - Maîtrise d'ouvrage"

Abstract

This research investigates whether and how the level of project performance is reflected in the number and the extent of delay claims that impinge on projects under different contractual settings. More specifically, it examines claims arising from delays and relates them to the available procurement strategies, particularly in instances where project time is found to be an important consideration for the building owner.

Literature review shows that "project procurement strategies" and "delay claims" have been studied separately. A combination of case studies and surveys permitted the identification and the analysis of some of the critical root causes of claims that affect the performance of the building process under different procurement strategies. All facts were obtained from historical data, since cases were drawn from case law, which represents a facts-based judgement and is not biased by subjective opinions. This gives an insight into the differences between alternate procurement strategies and facilitates the evaluation of the building process performance under each of them.

The availability and access to information proved to be the most critical category of causes of claims for all procurement strategies. The findings of this research point to the consequences (in terms of claims) of the constraints within which public sector owners operate. They also throw an unexpected light on the likelihood of all types of owners running into trouble when non-traditional procurement strategies are adopted, suggesting the need to fine-tune the practicalities of these strategies.

This research is, therefore, intended to partially fill the gap in the available knowledge of the sources, causes and effects of conflict under different procurement strategies. It also provides owners with suitable benchmarks for assessing the risks associated with a particular procurement strategy, as well as creating an increased awareness among them of likely causes of disputes and their frequencies. Thus helping to shape strategies that improve the performance of the building process by minimizing conflict occurrences in the first instance.

Résumé

La décision d'acquérir un bâtiment précède généralement sa réalisation, de telle sorte que l'appréciation de sa qualité par le maître d'ouvrage devient impossible. Par ailleurs, la maîtrise d'ouvrage porte principalement sur la performance du processus de conception et de construction mais indirectement sur la qualité du bâtiment lui-même.

En général, la stratégie d'acquisition du bâtiment, autrement dit la maîtrise d'ouvrage, établit le cadre contractuel qui détermine l'attribution de l'autorité et de la responsabilité des participants au niveau du projet. De plus, les contrats de construction répartissent l'autorité et la responsabilité parmi les organisations participantes en fonction des liens contractuels, ces derniers étant à leur tour définis par le modèle stratégique adopté pour l'acquisition du bâtiment.

Étant donné que la stratégie d'acquisition du bâtiment détermine les limites ou champ d'intervention de chaque participant, l'ensemble des contrats de construction sert à clarifier et à communiquer les particularités des champs d'intervention à chaque intervenant.

Le fait qu'il n'existe pas une seule stratégie d'acquisition du bâtiment (ou une seule forme organisationnelle) qui est la meilleure pour n'importe quel sort de projet - à cause des caractéristiques particulières de chaque projet de construction - a, comme conséquence, l'obligation d'évaluer chaque stratégie à la lumière des caractéristiques spécifiques de chaque projet.

Parmi tous les scénarios possibles en ce qui concerne la stratégie d'acquisition d'un bâtiment, la sélection de celle qui est la plus performante reste la première priorité du maître d'ouvrage.

Les résultats des recherches antérieures ont démontré que la performance du processus de conception et de construction est affectée inversement par le niveau des

conflits inter-organisationnels. En conséquence, pour obtenir un projet de qualité qui répond aux exigences et aux objectifs du maître d'ouvrage, ce dernier cherchera à minimiser les conflits et les contestations qui en découlent.

Les réclamations sont une conséquence des conflits qui découlent d'une approche inappropriée à la maîtrise d'ouvrage. Cette proposition est explorée et vérifiée au cours de notre recherche.

Les projets rencontrent souvent des retards qui aboutissent à des réclamations; de ce fait, ces réclamations peuvent être considérées comme un bon indicateur de la validité de l'approche adoptée par le maître d'ouvrage.

Le concept des "conflits inter-organisationnels" et son lien d'une part avec le concept de "design de l'organisation du projet" et d'autre part avec le concept de "réclamations" - comme manifestations de ces "conflits inter-organisationnels" - est élaboré. Il suggère que le nombre, la sévérité et la récurrence des réclamations dues à des retards donnent une bonne indication permettant d'évaluer la performance du processus de conception et de réalisation du bâtiment.

Les réclamations dues à des retards sont identifiées à partir de la jurisprudence. L'analyse de cette jurisprudence fournit l'information qui permet d'explorer les relations entre les concepts mentionnés ci-dessus et d'approfondir l'identification des sources de conflit sous les différentes stratégies de maîtrise d'ouvrage.

Cette recherche examine la question de savoir si le niveau de la performance d'un projet est reflété par le nombre et l'étendu des réclamations dues à des retards et de savoir si ces réclamations ont un impact différent sur les projets en fonction des différentes stratégies de maîtrise d'ouvrage. Plus spécifiquement, les réclamations dues à des retards sont examinées en fonction des différentes stratégies d'acquisition du bâtiment, surtout dans les cas où la durée du projet est considérée comme très importante par le maître d'ouvrage.

Quelques facteurs critiques qui déterminent le succès ou l'échec d'un projet sont identifiés à partir de l'analyse d'un grand nombre des projets qui ont donné lieu à des problèmes. Cette analyse permettra d'expliquer les différences entre le niveau de performance des différentes stratégies d'acquisition des projets.

L'examen de ces facteurs stratégiques - considérés en fonction des différentes stratégies d'acquisition de bâtiments - nous a permis, d'une part, d'identifier ceux qui entraînent des pertes de temps et des coûts additionnels et, d'autre part, de proposer une approche à l'évaluation de la performance des différentes stratégies d'acquisition de bâtiments.

Un examen des sources des conflits donnant lieu à des réclamations et des litiges, en tenant compte des différentes stratégies d'acquisition de bâtiments adoptées nous permettra d'identifier quelle stratégie est la plus susceptible d'aboutir à un haut niveau de réclamations, ce qui, à son tour, implique une grande perte de temps et un grand impact financier.

En conséquence, il devient possible de suggérer quelle stratégie adéquate de maîtrise d'ouvrage sera la plus appropriée, tout en tenant compte des objectifs du maître d'ouvrage.

Un examen des stratégies de recherche utilisées en sciences humaines (expériences, enquêtes et études de cas) nous a permis de conclure qu'une combinaison des deux dernières (enquêtes et études de cas) est la meilleure pour rencontrer les exigences de notre recherche. Cette approche a, donc, été appliquée à cent vingt-et-un cas qui furent identifiés dans les textes juridiques, puis sélectionnés pour une étude très approfondie.

De plus deux enquêtes effectuées dans la région du Montréal métropolitain ont permis d'établir des groupes de contrôle. La première enquête permet de comparer la distribution des projets de bâtiments parmi les différentes stratégies d'acquisition du

bâtiment et la deuxième permet d'établir et d'esquisser la perception des experts sur l'importance relative des différentes sources des réclamations.

Les études des cas et la comparaison de celle-ci avec le groupe de contrôle ont permis d'identifier les stratégies susceptibles d'avoir une grande incidence de réclamations, et d'apprécier jusqu'à quel point la résolution de ces réclamations peut être longue et coûteuse. En conséquence, les propositions sur le choix des stratégies d'acquisition de bâtiments peuvent être suggérées aux maîtres d'ouvrages tout en tenant compte de leurs propres objectifs.

Un des problèmes majeurs rencontrés dans la poursuite d'une recherche de cette nature est l'absence de consensus sur la définition et la catégorisation des différentes stratégies d'acquisition de bâtiments; en plus l'utilisation de la terminologie dans ce domaine est confuse et peu consistante. Une catégorisation en des stratégies d'acquisition de bâtiments en trois grandes familles est adoptées, d'après la catégorisation de Masterman (1992); elle est discutée en détail et elle est utilisée comme base d'une méthode logique permettant la catégorisation des différentes stratégies d'acquisition observés en Amérique du Nord.

La base théorique pour notre recherche a été empruntée à l'école de pensée qui étudie la prise de décision dans un environnement inter-organisationnel. En fonction de cette approche il a été montré précédemment que le niveau des conflits inter-organisationnels affecte inversement la performance du processus de production des bâtiments, et, de ce fait, correspond à un mauvais choix de stratégie d'acquisition. Notre recherche propose d'utiliser l'incidence des réclamations dues à des retards comme façon de mesurer le niveau des conflits inter-organisationnels, en associant les causes principales aux caractéristiques déterminantes de ces conflits. Une fois q'une façon de mesurer le niveau des conflits a pu être développée, il devient possible d'évaluer la performance des différentes stratégies d'acquisition et de conseiller les maîtres d'ouvrage en conséquence.

La recherche est présentée en cinq chapitres:

Chapitre 1 (Le processus de production de bâtiment): Ce chapitre discute en détail le processus de production de bâtiments et le problème de leur acquisition, considéré comme une décision stratégique dans un contexte organisationnel particulier. Ceci nous permet d'esquisser la toile de fond nécessaire à la compréhension du contexte de notre recherche. L'idée d'utiliser la notion de conflit inter-organisationnel comme outil d'évaluation du processus de production de bâtiments est également présenté afin d'avancer notre hypothèse, à savoir: qu'on peut se servir des réclamations dues à des retards - considérées comme manifestations des conflits inter-organisationnels - comme façon de mesurer et d'évaluer la performance des différentes stratégies d'acquisition disponibles au maître d'ouvrage, parmi lesquelles il doit faire son choix.

Chapitre 2 (Conflits et réclamations): Ce chapitre explore les problèmes inhérents aux conflits inter-organisationnels et en identifie les causes principales; il trace la transformation de ces conflits en disputes et puis en réclamations.

Certains facteurs critiques communs affectent le succès ou l'échec du projet. L'accent est mis sur les facteurs stratégiques qui sont caractéristiques des différentes approches à l'acquisition de projets. Il devient alors possible d'identifier ceux qui sont associés à une grande perte de temps et qui ont un grand impact financier. Nous pouvons ensuite évaluer les performances des différentes stratégies d'acquisition de bâtiments.

Chapitre 3 (Méthodologie de recherche): Ce chapitre discute le choix de la stratégie de recherche grâce à un examen et une discussion des stratégies de recherche utilisées en sciences sociales (expériences, enquêtes et études de cas). Les enquêtes et les études de cas, ensemble, paraissent offrir le niveau de détail nécessaire pour répondre aux besoins de notre recherche. Une explication est donnée quant à la façon dont les cas ont été identifiés et choisis parmi les cas de réclamations ayant été l'objet de jugements en cours. Les hypothèses de recherche sont avancées, la stratégie de recherche développée - compte tenu de la nature et de la disponibilité des données qui devaient être recueillies pour appuyer les propositions - et les variables définies.

Chapitre 4 (Analyse des données et discussion): Ce chapitre présente les résultats des études et des enquêtes en quatre sections: les caractéristiques des méthodes d'acquisition de projets, les conséquences des réclamations, les causes des réclamations et l'interdépendance des trois sections précédentes. Chaque section se termine par une discussion des résultats qu'elle a permis de proposer.

Chapitre 5 (Conclusion et recommandations): Ce chapitre présente les conclusions suggérées par notre étude ainsi que des recommandations portant sur les recherches futures.

En résumé, donc, cette étude examine l'interrelation entre les différents cheminements utilisés pour l'acquisition de bâtiments et les réclamations qui peuvent surgir à cause des délais; elle permet d'analyser et de quantifier les aspects essentiels de cette interrelation. Tous les faits on été obtenus à partir de données objectives puisque les cas ont été tirés des dossiers juridiques qui présentent des jugement fondés sur des faits; il a été possible d'éviter tout biais dû à des opinions subjectives.

Nous tenons à souligner le fait que notre approche globale à la problématique de la maîtrise d'ouvrage et des difficultés qui peuvent en découler est tout à fait inédite en Amérique du Nord. À notre connaissance, nous sommes des précurseurs à cet égard.

Nous espèrons que les résultats de cette recherche offriront aux maîtres d'ouvrage des indications appropriées qui les aideront à évaluer les risques associés à une stratégie d'acquisition particulière, et à les conscientiser sur les causes possibles des disputes et de la fréquence de celles-ci.

Cette recherche vise, donc, à combler partiellement le vide dans la connaissance disponible concernant les sources, les causes et les effets des conflits dans l'industrie de la construction Nord-Américaine. L'investigation et l'identification des causes qui contribuent à la naissance des conflits, peuvent aider à formuler des stratégies qui pourraient minimiser le risque de conflits dès le départ du projet.

Table of Contents

List of Tables

List of Figures

Acknowledgment

I would like to express my deepest gratitude to my supervisor and mentor professor Colin H. Davidson who gave me the opportunity, constant support, parental guidance and instructive and guiding criticism throughout our long discussions and in the development of the ideas for this research.

I am also truly grateful to Dr. Sabah Alkass, my co-supervisor, for his invaluable time, friendly advice, constant support and constructive suggestions throughout this research.

I wish to thank Mrs. Regula Brunies, senior vice president of Revay and associates Ltd. For her interest and valuable assistance.

I would like to acknowledge the support of my colleagues in the IF Research Group (past and present) especially Dr. Rashid A. Mohsini, a pioneer in the field and a good friend in times of need, who gave unstintingly his time and his invaluable advice even from far away; and my friend Constantine Katsanis another lonely traveler in the glorious doctoral path.

Special thanks to Anis Nazar for his invaluable assistance with the survey questionnaires and Prof. Jerry Tomberlin for helping with the intricacies of statistics.

I would also like to thank several persons for their encouragement and constant support throughout this research: Prof. Iskandar Gabbour, Andrée Habra, Constance Bourcier and Nicole Larivière.

Finally, I am eternally grateful to my beloved parents and my wonderful brother Amr for their endless encouragement, patience and unfailing support without which this thesis could not have seen the light; and to whom I dedicate this work.

T. A. M. was the recipient of the "Bourse d'Excellence de la Francophonie" Scholarship from the government of Canada.

Dedication

To my beloved family:

My dear parents

And

My wonderful brother Amr

I owe you an immense debt of gratitude

INTRODUCTION

Buildings are usually procured before they are built, so that prior quality assessment of the product by the owner is impossible. Difficulties are compounded by the fact that the owner's procurement decisions directly affect the performance of the designing and building process, and only thence the performance of the building itself.

The procurement strategy establishes the contractual framework for any project and determines project-related authority and general responsibility assignments. Construction contracts further expand and define this authority and responsibility among the organizations involved. They follow the pattern of the procurement strategy by assigning roles and responsibilities to those who will be operating under the contractual relationships. In addition, because a procurement strategy implies a general scope of work for each participant, construction contracts must clarify and communicate the details of that scope.

Accepting the fact that there is no one procurement strategy (or organizational profile) suitable for any type of project, because of the unique features of each building project (site, requirements, timing and so on), it can then be suggested that each strategy should be evaluated in the light of each project's specific characteristics.

Within all the available scenarios and variants of the project procurement strategies, selecting the highest performing project organizational strategy still remains the highest priority for the building owner.

From the results of previous research, it has been demonstrated that the performance of the designing and building process is adversely affected by the level of inter-organizational conflict. Consequently, to obtain a quality project that fulfills the owner's objectives, he or she is interested in avoiding inter-organizational conflict and disputes. Construction claims are in themselves a manifestation of inter-organizational conflict; they are assumed to be the result of the selection of an inappropriate procurement strategy. This suggestion is explored and verified during the course of this research. Projects are nearly

always delayed, ending up with claims for delays. This suggests using such delay claims as an indicator of the appropriateness of the chosen procurement strategy.

The concepts of "inter-organizational conflict" - and its link to "project organization design" - and that of "claims" - as a manifestation of "inter-organizational conflict" - are discussed. They suggest that the project process performance may be revealed by the number, severity and recurrence of "time-related claims" or (delay claims). "Time-related claims" are identified from case-law. The analysis of case-law provides data that enables the relationship between the above concepts to be explored as well as offering an in-depth understanding of the root causes that give rise to conflict and claims under different project procurement strategies.

This research investigates whether and how the level of project performance is reflected in the number and the extent of delay claims that impinge on projects under different contractual settings. More specifically, it examines claims arising from delays and relates them to the available procurement strategies, particularly in instances where project time is found to be an important consideration for the building owner.

Identification of some of the common critical factors affecting project success and failure - drawn from a number of building projects in which such problems arose - gives an insight into the differences between alternate procurement strategies. By placing emphasis on strategic factors within different approaches to project procurement, it should be possible to identify those which affect time and cost overruns. This should allow us to evaluate the performances of the alternate building procurement strategies.

A study of the root causes of conflict that lead to claims under different procurement strategies can help in suggesting which strategy is likely to lead to a higher incidence of claims, involving more time lost and having a higher financial impact. A suitable procurement strategy can then be identified, without losing sight of the owner's objectives.

An examination and discussion of social science research strategies for experiments, surveys and case studies; suggests that the latter two provide the necessary high level of inter-related detail required to meet the needs of this research. One hundred and twenty one cases were identified and selected from adjudicated claims for an in-depth study. The control group was established from two surveys in the Metropolitan area of Montreal, the first survey is used to compare the distribution of building projects among the different procurement strategies and the second aims at getting experts' perceptions on the relative importance of pre-identified root causes of claims.

One of the major problems in undertaking such a research is the absence of any consensus on the definition and on the categorization of different procurement strategies, as well as the confusing and interchangeable use of procurement terms. A three-part categorization of building procurement strategies, following Masterman's (1992) categorization, is discussed in detail and introduced as a logical method for categorizing the different procurement strategies in North America.

The "Inter-organizational Decision Making" school's theory has been chosen as the framework for this research. Inter-organizational conflict has been shown to inversely affect the performance of the procurement strategies. The proposition of this research is to investigate the suitability of using time-related claims as a measure of inter-organizational conflict by linking the root causes of claims to the determinants of inter-organizational conflict. A yardstick can then be developed to assess the performance of different procurement strategies and advise owners accordingly.

The argument is developed in five chapters:

Chapter 1 (The building process): This chapter discusses in detail the building process and the building procurement problem, considered as a strategic decision in an organizational context, to give the theoretical background necessary for this research. The concept of the use of inter-organizational conflict as the building

process performance-appraisal tool is also discussed to advance the premise of this research which is to use claims - which are assumed to be a manifestation of inter-organizational conflict - as a yardstick to evaluate the performance of the different procurement strategies available for the building owner to choose from.

Chapter 2 (Conflict and claims): This chapter explores the inherent problems and identifies the root causes of inter-organizational conflict that are manifested in disputes and claims.

Some of the common critical factors affecting project success and failure are discussed. Placing emphasis on strategic factors within different approaches to project procurement; should make it possible to identify those which affect time and cost overruns. This would allow us to evaluate the performances of alternate building procurement strategies.

Chapter 3 (Research methodology): This chapter discusses how the research strategy is selected through an examination and a discussion of social science research strategies (experiments, surveys and case studies). Surveys and case studies combined are found to provide the necessary high level of inter-related detail required to fulfill the needs of this research. An explanation is given as to how the cases were identified and selected from adjudicated claims. The research hypotheses are stated; the strategy for the research is developed, considering the data that need to be collected to support the stated propositions, and the variables defined.

Chapter 4 (Data analysis and discussion): This chapter presents the results in four sections: project procurement characteristics, claims outcomes, causes of claims and relationship between classifications. Each section ends with a discussion of the results under that particular section.

Chapter 5 (Conclusion and recommendations): This chapter presents the conclusions deduced from the present study together with the recommendations for further research.

As far as we are aware, this is the first study in North America which looks into the relationship between different project procurement paths and delay-related claims; it is also the first which attempts to analyze and quantify it. All facts were obtained from historical data, since cases were drawn from case-law which represents a facts-based judgement and is not biased by subjective opinions.

It is hoped that the results of this research will provide owners with suitable benchmarks for assisting them in assessing the risks associated with a particular procurement strategy, as well as creating an increased awareness among them of likely causes of disputes and their frequencies.

This research is, therefore, intended to partially fill the gap in the available knowledge of the sources, causes and effects of conflict in the North American construction industry. Such an investigation into, and identification of the "contributing causes" to conflict, can help shape strategies that may minimize conflict occurrences in the first instance.

CHAPTER 1:

THE BUILDING PROCESS

1.1 INTRODUCTION

Buildings are usually procured before they are built, so that prior quality assessment of the product by the owner is impossible. Difficulties are compounded by the fact that the owner's procurement decisions (strategies) directly affect the performance of the designing and building process and only thence the performance of the building itself.

The building industry is different from other industries, since it is characterized by the *temporary* and *multi-organizational* nature of the building project organization, where different task-organizations are temporarily assembled to build the project that satisfies the owner's needs and constraints. These task-organizations may never meet again and are therefore involved in a power struggle to promote their own long term objectives over the short term objectives of the building project, thus causing inter-organizational conflict which was found in previous research to be inversely proportional to the performance of the building project (Mohsini, 1985).

An understanding of the unique nature of the building industry by itself is not sufficient to improve its performance since owners are often at a loss in choosing an appropriate way to procure their buildings due to the wide variety of available building procurement options. Thus owners are faced with a procurement problem.

This chapter discusses in detail the building process and the procurement problem, considered as a strategic decision in an organizational context, to give the theoretical background necessary for this research. The concept of the use of inter-organizational conflict as the building process performance-appraisal tool is also discussed to advance the premise of this research which is to use claims - which are assumed to be a manifestation of inter-organizational conflict - as a yardstick to evaluate the performance of the different procurement strategies available for the building owner to choose from.

1.2 THE BUILDING PROJECT ORGANIZATION

Unlike traditional ***closed*** organizations, the building industry is an ***open*** organization. In closed organizations, the components are not readily interchangeable, meaning that there is only one participant assigned to do a particular job; in open organizations (like the building industry) the different components (e.g. contractors, architects, engineers) of the organization are interchangeable and intervene in response to changing conditions, according to the availability of work and their desire to perform it. Their participation is short-term or "ephemeral".

The building industry[1] is characterized by being custom-oriented and incentive-dependent, and by its dependence on human factors; consequently, the building process[2] is highly fragmented and sometimes divisive (Barrie and Paulson, 1992). It is also marked by the fact that its product is location specific, thus differentiating it from other manufacturing industries (Roberts, 1974).

The building *industry* is therefore a conglomeration of quite diverse participants from different fields. The building *project organization*, unlike project organizations in other industries, is composed of a number of usually small independent organizations which only come together on a temporary basis and establish links with each other when and for as long as the need arises; the building project organization is a "multi-organization" (Figure 1.1).

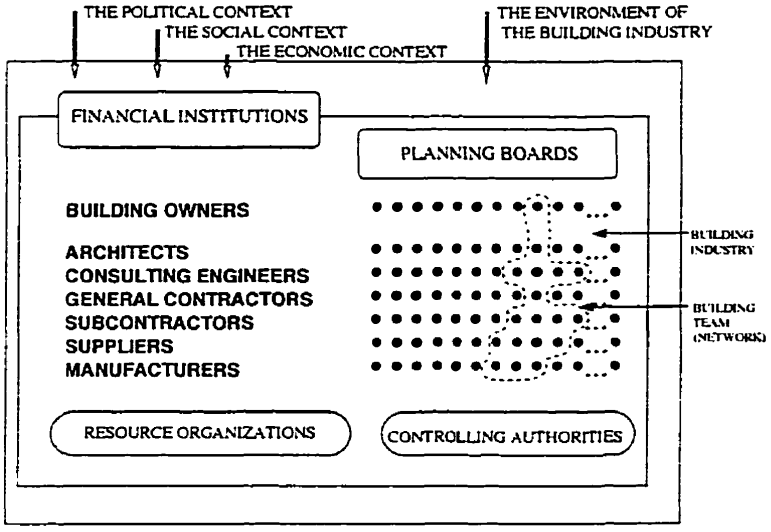
As soon as the project is completed, the project organization is dissolved and the participating organizations (usually called "task-organizations") join other projects. Also, as there are many task-organizations that can perform the same task every time that a new

---

[1] **The building industry:** is the linkage between supply and demand for man-made environment or building space. The elements of the building industry are diverse; they vary from owners (demand side) with their different profiles; and architects, engineers, contractors, sub-contractors, suppliers, and manufacturers (supply side) [Katsanis and Davidson, 1996].

[2] **The building process:** Describes the whole process from perception of the need to the occupancy of building by the owner [Davidson, 1988].

project organization is assembled, each task-organization may have to work with an entirely new set of participants on each successive project with which it becomes involved; therefore *temporariness* is an important feature that distinguishes the building project organization from almost any other.



The building team in the building industry and the building industry within its environment. Members of the building team are selected from among the many enterprises in each category which exists within the building industry; they come together to carry out a particular building project. Extra-industry participants are depicted outside the project boundary (planning boards, financial institutions, resource organizations and controlling authorities). Environmental impacts are shown by arrows.

The Building owner, although shown within the industry, belongs to a system of his own, external to the industry, and has functions and interests quite separate from the industry, yet closely involved with the building process wherever he or she needs a building.

Figure 1.1: Building project as a temporary multi-organization (After Davidson, 1988)

In a building project, the formation of the building team is progressive, from the time the building owner makes an initial contact directly (or through a representative) with the first party whose services he or she requires (usually, the architect) until the last specialist subcontract is signed. Thus although a large number of task-organizations are involved at some time or other, or for some period or other while the building project is being carried out, not all are involved in the process simultaneously (Mohsini and Davidson, 1991).

Thus in management and in legal terms, the organizational structure of the building process is temporary and multi-organizational in nature. Task-organizations establish links with each other on a project-by-project basis; the procurement strategy and the contractual relations chosen by the owner govern these relationships. Although the different task-organizations come together to form a "project team", they are in fact necessarily fundamentally independent of each other. The consequences of the decisions that they make are interdependent (even if the decisions are actually made independently) and, if not in harmony with those of other participating task-organizations, can disrupt the working of the project, hence creating a management problem (Davidson and Mohsini, 1987).

1.3 BUILDING PROJECTS AS TEMPORARY MULTI-ORGANIZATIONS

While temporariness is a common characteristic of any project organization by its nature (since projects are defined in terms of a start date, a lapse of time and a finish date), the multi-organizational characteristic is, as has been mentioned, specific to building project organizations[3]. Each organization participating in the building team is itself an independent organization, with its own objectives, long-term plans and so on (Davidson, 1988; Mohsini and Davidson, 1986).

[3] Some of the entertainment industries (e.g. film-making) also possess some of these characteristics.

A temporary multi-organization thus has to reconcile the disparities between two levels of organizational objectives:

1. The "temporary" objectives of the organization responsible for the project;
2. The "permanent" objectives of each participating task-organization.

The first level of objectives in building projects is generally defined by the owner (where the term "owner" includes the consideration of the interests of the users and the affected community - even if this "consideration" is often only marginal). These "temporary" objectives are the requirements and the constraints that are imposed upon the project by the purchaser and by the environment within which he or she operates and within which he or she must build; the project organization is obligated to meet these requirements and accept the constraints.

The second level of objectives includes those that are typical of any permanent organization namely, survival in the marketplace, enhancement of its domain and its position in it, and so on.

Each of the task-organizations participating in a project is a permanent organization in its own right, and as such also has its own permanent organizational objectives. However, once it becomes part of the project organization, the independent organization has to undertake to confine, to a certain extent, the achievement of its independent objectives in order to respect the project's system of objectives (the first level objectives). Thus, the degree to which these second-level objectives are met depends largely on the relative bargaining power of the firms within the project organization, and on the extent to which the disadvantaged organization may or may not be able to meet its survival objective, possibly even abandoning its role in the project organization and jeopardizing the first-level objectives of the temporary organization as whole (Mohsini, 1992).

A project organization that is mandated to serve the interest of the client, and hence is committed to fulfilling the first-level objectives, must create an environment that minimizes the risk of individual participants failing to meet their own objectives adequately; in other words, the mode of organization must bring under control, as far as possible, the disparity between the project-level objectives and the participant-level objectives.

As result, a situation that requires joint decision making is transformed into a kind of contest to claim greater bargaining powers, and all this despite the abundance of precedents, both in practice as well as in the literature which suggest that, in situations where interdependence exists, the combined returns of all task-organizations that seek to maximize their separate return functions is less than the joint returns in situations where the task-organizations are willing to coordinate their actions under a super-ordinate objective. This situation is known in management terms as "inter-organization conflict".

1.4 PROCUREMENT STRATEGY - A CONTRACTUAL FRAMEWORK

As most buildings are normally purchased before they are designed or built, their acquisition cannot be based on the familiar methods of evaluating and selecting off-the-shelf products. Instead, a building owner has to identify and systematically compare the various procedures that he or she can set in motion to obtain his or her building. Furthermore, as the building owner has to deal with an industry that is often described as a multi-industry, referring to its unique characteristic that on any project a large number of task-organizations are brought together, he or she is going to have to deliberately integrate these specialist organizations into a building team through a process of organizational design. This process of strategic decision making (or procurement) refers specifically to the sequence of decisions and/or actions that the client must envisage as soon as he or she contemplates acquiring a new facility.

These procurement strategies establish the contractual framework that will determine the nature of the relationships between the various participants in the project

team, together with the timing and duration of their interventions. Legal contracts merely translate these strategies into the rules governing the relationships, rights and responsibilities of each party.

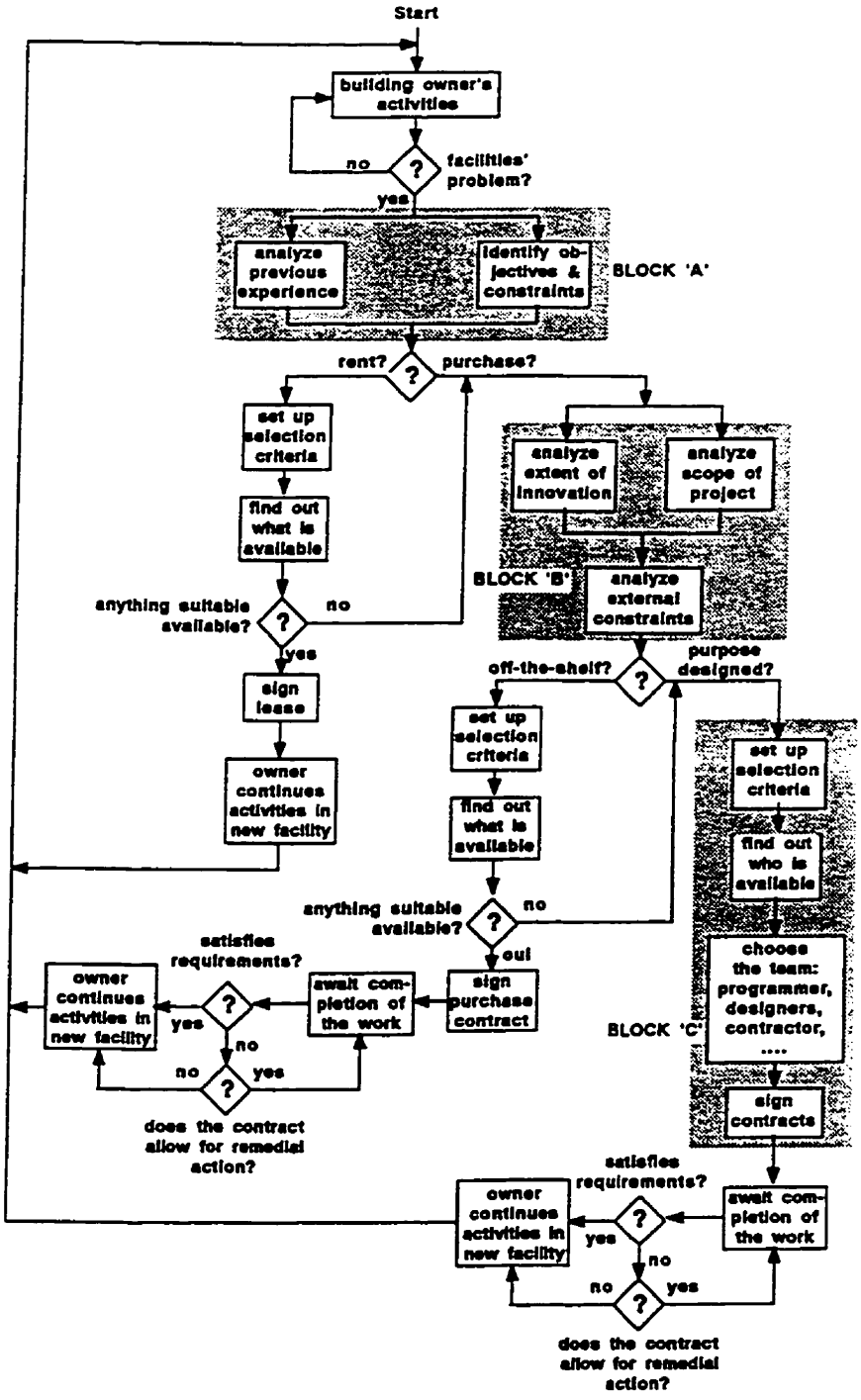
Given the multi-organizational nature of the project organization, these different procurement strategies correspond to the many possible forms that the relationships between the different independent organizations can assume, the extent of the bargaining powers allowed to each of them, and, by setting the timing, the degree of uncertainly within which they must operate. Thus, selecting a procurement strategy is, in fact, equivalent to a strategic decision, taken by the owner, to decide how the building process is to be organized and, by implication, how well it will perform. The procurement process usually involves four stages (Mohsini and Davidson, 1991, see Figure 1.2):

Stage 1: The owner makes the strategic decision whether to purchase, to lease the required facility or to commission a purpose-built facility. This decision is based on the owner's objectives and constraints as well as on the market availability of this type of facility.

Stage 2: If the commissioning of a purpose-built facility option is selected in the first stage, then the question of organizing the building process is addressed. The bespoke nature of the building project (the building being purchased before being built) represents a challenge to determine the most appropriate way of organizing the process to fit the particular needs and constraints of the project.

Stage 3: In the third stage, a project organization is actually assembled in accordance with the dictates of the selected procurement process.

Stage 4: In the fourth stage, the project is developed through the various phases of design and design development, and the owner awaits the end of the construction for the project to be delivered and ready to be occupied.



(Blocks 'A', 'B' and 'C' represent the procurement path)

Figure 1.2: Building procurement - a strategic decision (Mohsini and Davidson, 1991)

Since most clients are generally interested in acquiring only a specific type of constructed facility, they should be aware of the critical problem posed by the second stage of the procurement process (i.e. to be able to determine the most appropriate way of organizing the building process). Some clients require periodic acquisition of new facilities whereas others only require one once in a long while and may not be so conversant with the various contractual alternatives (Hendrickson and Au, 1989). One client project manager interviewed stated that, "there are something like 137 different standard conditions of contracts; it is difficult for a client to keep up with the advantages of each one" (Gardiner and Simmons, 1992). Thus, the building owners must have at hand some systematic selection procedure to guide their choice. To guide in making this decision, information about how different task organizations fare under different procurement strategies should be forthcoming.

1.5 PROCUREMENT - A RANGE OF PROCESSES

For a long period of time, the traditional (design-bid-build) process has been the most common form for building procurement. In this process, the owner appoints consultants for design and cost control, then later selects a main contractor to carry out the work based on an agreed upon fee.

In its landmark report, "Interdependence & Uncertainty: A Study of the Building Industry" (Crichton (ed.), 1967), the Tavistock Institute contended that the traditional process of construction is a closed loop system. The flow of information takes place in only one direction without any feedback to the initiator of the previous phases. Thus while design effects scheduling, scheduling cannot effect design. This uni-directional flow causes many of the woes of the industry. Each individual organization closely guards its experience and its expertise, and does not want to share them with competing organizations.

The traditional (design-bid-build) process of construction has also been found to be inadequate in dealing with the growing complexity of the techno-socio-economic

environment of the building process. The Tavistock report suggested that a system with proper feedback and adequate sharing of information was needed by the industry, and that unless such a system was developed, the building industry would have difficulty in evolving to meet changing demands on its services.

Other negative factors that are characteristic of the traditional building procurement processes (and which are bringing pressure for change) include (Barrie and Paulson, 1992; Masterman, 1992; Mohsini, 1985):

- Inadequate project briefing;
- No overall coordination;
- Separation of design and construction;
- Remoteness of manufacturer from the building process;
- Increased size of projects;
- Changing owner profile;
- International competition;
- The changing socio-economic environment.

They all suggest the opportunity of developing alternate procurement processes.

The procurement of building projects by means of non-traditional methods is a growing trend; the switch to these non-traditional project procurement practices is frequently advocated due to their promise of higher productivity in the utilization of resources (materials, equipment, labor, money, time, and management) than is possible under the traditional method. In reality, however, each of these alternative procurement methods attempts to address a particular set of problems and, in a world of trade-offs, ends up introducing some problems of its own. Furthermore, since the extent or the nature of the relative advantages and disadvantages of each procurement strategy are sparsely studied and hence are largely unknown, the selection of one over the other is almost entirely based upon subjective data and claims (Barrie and Paulson, 1992; Tatum, 1986; Havilland, 1976; Glover, 1974).

Today, when the owners decide to acquire new buildings to meet some specific needs through a process of designing and construction, a complex procedure is set in motion. They are faced with a large number of plausible project organization forms to choose from. They might wish to remain with the traditional form of procurement or choose one of the more recent forms such as design-build, construction management and their variants (turnkey, project management, etc.). Therefore, the owners have to be very knowledgeable (or have good advisors) to be able to make the right decision and select the process most suited to their requirements.

This proliferation of the different ways of organizing the building process has, in turn, raised the question of comparing these processes and finding the best fit between what they can deliver and the particular requirements and constraints of the building owners. A number of authors have addressed this particular problem and have produced recommendations, mostly of a qualitative nature, to guide the building owner through the maze of available options. Their shortcomings, however, lie in the fact that searching for a basis of comparison poses a problem of its own as different procurement strategies may be analyzed and compared in many different ways. For instance, a survey of recent literature on this particular problem shows that different project-procurement strategies can be described and compared in many different ways, for example (Mohsini, 1993):

- In terms of the sequence in which building procurement options (design-bid-build; design-build-bid) are performed (Fazio *et al*, 1988);
- In terms of the dominant contractual framework (turnkey; design-build) which governs each one of them (Ibbs and Ashley, 1987; Naoum and Langford, 1987; Nahapiet and Nahapiet, 1985; Sidwell, 1983);
- In terms of the central control and integrating mechanism underlying each of the processes (separated and co-operative procurement

strategy; integrated procurement strategy and management-oriented procurement strategy) (Masterman, 1992);

- In terms of the organizational variables affecting the performance of the process, e.g., inter-organizational conflict, learning experience, construction methods, design approaches, and the organization forms they give rise to (Kumaraswamy, 1996; Tatum, 1989; Lansley, 1986; Mohsini and Davidson, 1986; Havilland, 1976).

Procurement strategies must be related to the priorities of the building owner (which is the most pressing constraint for him: cost? time? quality?). Each strategy is ideal for some aspects of typical client demand, whilst being weaker on others. No procurement path is best in all circumstances.

1.6 BUILDING PROCUREMENT - AN ORGANIZATIONAL PROBLEM

The very fact that buildings are sold before they are produced so that the usual methods of product appraisal, prior to purchase, cannot be applied to buildings causes serious problems to owners. The future building owners - once they decide that their building needs can best be met by designing and building a new custom-made facility - are faced with a large number of procurement strategies. The selection of the most appropriate procurement strategy (that meets a project's specific characteristics and constrains) should be based on the assumption that where a combination of project conditions and organizational form offers a higher expectancy that the permanent objectives of all participants will be met, there will be a lower potential for inter-organizational conflict and consequently higher project performance will be achieved.

Thus, the fundamental problems that a building owner faces can be summarized as:

a- How to achieve a quality product without the benefits of being able to evaluate it before its purchase?;

b- How to evaluate the alternate project organizational forms by which the building process can be organized?;

c- How to reconcile the long term objectives of each of the task-organizations with the short term objectives of the project and avoid inter-organizational conflict?.

d- How to avoid time-, money-, and effort-consuming disputes and claims?

Classical organizational theory focuses on the principles of how the internal organization of the "closed systems" firms function. It presumes that the task of the manager is "universal" and that the manager's duty should be centered on the best way to divide up the tasks within the organization and on the best way to obtain an integration of the parts of the organization itself. Classical theory assumes that the function of management should necessarily be separated from tasks of production, and that organizations should be broken down into departments or sections or work groups which are functionally independent. Thus, the classical organization theory only explains the performance of large permanent organizations (which are closed organizations) and does little to explain how the building industry operates.

Another argument for the failure of the organizational theory to address the specific problems of the building industry is that the temporary and multi-organizational nature of the building team is an additional contingency affecting the structure of the building team itself. In essence these two characteristics lead to a less bureaucratic and more decentralized structure - as time and coalition politics work against centralization - than would be foreseen using the Classical organizational theory.

Recent developments in organizational theory are at last recognizing that the closed system is not the only form of organization and there are other forms of organizations, which are equally valid in particular circumstances. Prior to 1967, the dominant question in the field had been ***"What is the single best way to manage and organize?"*** By introducing the "Contingency Theory of Organizations", the main concern changed to ***"What management style and organization form is suited to a particular situation?"*** More

specifically, the focus was on the fit between an organization and its environment (Lawrence and Lorsch, 1986).

The "Contingency Theory of Organizations" proposed by Lawrence and Lorsch (1969) suggested the existence of a continuum of organization types, ranging from strict, authoritarian, a-personal organizations in a stable environment, to work groups bound together only by a degree of communality of objectives in a rapidly changing environment. Lawrence and Lorsch claimed that the more different the patterns of thought and behavior of the individuals who are required to work together, the more difficult it is for them to achieve an integrated effort. They also recognized that in order for the tension to be resolved, formal differentiation between the individual activities and organizations was an essential requirement for high performance, provided that - thus differentiated - their actions are somehow properly integrated depending on the environmental conditions and requirements of the task. Thus, there exists a continuum of organizational types with *closed systems - stable environment - defined task* at one extreme, and *open systems - unstable environment - undefined task* at the other.

It is interesting to note that the shift from traditional building process to alternative building processes was timely and coincided with the shift in the paradigm of organizational behavior.

Miller and Rice (1967) argue that the reasons for the present poor performance of the building project organization are, firstly, the lack of integration between the individual organizations and, secondly, the fact that the considerable differentiation between the individual members of the building process has only a reduced impact because the boundaries that accompany the differentiation are both ill-defined and wrongly situated. One can add that the increase in the complexity of building projects and in the interdependency of task-organizations have led to more informality and flexibility in the project control mechanism.

Social and technological changes have undermined the traditional organizational boundaries, and the informal practices that have grown up in response to the demands of reality have blurred the formal boundaries. As a result, there is a situation of uncertainty. Miller and Rice claim that unless a boundary is adequately located and clearly defined *as to its nature as well as its location,* different people will draw it in different places and hence there will be confusion between "inside" and "outside". In the case of an individual, this confusion leads to anxiety; in the case of an enterprise, to inefficiency and failure. They suggest that there is a need to redraw the organizational boundaries of the building process so that, if possible, the formal boundaries coincide with the administrative interfaces.

These formal boundaries between the different organizations in the building process are defined by the contractual arrangements; consequently by changing the contractual arrangements one can effectively alter the position of the organizational boundaries, which in turn alters the organization of the building process. This is for the obvious reason that the contractual arrangements are the principal integrating device of the building process, formally linking together the different organizations involved in the project. By introducing changes in the contractual arrangements (i.e. through the procurement strategies, which are the strategic decisions taken upstream and represent the framework of the contractual arrangements) it should be possible to increase integration, improve the definition of the differentiation and therefore improve the performance of the building process.

For the purposes of identification and communication, it is necessary to adopt a term to describe this organization. An examination of past research and literature reveals that phrases such as "building procurement method", "procurement form", "procurement strategy", "procurement process", and "procurement path" have been used by various authorities when referring to this concept (Masterman, 1989; NEDO, 1985; Bennett, 1985).

Franks and Harlow (1990) describe "the amalgam of activities undertaken by a owner to obtain a building" as a "building procurement system" and an examination of definitions of the last two words of the phrase confirms that when joined together, they relate to the organizational structure used to acquire a product, in this case a building.

The procurement process is seen as the interface between the building industry and its owners. It consists of a set of strategic decisions taken up-stream for an individual project. Choosing an appropriate approach to procurement would allow better value for the building owner's money, by allowing the project participants to work as an effective team for design and construction. Hence a procurement strategy is seen as a *key set of decisions* (i) which must be planned for, and (ii) which requires the participation of high-level decision-makers. During the '70s and 80's, a wide spectrum of approaches to procurement was identified: systems' approach, performance specifications, design-build-bid, construction management, two-step plus footprint, etc. All of these approaches explicitly or implicitly emphasized inter-firm coordination based on continuity and shared responsibility.

In this research we shall adhere to the term "*Procurement Strategy*" since, as we have explained, procurement is a strategic decision taken upstream by the owner, governing all ensuing contractual relationships.

The procurement strategy is defined[4] as:

> *"The framework within which construction is brought about, acquired or obtained".*

[4] This definition was developed by the W92 (Procurement Systems) Commission of the International Council for Building Research, Studies and Documentation (CIB) at its meeting in 1991. In its meeting in Montreal (1997) it was recommended that this definition *should be extended to the whole life cycle of the procured facility.*

Thus, procurement is a "process" term which refers to the acquisition of new buildings or space within buildings either by: (i) directly buying, renting or leasing from the open market, or by (ii) designing and building the facilities to meet a specific need (Glover, 1974). **The research reported here deals specifically with an aspect of the second approach.**

Procurement strategies must be related to the priorities of the building owner (which is the most pressing constraint for him or her: cost? time? quality?). Each strategy is ideal for some aspects of a typical owner's demands, whilst being weaker on others. No procurement strategy is best in all circumstances. The way to determine which procurement strategy to use is to consider the priorities that the owner has for the particular project and to check them against the characteristics of each strategy.

1.7 CATEGORIZATION OF PROCUREMENT STRATEGIES

There is no recognized standard for categorizing procurement strategies, although several authors and bodies (Sharif and Morledge, 1994; Masterman, 1992; Barrie and Paulson, 1992; Franks and Harlow, 1990; Hibberd *et al*, 1990; NEDO, 1985; Franks, 1984) have developed their own.

In this research, we have favored Masterman's (1992) categorization since it focuses attention on the interaction between design and construction, which we perceive as the most critical issue in any building project.

Recent research (Barrie and Paulson, 1992) identified the following procurement strategies as the most popular project delivery options in North America: traditional, turnkey (including design-build and design-manage), owner-builder, professional construction management and program management[5] as well as several variants. These

[5] This procurement strategy is interchangeably called project management.

procurement strategies can be classified under three general headings: separated and co-operative procurement strategy, integrated procurement strategy and management-oriented procurement strategy, the categorization proposed by Masterman (Figure 1.2).

1. ***Separated and co-operative strategy***: where the responsibility for the design and construction aspects of the project are the responsibility of separate organizations (separate design and construction teams). Within this strategy, the variants provide scope for the two teams to be brought together at an early stage so the construction team can contribute to the design process. In North America, the main variant in this strategy is:

   The traditional procurement strategy: where a designer (architect, architect/engineer or engineer) is first employed by the owner to prepare the plans and specifications (with some responsibility of inspection or monitoring during construction), usually before the constructor is selected. A single general contractor is the one who takes the responsibility of the construction and contracts the parts of the work to some specialty subcontractors. The subcontractors' legal relationships are with the general contractor directly.

   Several other variants exist under the traditional procurement strategy:

   The "*two stage selective tendering*" and the "*negotiation systems*" which are similar in that a limited number of contractors are invited to submit tenders on outline design information produced by the design team. Until this invitation, the design team's tasks have been the same as in the traditional procurement strategy. A contractor is chosen at this outline stage and becomes involved in evolving the detail design of the building. The contractor may make constructability suggestions based on his experience.

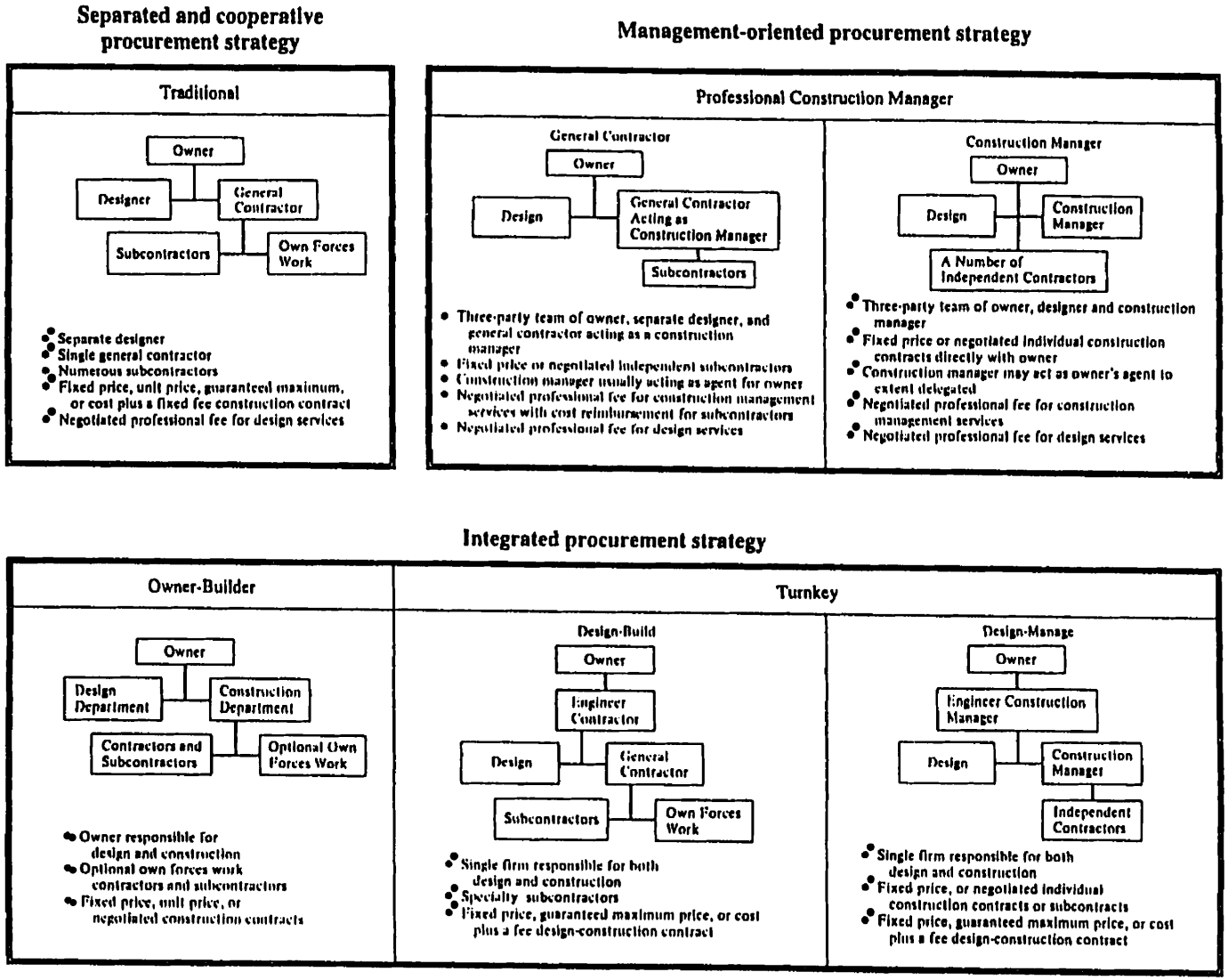


Figure 1.3: Categorization of building procurement strategies in North America (after Barrie and Paulson (1992) based on Masterman's (1992) categorization)

With "*continuity and serial contracts*" the initial project is carried out using the same procedures as in the traditional procurement strategy, the difference arises at the tender stage. A contractor who is successful on the initial project will be able to submit prices for future work on an on-going basis, assuming he performs properly.

The "*cost reimbursable contracts*" resemble the "*two stage selective tendering*" and "*negotiation systems*" except that the method of reimbursing the contractor changes. The contractor tenders on an outline design and then assists the design team to evolve the detail design.

The contract types (methods of payment) used under the separated and co-operative procurement strategy include single fixed-price or lump-sum contract, unit-price contract, negotiated cost-plus-fixed-fee contract, guaranteed maximum-price arrangement.

The traditional project procurement strategy is best suited for the project owner who values the familiarity of the standard form of contract documents and allocation of risks long associated with this method. The traditional project procurement strategy may also be preferable for the owner who has the time to allow for the project design to be completed before bidding and start of construction. An owner who also desires certainty of price associated with a completed design, as in the case of a public owner (who is also restricted to competitive sealed bidding procedures), would look to use the traditional method.

However, the separation of design and construction (both in terms of its phases and its participants) make the co-ordination and integration of the construction and the design a difficult issue.

2- ***Integrated procurement strategy***: where the design and construction become the responsibility of one organization, usually a contractor, and the owner has only one organization to deal with. In North America, several variants exist:

a) In the *"turnkey"* approach, all the phases of a project are handled by the same organization, other than the owner. It can be divided into " design-build" and " design-manage"; however, general usage treats the turnkey and the design-build interchangeably. In the case of design-build, the constructor acts as a general contractor with a "single-firm" control of all subcontractors. In design-manage, nevertheless, construction is performed by a number of independent contractors in a manner similar to the professional construction management concept.

Having the capability of using any one of several types of contracts, the turnkey approach has its own advantages and disadvantages. The type of contracts include fixed price (lump sum or unit price), guaranteed maximum price, cost plus a fixed fee, and cost plus an incentive fee.

The design-build project delivery method is useful for the project owner who does not desire to be extensively involved in the design and construction process, seeks a facility with state-of-the-art capabilities and requires performance-type guarantees from the facility. Also, a reduction of project time can be achieved using phased construction and incorporation of construction expertise into the design.

The major disadvantage is that the owner may not be aware of the weaknesses in the project completion, and he may not have a great control on design-construction integration and the schedule and costs (Barrie and Paulson, 1992).

The project performance may be subordinated under lump-sum or guaranteed maximum-price contract.

b) The "owner-builder" procurement strategy is generally characterized by the owner taking the responsibility of the construction process and building the facility with his or her in-house resources or alternatively through out-sourcing. The owner establishes some or all of the required (design and/or construction) resources for development of his or her project and performs some or all of his or her own design work and some or all of the construction with his or her own in-house resources. Many different contract types, as used in the traditional procurement strategy, may be applied in this approach.

The owner-builder project procurement strategy is best for those owners who are experienced, knowledgeable, have in-house capabilities and want to be significantly involved in the design and construction process.

The advantages of this approach may be considered more significant than its disadvantages; however, they may not be applied to any situation. Its application generally may be justified for projects which are relatively large and take a long time to complete.

In the "owner-builder" there is a high potential for a real integration of all aspects of the project since all the resources may be brought together easily. Moreover, the doer is the user. All the activities through the project development are done or managed through a single authority that is the owner. The proof of this claim is in the new trend of some successful construction companies turning, according to Barrie & Paulson 1992, into owner-builders, constructing apartment houses, office buildings and other rental or lease-back facilities.

3- ***Management-oriented procurement strategy***: where, the emphasis is placed upon overall management of the design and construction process in close synchronization with the design. The main variant in the North American context is:

"*Professional Construction Management*" (PCM): where all the activities in the project delivery process are treated as integrated tasks. PCM unites a three-party team (i.e. the owner, designer, and construction management) (Barrie & Paulson 1992). A construction Manager (CM) may be employed to provide construction experience services for the project. Alternatively, a General Contractor (GC) may act as the construction manger.

In this approach, there is potential to use different types of contracts. Usually PCM contracts with the owner will provide for full reimbursement of field costs, plus a fixed fee for home-office costs and profit (in the GC option); alternatively, in certain situations, home-office costs plus a fixed fee for profit only (in the CM option).

A project owner might select the construction management project procurement strategy because of the size and complexity of the project that necessitate added supervision and management. Also, if the project architect/engineer and general contractor are not willing to take on inspection and managerial roles, especially in the light of their expanding potential for liability, the owner may choose this strategy. The owner may also choose this strategy if the project time can be shortened through expert management and coordination, and if the use of fast-track/multiple-prime project variants necessitates that either the project owner or the construction manager manage and administer the project.

PCM has several advantages as well as disadvantages; it is considered competitive with the traditional approach (with a negotiated contract) and the turnkey approach in overall project delivery time (Barrie & Paulson 1992); however, using a phased construction may involve the owner in the risk of overrunning budgets.

PCM provides closer communication amongst the participants. The owner has an opportunity for full involvement in the project delivery process. He or she can use specialized construction skills, in addition to the CM's knowledge, at all phases of the project with no conflict of interests with the designer. The application of different management techniques to project performance improvement is also possible. Application of value engineering (in the design, bidding, and award stages) and a constructability program (in all phases of the facility delivery process) are considered as other advantages of this approach.

However, the attainment of success in the project is highly dependent on the CM's skills. The overall costs or quality may not be guaranteed by the CM option, in contrast with the GC option with a lump-sum contract (Barrie & Paulson 1992)

1.8 BUILDING PROJECT PERFORMANCE APPRAISAL

Building project performance is defined in this research as:

" The effectiveness of the process, throughout its duration, in utilizing the available resources to satisfy the building owners' requirements and activities and to meet their constraints; and which results in the maximum collective benefit to all the participants without resorting to exploitation within the prevailing environmental conditions".

In building projects, the term "Performance" is understood to involve all aspects of the building process; these are productivity, timeliness, safety, quality and risk. All these aspects are not mutually exclusive; each impinges on the others.

Most of the literature focuses on post-occupancy evaluation of building performance, rather than on project performance during the various phases of inception, design, construction and commissioning, which are the main concern of the current thesis research.

The central problem concerning performance appraisal is one of setting up the most useful feedback loop, so that evaluation findings can influence subsequent building projects as beneficially as possible. In the case of building projects, however, the strategic decision making rests with the owner whose decisions are concerned with the project as a whole and not with its phases or parts in isolation, however important they may be. Therefore, to be useful, performance appraisal must satisfy two primary conditions:

1. It must take place at the level of the project;
2. Its results must be expressed in a format that helps the owner (whether a repeat owner or a new owner) to optimize his or her strategic decision-making function in future projects.

Nowadays, a number of generic classes of arrangements governing designing and building have been developed, as we have discussed previously. These procurement strategies establish the nature of the relationships between the various participants in the project team, together with the timing and duration of their involvement. In due course, the procurement strategy decided upon will lead - without further high-level decision needed - to a set of contracts legally binding the participants to fill determined roles. Given the multi-organizational nature of the project organization (mentioned above), these different procurement strategies correspond to the many possible forms that the relationships between the different independent organizations can assume, the extent of the bargaining powers

allowed to each of them, and, by setting the timing, the degree of uncertainly within which they must operate. Thus, selecting a procurement strategy is, in fact, equivalent to the owner deciding how the building process is to be organized and, by implication, how good will be the *process* performance.

To guide in making this decision and at the same time to avoid inter-organizational conflict, two types of information must be forthcoming; they are obtained from the appraisal activity mentioned above:

1. Information about how different task organizations fare under different procurement strategies;
2. Information as to how the aggregated performance of all individual task organizations, under a particular procurement strategy, compares with the project-level expectations.

There appears to be general agreement in the literature on the performance appraisal of building projects, that post-occupancy evaluation of the building process is of little use. The results of such evaluation cannot be used to improve the performance of the building itself, since it is too late to improve the building process, even if better processes might have produced a better building, and it is too late to get any useful feedback. Several researchers have tackled this problem and laid the foundation for a practical methodology to evaluate the performance of building projects (Mohsini, 1992).

The work of three researchers (Mohsini, 1985; Havilland, 1981, 1976; Roberts, 1974 - all in a North American context) is now discussed in detail since they provide the theoretical background to this research.

1.9 PREVIOUS RESEARCH ON PROJECT PERFORMANCE APPRAISAL

In his seminal work, Roberts (1974) describes a pilot study to determine the feasibility of measuring building project performance from the point of view of all the participants collectively and suggests how project performance (which refers to the level of utilization of resources) can be improved.

Roberts used the broad definition of performance applying to the building process rather than to its products as the link between current organizational theory and its application to building project teams, thereby making comparison of different forms of project organization possible. Roberts concluded (i) that the performance of a building project is dependent upon how well the organizational form underlying the project's procurement process matches the owner's conditions and (ii) that it is possible to measure, in quantitative terms, the variables of project performance and to identify where performance loss has occurred, thus laying the theoretical foundation for the feasibility of a methodology for a project organizational design. Thus the scope of the owner's problem is reduced to one of choosing the optimum procurement system that ensures a well matched, dispute-free organizational form.

Haviland (1981) recognized that to better manage projects one has to look into their organization structures. Haviland's project acquisition model leads a building owner to the selection of the most appropriate project strategy by the use of a two-step approach to identify and screen feasible building projects' organizations. First, he listed the main determinants of project organizational forms (which he called *variables*) and the various states (which he called *options*) that each of these variables can assume. Second, applying a set of logical rules he identified 185 realistic project organization forms. Haviland's model, however, stops short of identifying the set of viable strategies for a given set of project conditions (i.e. *which single organizational form enables the highest performance to be achieved*?). The problem of selecting the optimum procurement strategy from this set of

viable ones remains unanswered, mainly because the model lacks a "**performance yardstick**" by which further evaluation may be achieved.

Mohsini (1985) introduced the possibility of using inter-organizational conflict to compare the performance of alternative project organizational forms. Mohsini focused his study on the traditional building process and found out that:

- In temporary multi-organizations, the independent task-organizations only induce conflict when prevailing conditions are such that their independent organizational objectives cannot be attained when performing their allotted task;
- The factors that influence the extent to which different conflict-inducing factors affect the performance of the project organization are:

    1. **Domain Consensus**: The greater the clarity of scope of participation and the degree of specialization the better the project performance;
    2. **Availability and access to information**: The more successful exchange of information the better the project performance;
    3. **Interdependence of tasks**: The greater the coordination and cooperation in dependent tasks the better the project performance.

Mohsini concluded that more precise knowledge of the determinants of inter-organizational conflict is necessary for designing high performance project organizations and for managing them efficiently.

To place Mohsini's work in its proper context, one has to understand and accept the "Inter-organizational Decision Making" school's theory showing that in inter-

organizational decision making situations - whether temporary or permanent - coordinated decision-making (i.e. where the task-organizations' *level* of achievement is prescribed within the *overall* project-level objectives) produces a higher level of overall performance, as compared to a situation where all individual task-organizations are allowed or encouraged to *maximize* their individual goals.

Within this framework then, maximizing the overall project performance means a high level of *coordinated* decision making, which in turn means attaining the lowest possible level of inter-organizational conflict (i.e. conflict between participating task-organizations).

1.10 SITUATION OF OUR RESEARCH

The building industry is changing very rapidly. Projects are becoming larger and more complex, costs are rising dramatically and unpredictably, shortages and uncertainties in the market place are demanding more responsive management, and the general level of difficulty involved in accomplishing even simple projects is growing at an even faster rate. Consequently, in this climate of increasing uncertainty and growing stakes, important strategic decisions cannot be optimally made on the basis of entirely subjective data. In order to reduce the risks and increase the efficiency of the building industry, therefore, more precise methods to measure the performance of alternate project procurement practices are urgently needed. The selection of a project procurement method is a strategic decision (Davidson and Mohsini, 1987)

Within all the available scenarios and variations in project procurement strategies, selecting the highest performing project organizational strategy still remains the highest priority for the building owner. This research builds on previous work regarding conflict, and investigates how, or whether, the level of project performance is reflected in the number and the extent of delay claims that impinge on projects under different contractual settings. Indeed, it can be suggested that project performance correlates inversely with the number

and the gravity of the sets of claims. More specifically, this research examines claims arising from delays and relates them to the available procurement strategies, particularly in instances where project time is found to be an important consideration for the building owner.

In other words, this research builds on the work of Mohsini by using "Time-related Claims" (or "Delay Claims") as the basis of measuring the level of cooperation or of conflict between the task-organizations in building projects.

The Meta-proposition here is:

> "Given that the greater the total amount of inter-organizational conflict in a building process, the lower the overall project performance, a project organization's overall performance is inversely proportional to the number of claims".

Thus the way building owners arrange to procure the building they need, directly influences the way the industry responds. If the owners want better value for money, they can improve the performance of their project through the wise choice of a suitable procurement process, long before the project starts; this is analogous to strategic decisions in organization theory.

1.11 CONCLUSION

In this chapter, we have discussed the nature of the building process and have shown the inherent difficulties that the owners face when choosing an appropriate procurement strategy to acquire a building project.

A three-part categorization of building procurement strategies (Masterman, 1992) has been discussed in detail and will be adhered to throughout this research.

The "Inter-organizational Decision Making" school's theory has been chosen as the framework of this research. The claims aspect of inter-organizational conflict, which has been shown in previous research to be dysfunctional to the performance of the building process, is proposed as this research's performance evaluation criteria.

Since a construction claim is in itself a manifestation of inter-organizational conflict, the proposition of this research is to investigate the suitability of using time-related claims as a measure of inter-organizational conflict. Linking the root causes of claims to the determinants of inter-organizational conflict provides a yardstick that can be used to assess the performance of the building process under different procurement strategies and advise owners accordingly.

In the next chapter (chapter 2), conflict (inter-organizational conflict in particular) is discussed in detail and is linked to claims.

CHAPTER 2:

CONFLICT AND CLAIMS

2.1 INTRODUCTION

To study the performance of different procurement strategies, one has to explore the inherent problems and identify the root causes of inter-organizational conflict that are manifested in disputes and claims.

Identification of some of the common critical factors affecting project success and failure, drawn from a number of building projects in which such problems arose, should give us an insight into the differences between different procurement strategies in this regard. By placing emphasis on strategic factors within different approaches to project procurement, it should be possible to identify those which most affect time and cost overruns. This would allow us to evaluate the performances of alternate building procurement strategies.

There is a considerable body of literature relating to the procurement of buildings (Griffith and Headley, 1997; Conlin *et al.*, 1996; Shirazi *et al.*, 1996; Winch and Campagnac, 1995; Masterman, 1992; Mohsini, 1992; Chappell, 1991; Winch, 1989; Skitmore and Marsden, 1988; Lansley, 1986; Mohsini, 1985; Franks, 1984; Havilland, 1981, 1976; Roberts, 1974, and many others). But none of them has yet been able to provide a "yardstick" to measure and quantify project performance under different procurement strategies for the purpose of advising or being able to advise owners as to which procurement strategy to adopt that best meets with their constraints and their project characteristics.

As far as research in time-related claims within the building process is concerned, there seems to be much less research reported in the literature. Several researchers have discussed construction claims from different angles: their causes, quantification, alternative resolution techniques and prevention (Havilland, 1996, 1995a, 1995b; Alkass *et al.*, 1993; Mazerolle and Alkass, 1993; Bubbers and Christian, 1992; Clark, 1990; Arditi and Patel, 1989; Heather, 1989; Brunies, 1988; Bramble and Callahan, 1987; Kraiem and Diekmann,

1987; Cobb and Diekmann, 1986, etc.) but, they did not address the possible effects of the process of building procurement on the likelihood of claims.

Recognition that a contract in the construction industry is used to pass risks on from owner to others is not apparent in the process usually adopted in the selection of a contracting strategy. Furthermore, the fact that such risks must carry a premium does not appear to be fully appreciated by owners. Both these facts tend to open the door to conflict.

2.2 CONFLICT IN TEMPORARY MULTI-ORGANIZATIONS

Gardiner and Simmons (1992) define conflict as:

> *"Any divergence of interests, objectives or priorities between individuals, groups, or organizations; or nonconformance to requirements of a task, activity or process"*

They cite Handy (1983) who suggested five different situations in which conflict can arise; these are:

- Formal objectives overlap;
- Role definitions overlap;
- Unclear contractual relationship;
- Simultaneous roles, and
- Hidden objectives.

The question of whether conflict is intrinsic in construction processes has attracted much attention recently. This attention was focused on the legal implications of the adverse impact of disputes arising from such conflict, particularly when they lead to litigation. Sykes (1996) passed on the wide spread notion that "claims" and "disputes"

are inevitable within construction relationships, while Hartman (1993) and Clegg (1992) showed that "construction contracts cause conflicts". They based their work on the assumption that "conflict" is inevitable in human relationships and, since all models of project organizations attempt to regulate the relationships between individuals as well as between organizations, "conflict" is inevitable.

However, a difference should be made between constructive form of conflict (which stimulates better solutions for a problem through the interaction of ideas - and should be promoted) and destructive conflict (which could lead to serious disputes and damage to relationships - and is best avoided) (Rhys Jones, 1994; Mohsini, 1985). It is useful to note that some claims are necessary (for example to allow for changed conditions that require extra work), while others may be avoidable.

Given the many competing interests and rapidly changing scenarios in the building process, which, as we have pointed out, is distinguished by its multi-organizational nature and temporariness, it is reasonable to consider conflict to be 'congenital'. However, it is worth investigating whether 'destructive conflict' leading to incapacitating disputes (e.g. unresolved claims) is merely endemic rather than congenital. For this purpose, it is necessary, as indicated by Fellows *et al.* (1994) to understand the underlying causes, rather than merely scan the surface symptoms of conflict. If it is then found that some specific causes of conflict may be minimized, it would be useful to design suitable strategies to reduce the destructive conflict that has plagued many construction projects. On the other hand, an investigation into and an identification of the 'contributors' to constructive conflict can help shape strategies that may shift the distribution of conflict occurrences from the construction phase to the planning and design phases. Constructive conflict at such earlier phases of the project may well lead to better solutions that help minimize changes, problems and destructive conflict later in the project (Gardiner and Simmons, 1995).

Thus, in either of the above two scenarios, conflict needs to be managed effectively in order to derive the potential benefits, as indicated by Hughes (1994). It is therefore crucial to investigate the root causes of conflict in order to minimize, if not avoid, claims and protracted disputes.

Diekmann and Girard (1995) described how a 'Disputes Potential Index' was developed in the USA, in order to predict the likelihood of contractual disputes on construction projects. While 'people', 'process' and 'project' issues were all found to contribute to such predictions, they concluded that 'people' were the most important factor to avoid contract disputes.

Conlin *et al.* (1996) noted a correlation between the 'type of procurement' and the types and frequencies of disputes, based on a UK study covering 5 procurement types and 483 dispute events.

While the choice of procurement strategy cannot be based merely on the potential to minimize unhealthy conflict and disputes, this can be incorporated as one of the important criteria to be considered in selecting an appropriate procurement strategy. Conlin *et al.* (1996) indicated that both the choice and the implementation of the procurement methods currently used in the UK construction industry had been shown to be one of the identified causes of conflict.

McDermott and Quinn (1996) stressed the importance of sorting out the symptoms from the causes. This is not always easy, just as it is most difficult - for example - to argue whether the frequent involvement of lawyers in construction matters was itself a symptom or a cause of conflict. However, if conflicts from claims or other sources are not resolved, they lead to disputes which are considered as a detrimental drain to project resources, and should therefore be averted in full.

Since many conflicts in construction projects are manifested in claims for extra costs and/or time extensions, it appears worthwhile to examine the common root causes of claims and the disputes arising from them. Identifying the root causes of claims under different contractual frameworks (or procurement strategies) can help assess the performance of these strategies and provide owners with the yardstick they need and which was found to be lacking, if they are able to compare available choices of procurement strategies. Our research investigates the causal patterns of conflict in the North American building industry.

2.3 CONSTRUCTION CLAIMS

Goldsmith defined the word "claim" as "an assertion of a right to something" or "the demanding of something rightfully due to one".

A construction claim can be viewed as a request by a construction contractor for compensation over and above the agreed-upon contract amount for additional work or damages supposedly resulting from events that were not included in the initial contract. In theory, the request for the compensation becomes a claim only when the dollar amount of the claim is reflected by the other party either in part or in whole. The "other party" (i.e., the entity the contractor "claims against") is usually the project owner or the project owner's designer or construction manager

This view of claims is very narrow, as the reverse may happen (i.e. the project owner may claim a compensation from the contractor, and/or the subcontractor); thus the following definition is proposed:

> *" A contractual claim is a written notice from either party to the contract (owner/contractor) to the other party requesting a relief (i.e. an extension of time or additional payment) due to unforeseen conditions, or changes to the work or interpretation of the contract ".*

According to Statistics Canada (1994), about $94 billion were spent on construction projects in 1993, which amounts to almost 13.5% of the Gross Domestic Expenditure. Based on the Rose report (1991), a 20% increase in project cost is due to claims; this means that the annual cost of claims alone amounts to approximately $18.8 billion in the early to mid nineties, (incidentally, this figure must be compared to $10.8 billion in 1990 suggesting that there is an upward trend in the cost of claims). The American Society of Civil Engineers also corroborates this percentage of claims for the US building industry in the 1980s (The Gazette, 1992)

The increasing number of claims is likely to be due to:

1- *Increased complexity of the building process:* New technologies that have evolved and need to be incorporated in the project design; the owner's increased demands or constraints on the design of the project (e.g. environmental considerations, safety provisions) lead to a more complex design; interpretation of contract documents (drawings and specifications) has become very difficult since the designer cannot produce drawings and specifications that are definitive, precise and clear. Contractors might assume a certain set of production requirements when preparing a bid estimate, only to encounter a different set of conditions when performing the production. If the unexpected production process results in the contractor incurring substantial and unanticipated added cost, the contractor is likely to file a claim for damages against the project owner and/or his or her project designer.
2- *Uncertainties:* The fact that contract documents necessarily contain specifics and do not deal with uncertainties, in itself constitutes a potential claim problem, since at any time that deterministic solutions are imposed in an uncertain and unpredictable environment, an apparent conflict results.
3- *Quality of contract documents:* Contract drawings and specifications vary in quality and often contain vague or "legal jargon" terms, which induce claims.
4- *Economics of the construction industry:* Conflict occurs when profitability or performance is considered less than anticipated. The construction industry has had one

of the lowest increases in productivity in recent years [0.8% in USA compared to 2-3% increase in general economic productivity rates (Adrian, 1988)], where productivity is defined as:

Productivity = Units of dollars of output / Labor hours of input

Increasing the productivity does not necessarily mean getting a person to work *harder* (i.e. produce more output per labor hour of effort), but to work *smarter* (proper tools, more efficient work methods, minimizing work delays such as those caused by a project owner's indecisiveness).

The gap between increasing cost and flat productivity increases the number of disputes and consequently of claims. Other economic considerations impact on the economics of construction such as: increasing interest rates, increase in the price of raw materials, taxes, tariffs and local laws and regulations, all of which therefore increase the potential of disputes and claims.

5- *Changing project delivery strategies:* For a long period of time, the traditional process was used to procure building. It is characterized by the fact that the responsibility, liability and authority of each task organization involved in the process are quite distinct and well defined in the contract documents. The fact that these documents have been used for many years, have been tested in court, and are familiar to all parties results in a rather clear understanding between the parties as to the responsibility of each. This is not to say that there are not occasional misunderstandings between parties as to the interpretation of the contract or the responsibilities. Nonetheless, the repetitive use of the traditional contracting process and the use of standard documents have aided in keeping these misunderstandings to a minimum.

In the previous chapter, we have seen why owners are seeking new procurement strategies. Some of these new delivery systems add a fourth party (over and above the

project owner, the designer, and the contractor) to the project team, whereas others merely change the duties and responsibilities of each of the three main parties or entities.

These new delivery systems have gained in popularity faster than the accompanying documents have been *developed* and *tested* to support the process (i.e. no proper contract documents, documents still lacking in detail or completeness, even though the new systems have been repeatedly implemented in the last two decades)

The occasional use of the general conditions documents originating in the traditional process for the new alternate building processes has lead to confusion, overlaps of responsibilities and a lack of clear and specific definition of duties for each project team member, creating a high potential for dispute and subsequent claims.

2.4 CAUSES OF CLAIMS

A search in the literature has revealed some of the causes of claims in different countries. Table 2.1 gives a synthesis of these causes.

Table 2.1: Classification of common causes of conflict and claims cited in the literature

Authors	Country	Research findings
Kumaraswamy (1996)	Hong Kong	Top ten claims categories (ranked): 1- Variations due to site conditions; 2- Variations due to client changes; 3- Variations due to design errors; 4- Unforeseen ground conditions; 5- Ambiguities in contract documents; 6- Variations due to external events; 7- Interference with utility lines; 8- Exceptional inclement weather; 9- Delayed site possession; 10- Delayed design information Top ten causes of claims (ranked): 1- Inaccurate design information; 2- Inadequate design information; 3- Inadequate site investigation; 4- Slow client response (decisions); 5- Poor communications; 6- Unrealistic time targets; 7- Inadequate contract administration; 8- Uncontrollable external events; 9- Incomplete tender information; 10- Unclear risk allocation.
Havilland (1996)	USA	The A/E Management practices study conducted on behalf of CNA/Schinnerer (Professional Liability Insurers) indicate that clients are a very important ingredient in project success. The top 20 Claims starters or aggravators (ranked from 1 to 5, 5 being the most serious) include: 1- Site responsibilities are not clear and coordinated (4.10); 2- Client differences not resolved immediately (3.90); 3- Construction schedule, budget not tied to scope (3.85); 4- Client's project representative is inexperienced (3.74); 5- Clients have difficulty making decisions (3.60); 6- Key issues are resolved after agreement signed (3.56); 7- Project agreements are not well coordinated (3.46);

		8- High volume of change orders (3.39); 9- Client decisions are not systematically documented (3.35); 10- The client is a committee (3.31).
Semple et al. (1994)	Canada	Four common causes of claims (ranked): 1- Increase in scope; 2- Weather/cold; 3- Restricted access; 4- Acceleration. Six common categories of compensation (ranked): 1- Site overhead; 2- Loss of productivity; 3- Loss of revenue; 4- Financing costs; 5- Equipment costs; 6- Premium time. Six common contract clauses quoted in claims (ranked): 1- Delays; 2- Changes in schedule/Acceleration/Overtime; 3- Extra work/Change orders; 4- Responsibilities/Relationships; 5- Interdependence of the contractor; 6- Scheduling.
Hartman (1993)	Canada	Claims or Lawsuits are contract failures commonly caused by a difference in expectation between two parties to a contract due to one of three types of cause: 1- Unclear risk allocation; 2- Item disputed not covered by terms of contract; 3- Different interpretations of the contract by the two parties, resulting in misunderstanding of the work to be done, the quality standards to be met, the cost to be included - or not - in the contract, or the schedule constraints.
Langford et al. (1992)	England	Three variables influence the form and extent of conflict: 1- Ambiguity of role especially at boundaries (interfaces); 2- Interpersonal skills of key players; 3- Responsiveness to change.
Gardiner & Simmons, 1992 (after Handy-1983)	England	Five different situations in which conflict can arise: 1- Formal Objectives overlap; 2- Role definitions overlap;

		3- Unclear contractual relationship; 4- Roles are simultaneous; 5- Hidden objectives.
Hewitt (1991)	England	Six main categories of claims were identified: 1- Change of scope; 2- Changed conditions; 3- Delay; 4- Disruption; 5- Acceleration; 6- Termination.
Diekmann and Nelson (1985)	USA	A study of 427 claims on 22 federally administered project revealed ten factors in dispute development: 1- Poor management; 2- Adversarial culture; 3- Poor communications; 4- Inadequacy of design; 5- Economic environment; 6- Unrealistic tendering; 7- Influence of lawyers; 8- Unrealistic client expectations; 9- Inadequacy of contract drafting; 10- Poor workmanship.

From the above, it is quite evident that the owner's role is crucial to the success of the building project since the decisions taken by him/her at the onset are deterministic to the success of his/her project. Also, the three inter-organizational conflict-inducing factors - found by Mohsini to be detrimental to the building process performance - are observed at the base of all these claims, suggesting that these causes of claims can be grouped under the three general headings of inter-organizational conflict-inducing factors as follows:

- ***Domain consensus or scope of the project*** [e.g. ambiguity of role, changes in scope of work (alterations, additions or omissions), different interpretations of contract documents, unclear risk allocation, unforeseen physical conditions, etc.];

- ***Availability and access to information*** (e.g. late approvals, ambiguous documents, poor communication, late supply of information and drawings, delayed ordering of change orders or variations, etc.);
- ***Coordination*** (e.g. acceleration, disruption, problems in coordinating parallel as well as sequential activities, etc.).

This proposed categorization of the root causes of claims provides the possibility to link claims to the procurement strategies through the inter-organizational conflict aspect that was found by Mohsini (1985) to be deterministic to the performance of the building process.

Those involved in a construction problem quickly learn that it is not the hard (or the nuts and bolts) dollars which are important, rather it is the time-related cost that lead to the huge damages that are often at stake. The owners with the late facility have all sorts of extra costs or losses with which to contend in a delay posture; the contractors suffer the added costs of stretch-out, escalation of wages and other costs, and the loss from their inability to focus management on new spheres of work. (Hohns, 1979)

In this research the causes of time-related claims (delay claims) and their impact (outcomes of claims) are proposed as the criteria necessary to evaluate the performance of the building process under different procurement strategies.

The "Inter-organizational Decision Making" school's theory that is chosen as the theoretical framework for this research recognizes the importance of solving the inter-organizational conflict aspect, through a better understanding of its root causes and a reconciliation of the long-term objectives of the task organizations and the short-term objectives of the project, to improve the performance of the project organization (as mentioned previously in chapter 1).

The claims aspect of inter-organizational conflict, which has been shown in previous research to be dysfunctional to the performance of the building process, is proposed as this research's performance evaluation criteria.

2.5 DELAY CLAIMS

In a recently reported pilot study (Semple *et al.*, 1994), involving 24 cases of litigated claims in Western Canada, 33% of the common contract clauses quoted in claims concerned delays. Other clauses were in the areas of scheduling (16%), independence of the contractor (16%), responsibilities/relationships (16%), extra work/change orders (25%), and acceleration/overtime (25%). It is interesting to note that taken together, delays, changes in scheduling, and acceleration/overtime (which also indicate changes in project duration), account for almost three quarters of the most common contract clauses quoted in claims.

According to Bramble and Callahan (1987), delays are defined as " **the time during which some part of the construction project has been extended or not performed due to an unanticipated circumstance**". Construction claims dealing with delays are among the most complicated and difficult to analyze. Delays do not occur in vacuum. Sometimes they are overlapping or "concurrent" delays.

Determining the origins of the delay and the impact on the job, and even more importantly the responsibility for the delay, can easily lead to conflict. This potential for conflict is heightened by the fact that some delays are compensable only by time extension. For others, costs may be recovered by the contractor. In still other cases, a contractor may have no choice but to accelerate and to pay for acceleration costs or later put in a claim for recovery of these costs. According to Rubin *et al.* (1983) delays can be classified as:

1- **Excusable delays** (unforeseen by the contractor)
   - a- Compensable (caused by owner)
   - b- Non Compensable (Force majeure)

2- **Non Excusable delays** (caused by contractor or sub-contractor), owner is entitled to delay damages.

Furthermore, delays can be classified at the activity level as follows (Kraiem *et al.*, 1987; Bramble and Callahan, 1987; Rubin *et al.*, 1983):

A-Independent delays (classic): Where each delay occurs independently of any other delay and has no effect on any other activity of the project. This kind of delay is easy to identify, assess its impact on total project duration, and apportion entitlement to the parties of delay (Rubin *et al.*, 1983).

B- Concurrent delays: Where two or more delays occur at the same time or overlap, and where each one separately impacts project completion time. Concurrent delays and their entitlement were classified by Rubin *et al.* (1983) as:

Excusable + Non Excusable ----> only time extension

Excusable Compensable + Excusable Non Compensable ----> only time extension

Excusable Compensable + Excusable Compensable ----> time extension + damage

The following table (Table 2.2) demonstrates this classification

Table 2.2: Concurrent delays and entitlement

Delay 1	Delay 2	Contractor's Entitlement
Excusable	Non Excusable	Only time extension
Excusable Compensable	Non Excusable	Time extension or delay apportioned between owner and contractor
Excusable Compensable	Excusable Non Compensable	Only time extension
Excusable Compensable	Excusable Compensable	Time extension and damages

C- Serial Delays: Where a series of delays are connected together, of similar or of different causes, the effects of a delay may be amplified by a following delay (Rubin *et al.*, 1983).

The legal basis for establishing the delay claim entitlement is based on whether the claim is:

Contractual Claim: Which falls within specific clauses embodied in the contract, typically ground conditions, valuation, variations, late issue of information, and delay in inspecting finished work.

Ex-Contractual Claim: Which has no specific grounds within the contract document but results from breach of contract, typically extra work incurred as a result of defective material supplied by the client.

Ex-Gratia Claim Which does not have a ground to exist in the contract or common law, but the contractor believes that there is a moral basis, e.g. additional costs incurred as a result of rapidly increasing costs.

As far as owners and contractors are concerned, the kinds of situations coming under the above heading are generally concerned with:

- Changes in scope of work (alterations, additions or omissions);
- Unforeseen physical conditions;
- Supply of information and drawings;
- Variations;
- Problems in coordinating parallel as well as sequential activities;
- Delays and disruptions.

In general, contractors claim for extension of time and when entitled, claim for extra money including direct profits. It is important here to give our definition of time extension and impact costs.

Time extension: is the justified, quantified, and entitled period of time accorded to the contractor to finish the delaying (or delayed) work.

Impact costs: are not direct costs of changed and altered work, but rather, additional costs incurred in the performance of work affected by the delays and disruptions (Leonard, 1988). Impact costs can result from a number of construction problems, including: change orders; late and inadequate supply of information; late delivery of owner-supplied equipment and/or material; poor scheduling and coordination; changed subsurface conditions; labor disruptions; acceleration; restricted access to site; contractors' inefficiencies.

For the purpose of quantification, impact costs may be broadly classified into two categories:

1- **Time related:** are those costs mainly associated with extended duration.

2- **Productivity related:** are those costs resulting from productivity losses. Productivity losses can be defined as "the decline in labor efficiency due to specific causes from the level which could have been achieved except for the cause(s) under examination".

2.6 PHASES OF DISPUTE RESOLUTION

The procedures for the resolution of construction disputes are almost certainly outlined in the contract document. As disputes tend to be the rule rather than the exception, a growing perception by all parties of the drafting organizations responsible for standard forms of contracts is to strongly recommend providing clauses pertaining to their resolution at the earliest stage.

Practice shows that when any party to the contract feels that he/she is entitled to a relief from the agreed-upon contract due to unforeseen conditions, changes to the work and/or interpretation of the contract, he/she will notify the other party in writing outlining the entitlement, the extent of damages and their claim adequate relief.

A five-phase sequential process is common in the dispute/claim resolution:

1- **Architect's/Engineer's decision**;
2- **Negotiations** to reach an amicable settlement;
3- **Mediation**, where a third party acceptable to both parties is involved to help the parties reach an agreement;
4- **Arbitration**, where an arbitrator or a panel of arbitrators is chosen by both parties in accordance with contract dispute settlement arbitration clause, or appointed by the Dispute Review Board (DRB) in case of failure to reach an agreement, after strict adherence to contract clauses on claim submittal and times associated with it;

5- **Litigation**, where a judge or a jury are involved either as part of the contract dispute resolution requirements or in cases where not called for by contract but on the basis of proof of fraud, corruption or gross negligence on the part of the arbitrator(s) (where binding arbitration is stipulated in the contract).

For this research, we have chosen to consider only the cases which went to litigation since they represent the worst case scenarios, have the highest cost of resolution and are well documented.

2.7 SOME THOUGHTS ABOUT CLAIMS

Revay (1992) demonstrated that the likelihood of disputes (and/or claims) developing on most construction projects today is great, if for no other reason than because the language of the usual construction contracts is seldom so clear as not to leave room for disagreements. More importantly, the owner's ill-advised attitude of trying to save money, at the wrong end of the project, by shifting more and more risk and responsibility onto the contractor (or supplier) and a similar approach by contractors towards their sub-contractors are clear invitations to disputes. But the acknowledgment of the likelihood of disputes occurring on most construction projects need not force us to accept that they are inevitable.

Conflict management does not start when the dispute first raises its ugly head, rather it begins with the selection of the philosophy of contracting that could eliminate (or at least reduce) potential areas of disputes.

Even a cursory examination of trade journals and seminar brochures proves that today we are more interested in finding a cure for the symptom than for the disease. The following is a synthesis of the general perceptions of practitioners of claims as observed by the author:

1- The scenario for construction claims is invariably written right into the contract documents. Long before men and machines reach the job site, conditions for claims and disputes have often been signed by both parties. This happens, for example, when plans and specifications are incomplete or defective. More commonly, it happens when construction contracts are ambiguous, overly restrictive, or unfairly allocate particularly burdensome risks to one party alone.

2- The frequency and significant dollar impact of claims on a construction project establish the need for all entities involved in the construction process to be knowledgeable about the prevention and preparation (or defense) of claims.

3- Every construction claim entails two issues: **liability** and **financial damages.** The liability issue centers on such issues such as whether the work was performed according to specifications or whether individuals or firms performed their required duties. On the other hand, the financial damage issue centers on the quantification of alleged financial damages caused by the event that initiated the claim. While the liability issue usually centers on principles of law, the damage issue in great part is dependent on the use of topics such as accounting, productivity measurement and scheduling. The contractor's ability to prove and win his claim is dependent on his proving liability ***and*** damages, while the project owner can usually defeat a contractor claim by disproving the liability ***or*** damages. As such, knowledge of the quantification of damages as well as the liability is essential to the prevention, preparation or management of claims.

To date, the majority of the literature on construction claims has focused on the liability issue. Much of the literature recites case law passed down by courts or arbitrators who have ruled on various claims. To better administer construction claims, one has to deal with the quantitative issues which, coupled with a sound legal background, serve as a basis for preparing, defeating, or reducing and or preventing construction claims.

4 Delayed claims settlement provides little or no assistance at all in maintaining a healthy cash flow or bonding capacity. Prompt settlement of contract claims often means **survival** for some contractors, and the **avoidance of significant loss** for others. Failure to settle a claim usually results in a long, arduous and costly litigation process for all parties. The substantial **expenses** for witnesses, travel, transcripts, and attorneys' fees; the effect of **inflation**; and the fact that government - more than individual owners - pays no interest on claims, all of which reduce the ultimate benefits obtained from a favorable award[1]. Any attempt to reduce the gravity of this situation in advance should start from early stages of the project.

6 Site personnel should be trained to measure performance actually demanded against the performance standards of contracts. Adherence to the phrase "When all else fails, read the contract" leads to poor performance and often the waiver of one's rights to seek an equitable adjustment for extras

2.8 SOME LEGAL IMPLICATIONS

In any unresolved dispute, the owner suffers at least increased financing costs and in a commercial project, delays in the commencement of cash flow from the project. The contractor may be subject to increased labor, material, or equipment costs, increased overhead and an inability to proceed on to the next contract.

Due to a lack of any means for choosing an appropriate procurement strategy, which establishes the contractual framework of any project, owners have attempted to ensure the inclusion of various disclaimer clauses respecting damages for delay in the construction

[1] ASBCA (Armed Services Board of Contract Appeals) statistics in the United States show that the average time between (a) docketing a contractor's appeal from a contracting officer's decision, and (b) issuance of decisions by ASBCA is about 11 to 12 months. Cases appealed to the court of claims (following adverse board decisions) often are even longer, sometimes requiring several years before decisions. Then, too, there is always the risk of loss present in any contested trial; for example, about two-thirds of the approximately 900 cases a year docketed by the ASBCA are disallowed. (from Preparing Construction Claims For Settlement - by Overton A. Currie *et al.* Briefing Papers, 1990)

contract, leading to more confusion, since, in any legal situation, case law has established the following principles to deal with such clauses:

- If the contract is incomplete in the sense that it does not provide for every eventuality, then it will be presumed that the parties intended to adopt as implied terms the basic legal principles applying to the case, if any; or custom and practice, including those of the business or milieu involved;
- If there is no doubt about the intentions of the parties and if the contract is clear and plain, it will be interpreted in its clear and plain sense and its words will not be twisted or "interpreted". This principle of giving effect to the plain meaning of a contract is often called the golden rule of construction;
- An ambiguous clause is to be interpreted in such a way as to have effect rather than no effect;
- The ambiguous contract is interpreted against the person who drafted it (Contra proferentum);
- The person relying upon the clause bears the burden of proving that the facts of the case fall within the clause;
- The clause will not exempt liability for negligence unless express words are used.

2.9 PROCUREMENT STRATEGIES AND CLAIMS

In an attempt to link procurement strategies to delays and associated claims, a review of the literature was conducted. It was found that although there is a current trend to deal with claims and alleviate their impact on the building project, two approaches exist, namely: the *analytical* and the *preventive* approaches.

First approach (Analytical approach):

To assess claims after the fact (i.e. after a dispute remains unsolved and a claim is filed), and advise different parties to the claim (owner / contractor /

architect or engineer) on the liability and financial damages issues so that each party knows where it stands and acts accordingly before entering in the arduous procedure of litigation. Decision making tools were developed including expert systems, computer integrated systems for claim analysis, etc. (Tribaldos, 1994; Alkass *et al.*, 1993; Mazerolle and Alkass, 1993; Bubbers and Christian, 1992; Mazerolle, 1992; Alkass and Harris, 1991; Alkass and Mazerolle, 1990; Clark, 1990; Arditi *et al.*, 1989; Heather, 1989; Brunies, 1988; Bramble and Callahan, 1987; Kraiem, 1987; Cobb, 1986; Hart, 1980).

Second approach (Preventive approach):

To look for better ways to write construction contracts and modify the wording of existing contract clauses (Semple *et al.*, 1994; Hartman, 1993).

Regarding assessing the building process performance, while the first approach hardly touches the issue, the second approach stops short of tackling the real cause of delays which can be found in the procurement strategy, since, as we have pointed out, ***it is the procurement strategy which establishes the contractual framework for any project so that the contracts merely translate these strategies into the rules governing the relationships, rights and responsibilities of each party***.

The procurement strategy also sets the framework for project-related authority and general responsibility assignments. The construction contracts further expand and define this authority and responsibility among the organizations involved. They follow the pattern of the procurement strategy by assigning roles and responsibilities to those who will be operating under contractual relationships. In addition, because a procurement strategy implies a general scope of work for each participant, the construction contracts must clarify and communicate the details of that scope. Construction contracts are the tools by which an owner implements the specifics of its procurement strategy.

The intense search in recent years to find ways and means to abate, if not entirely eliminate, the adversary atmosphere which plagues so many construction jobs is perhaps the most powerful demonstration of the problems facing the industry.

We believe that the need to resort to such extreme actions as litigation or arbitration demonstrates a failure of the contractual process rather than an adjunct to the process. Since the building process - in our opinion - is characterized by two distinct features: 1) it is a circular process, and 2) it is a slippery process, any attempt to control this process should use the "frontal navigation" approach, setting the control from the outset and, hopefully, eliminating undue problems along the way. One way of doing just that is to select an appropriate procurement strategy that is known to be associated with minimum delays and disruptions.

Accepting the fact that there is no one procurement strategy (or organizational profile) suitable for any type of project, because of the unique features of each building project (site, requirements, timing and so on), it can then be suggested that each strategy should be evaluated in the light of each project's specific characteristics.

While the choice of a procurement strategy cannot be based merely on the potential to minimize unhealthy disputes and litigation, this can be incorporated as one of the criteria to be considered when selecting an appropriate procurement strategy. Selection criteria may include:

1- Project characteristics:
   - a- building category (residential, commercial, etc.) and type (e.g. house, school, library, etc.) to give an indication to the square-foot cost ;
   - b- project location;
   - c- project complexity;
   - d- legal and environmental constraints.

2- Owner characteristics:

a- type of owner (private or public);

b- degree of sophistication;

c- desired degree of control;

d- risk sharing profile.

2.10 CONCLUSION

This research is based upon the assumption that for an owner to achieve a quality project that fulfills his/her objectives, inter-organizational conflict/disputes have to be avoided, or at least minimized. Earlier research has shown that inter-organizational conflict is affected by the procurement strategies and has an impact on the project's performance (Mohsini *et al.*, 1995; Mohsini and Davidson, 1991; Davidson and Mohsini, 1990, 1987; Mohsini and Davidson, 1986; Mohsini, 1985). Since construction claims are in themselves a manifestation of inter-organizational disputes and since their root causes are observed to be similar to the inter-organizational conflict-inducing factors, they are assumed to be the result of the selection of an inappropriate procurement strategy. This suggestion remains to be explored and verified during the course of this research.

To undertake such a research, one has to look into: frequency of claims, their dollar amounts, and the time lost in settling them; then one must establish a link between these variables and the different project procurement strategies, without losing sight of the owner's objectives. One should be able to determine which strategy leads to an increased likelihood of delays, or is associated with longer periods of delays, or has a higher financial impact on the project. Then, it would be possible to develop a mechanism that selects a suitable strategy so that those claims that have a negative relationship with the owner's particular objectives are avoided or minimized from the onset.

As far as we are aware of, this is the first study in North America which looks into the relationship between different project procurement paths and delay-related claims and attempts to quantify it.

All facts were obtained from historical data, since cases were drawn from case law, which represents facts-based judgement and is not biased by subjective opinions.

It is hoped that the results of this research will provide owners with suitable benchmarks for assisting them in assessing the risks associated with a particular procurement strategy, as well as creating an increased awareness among them of likely causes of disputes and their frequencies.

This research is, therefore, intended to partially fill the gap in the available knowledge of the sources, causes and effects of conflict in the North American construction industry. Such an investigation into, and identification of the "contributing causes" to conflict, can help shape strategies that may minimize conflict occurrences in the first instance.

In the next chapter (chapter 3), the choice of the research strategy and methodology is explained and the research variables are discussed.

CHAPTER 3:

RESEARCH METHODOLOGY

3.1 INTRODUCTION

The concepts of "inter-organizational conflict" and its link to "Project organization design"; and that of "claims" as a manifestation of "inter-organizational conflict" have been discussed in the previous chapters and suggest that project process performance may be revealed by the number, severity and recurrence of "Time-related claims". "Time-related claims" are identified from "case-law". The analysis of case-law provides data that will enable the relationship between the above concepts to be explored as well as providing an in depth understanding of the causes that give rise to conflict under different project procurement strategies.

An examination and discussion of social science research strategies for experiments, surveys and case studies suggests that the latter two strategies provides the necessary high level of inter-related detail required to meet the needs of this research. An explanation is given as to how the cases were identified and selected from adjudicated claims. The research hypotheses are stated and the strategy for the research is developed, considering the data that needs to be collected to support the stated propositions.

3.2 THE NATURE OF RESEARCH

Research is triggered by an observation of a particular problem that needs to be investigated and requires a solution to be found. The normal sequence of any research is to learn more about the facts that surround the problem and adopt an adequate research strategy that, when implemented, will contribute to its solution. The role of the researcher is to use the "corpus of knowledge" and chose an appropriate methodology that enables him or her to understand and contribute to the solution of the problem. Any research has stated limitations and should always conclude with a discussion based on actual findings, possibly leading to suggested future work in the field under study.

The existing literature in the field (established knowledge) and the researcher's experience (acquired knowledge) are major aids in determining the research questions and suggesting the most fruitful areas to consider. Indeed, Zikmund (1994) defines research as: "*The systematic and objective process of gathering, recording and analyzing data for aiding making decisions*". Zikmund further observes that "re-search" literally means to "search again", which suggests that part of the process is to review a problem from a different perspective. We perceive research as the production of new knowledge or as a new way of organizing and/or applying existing knowledge. Therefore, it is fundamental to pose the right research question since it possesses many features that predetermine the nature of possible answers.

Phillips and Pugh (1994), as cited by Walker (1997), provide six criteria for recognizing a well-developed research project:

1- The work says something useful and novel (original) that the research community wishes to hear;
2- The researcher has demonstrated a command of current knowledge and an astuteness in identifying gaps in current knowledge of the chosen research field;
3- The researcher has demonstrated a grasp of research techniques and their limitations;
4- Research results have been effectively communicated;
5- The research work has been carried out in an international context so that a grasp of current worldwide knowledge has not been confined to a national or a local debate.

Furthermore, these authors provide some useful guidelines on the definition of originality of work within this context. These guidelines include:

1- Carrying out empirical work that has not been done before;
2- Making a new synthesis that has not been tried before;

3- Making a new interpretation of existing material;
4- Trying out something in a geographical area, such as a country, that has previously not been carried out in that area before;
5- Applying a particular technique in a novel way;
6- Introducing substantial new evidence to an old issue;
7- Being cross-disciplinary and using different methodologies;
8- Adding to knowledge in a way that has not previously been tried.

Construction management research appears to be limited in the number of strategies and techniques which are particularly favored and are in current use (Bresnen, 1990). Researchers in the field of construction management have to draw heavily on techniques and strategies from other disciplines, especially the wider field of the social sciences.

The researcher in construction management must either adopt from outside his or her field an appropriate research approach, or develop a strategy of research that fulfils the needs of his or her particular research; such a research strategy must completely address the research questions.

3.3 THE RESEARCH MODEL

Several researchers have proposed models for research methodology and research design (Davidson, 1997; Zikmund, 1994; Sekaran, 1992; De Vaus, 1991; Snyder, 1984; Paris, 1970; etc.). They all agree on the cyclic nature of the research strategy. This research is an adaptation of Davidson's model, which was chosen for its representativeness. The model adopted in this research encompasses the following steps:

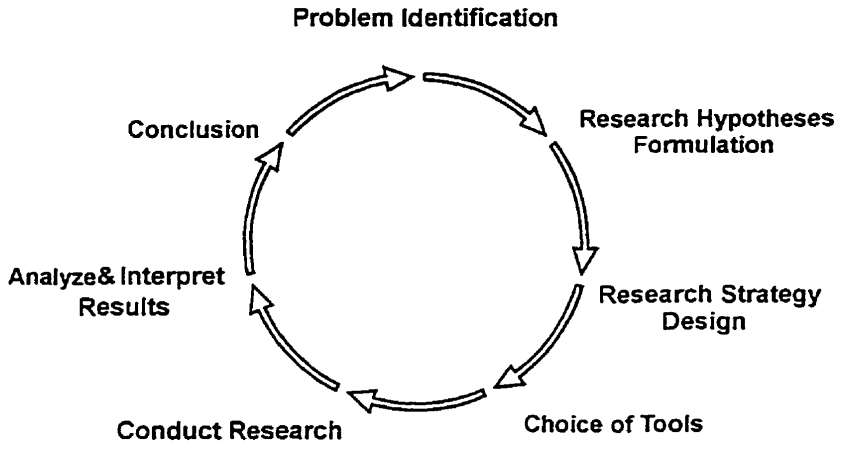


Figure 3.1 The research design (adapted from Davidson's model, 1997)

1- Identify the problem in the theoretical terms of the research field;
2- Formulate research hypotheses based on these theories;
3- Design an appropriate and defendable research strategy;
4- Decide on the choice of appropriate theoretical and practical tools (literature reviews, questionnaires, experiments, etc...) and develop a data collection methodology;
5- Conduct the research and document results;
6- Analyze and interpret results (data);
7- Draw conclusions from analyzed data based on formulated hypotheses;
8- Back to step (1), redefine the problem in the light of preliminary conclusions, etc.

These steps are to be repeated as many times as is necessary to substantiate (or negate) the proposed hypotheses and answer the research question. The current research follows the steps mentioned above with one slight modification: the first round of the cycle was initially designed as a pilot study with fewer data to test drive the process as reported earlier (Abdel Meguid, T. A., and Davidson, C. H., 1996).

3.3.1 Step 1: Problem Identification

This research was triggered by several "unanswered questions" that the researcher had faced in his professional activities; these were later substantiated by the literature review. The researcher's interest was triggered by the following questions:

1- Why do owners still end up with inferior quality products?

2- Why are projects still not performing well and finish behind schedule, or over-budget, or both?

3- Why do claims still persist in the construction industry?

4- Since procurement strategies are the decisions taken upstream of any project and affect all the ensuing decisions and hence the project performance, is it possible to use them to minimize those negative features of construction projects, in particular, claims?

5- Can a selection mechanism be found to help the building owner to choose, from the "pool of procurement strategies", a procurement strategy that satisfies the characteristics and constraints of his particular project?

This research builds on previous work done within the IF Research Group[1] (Davidson, 1990, 1989, 1988; Mohsini and Davidson, 1992, 1986; Mohsini, 1993, 1989, 1985; Mohsini *et al.*, 1995; Glover, 1976, 1974; Roberts, 1974). In other words, this research is based upon the assumption that to improve the performance of the building process, the owner has to be advised as to which of the procurement strategies that fit(s) his or her requirements would minimize inter-organizational conflict and, by association reduce claims. In effect the minimization of the frequency of claims, their outcomes and their causes can be a part of a project procurement selection mechanism.

[1] *IF Research Group.* Faculté de l'aménagement, Université de Montréal, established in 1976 (prior to that, from 1968-1976 research was carried out by the "IF Research Team") under the leadership of Professer Colin Davidson. It is the leading Canadian research group primarily concerned with Building Science and Information Science applied to technological innovation in building and its organizational implications, notably procurement, information management in the building process, information transfer from research to practice, and the performance concept and its implications for the design of high quality work-places. The IF Research Group is active within the International Council for Building Research, Studies and Documentation (CIB). The author is a member of this research group.

3.3.2 Step2: Research Hypotheses

As stated earlier, previous research looking into the procurement of buildings on the one hand and examining claims on the other, has been largely fragmented; though previous researchers have examined certain areas separately and from different points of view, none have examined the two research areas together as a whole. This research seeks to examine this particular aspect of the building process, i.e. building procurement together with its influence on claims management and vice versa, and evaluate their relationships and combined effects on the success of the project. Furthermore, the possibility of using claims as a yardstick to advise owners on the choice of a suitable strategy for their particular project is investigated.

As a basis for the research, the following hypotheses are proposed:

3.3.2a Meta-Hypothesis:

Given that the greater the total amount of inter-organizational conflict in a building process, the lower the overall project performance, a project organization's overall performance is inversely proportional to the number of claims which are a manifestation of such inter-organizational conflict.

Different procurement strategies induce differing levels of inter-organizational conflict. Accordingly, it is hypothesized that:

3.3.2b Hypothesis (1):

The closer the procurement strategy moves from the separated and coordinated system (traditional) to the management oriented system (project management, construction management) and to the integrated system (design-build, turnkey, owner-builder) on a continuum, the inter-organizational conflict decreases and so do claims.

3.3.2c Hypothesis (2):

Different outcomes of claims have different root causes that differ according to the characteristics of each procurement strategy.

3.3.2d Hypothesis (3):

The frequency and importance of the root causes of claims are different from what is generally perceived by construction industry participants.

3.3.3 Step 3: The Research Design

3.3.3.a Generalities

Yin (1990) identifies the research design as the logical sequence that connects the empirical data produced by research to the study's initial research questions and ultimately to its conclusions. One of the principal purposes of the design is to help avoid the situation in which the collected data does not address the initial research questions. Research design in the social sciences typically consists of an experiment, a case study, or a survey (Robson, 1993).

Experiments are undertaken to measure the effects of manipulating one variable on another variable and for finding causal relationships between variables (Robson, 1993). An experiment is carried out by selecting samples of individuals from known populations and allocating them to different experimental conditions. A planned change of one or more variables is introduced and measurements of its effect(s) taken. This manipulation should be achieved without biasing the results.

Surveys collect data in a standardized form from samples of a population and allow the researcher to carry out statistical inferences on the data, often with the help of computers (Norusis, 1996). This statistical inference, moving from the particular observations of the sample to the wider generalizations of entire populations, is a major reason why surveys are popular with researchers (Oppenheim, 1992).

One criticism of surveys is that only standardized data can be collected. The data can not easily be linked to other pieces of information which may have had a bearing on the response; as Diesing (1972) states:

> *Statistical generalizations tell us that certain regularities occur a certain part of the time, but say nothing about the actual inner or interpersonal transactions that bring them about. To see why a "regularity" appears in one case and not another, one must enter into the two cases and see how the particular perceptual and cognitive processes produced the two results.*

Case studies are identified by Yin (1990) as:

> *"empirical inquiries that investigate a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used".*

A common concern about "case studies" is that they provide very little basis for scientific generalization. Yin (1990) addressed this concern by stating:

> *"... Case studies, like experiments, are generalizable to theoretical propositions and not to populations or universes...the investigator's goal is to expand and generalize theories (analytic generalization) and not to enumerate frequencies (statistical generalization)".*

Yin (1990) suggests that the research design of case studies has traditionally been lacking of rigor and slack, the design often only emerging after a prolonged involvement in the field actually collecting data, only then realizing that equivocal evidence or biased views might influence the direction of the findings and conclusions. This looseness has been mistaken with allowing the research design to be too flexible in nature. Yin (1990) suggests that a case study research design should be drawn up explicitly at the commencement of the research; the research design can be tailored during the research to take account of any changing circumstances that the fieldwork throws up.

This means that issues are explored as they develop in the data collection phase (flexibility), sometimes necessitating spending more time on a particular case study than was originally envisaged at the research design stage. Also, it means deciding at the research design stage which features will be covered selectively. A strong research design may lead to important features being ignored as they are "outside the research design" or to data being misinterpreted due to a lack of provision at the research design stage.

Walker (1997) considers the case study research approach as the appropriate research model for a class of problems involving investigation of causal links through comparison of variables. Walker actually cites the problem of investigating whether or not a particular procurement method affects construction time performance as one example of this class of problems.

3.3.3.b Specifics

The study of the influence of procurement strategies on the incidence of claims and the different causes of claims is - in our opinion - considered to be so diverse that a remote, standardized form of data collection simply would not identify them. Also, the nature of the variables to be collected (qualitative and quantitative, or categorical and numerical in statistical terms) and the need to verify and substantiate them, suggest that neither surveys nor case studies alone can answer this particular research's methodological needs. It is for this reason that a combination of surveys and case studies approaches was favored for this research (i.e. a combination of a horizontal and vertical approaches to data collection and to the interpretation of results), since the influences would present themselves without any bias from the researcher or the research units of study. This combination allows a very high level of abstraction to be undertaken from the data, and overcomes both the methodological concern related to the number of case studies and the potential bias of the researcher.

At the commencement of the research, it was not known whether the number of cases would be enough to indicate the influences of procurement strategies on claims. Glaser and Strauss's (1967) theory of saturation was used (i.e. that in carrying out further case studies, no new categories of data are found, in other words, no further causes of claims were found), bearing in mind that to establish the required number of case studies, they must give adequate data and information, and that a subsequent case study would provide no new data. For this research, the samples must, however, be both manageable and yet large enough for each of the procurement methods used in the industry to be adequately represented, so that solid conclusions can be drawn.

This suggestion was implemented by carrying out the pilot study and identifying the variables that need to be studied as well as the causes of claims. When the additional cases were studied, no new causes of claims were identified, showing that this criterion had been satisfied.

3.3.4 Step 4: Choice of Theoretical and Practical Tools

3.3.4a Literature review

The first stage of this research was a comprehensive literature review covering building procurement methods, organizational forms within the building process, construction claims and the different methods of their resolution. The literature review revealed that there is an abundance of research done on procurement and claims separately and provided useful information on matters such as: variables in the context of the research topics; methodologies chosen by other researchers; gaps in available information, and views from different researchers. Previous research, in our opinion, has the following shortcomings:

Concerning project procurement strategies

- A problem of terminology exists between members of academia, between academia and practitioners, and even between practitioners themselves (even within the same country and culture). This is the reason why Masterman's project procurement classification was adopted since it deals with three groups or families of procurement strategies and not with individual classifications of procurement strategies which are subject to terminological debate;

- All literature suggests a normative approach to procurement strategies: suggesting which procurement strategy is better for what criteria, but without establishing an appropriate methodology to follow when choosing a project procurement path.

Concerning claims

Two approaches to claims were identified from the literature:

- *Quantitative approach* (symptomatic or de facto), manifested in an abundance of techniques to prove and quantify entitlement to a claim after it arises;
- *Preventive approach*, manifested in research on contract standardization, and better wording for the conditions of contract.

Our research approach - though preventive in nature - is novel since it is our objective to provide owners with a yardstick to evaluate the performance of each of the available procurement strategies and to chose one which meets their constraints, and which at the same time has a lower incidence of claims or yields claims with less negative outcomes.

3.3.4b Data collection

Two approaches to the data collection were contemplated:

Participative: an in-depth study of the problems associated with on-going building projects through the projects' cycles or phases. This approach was discarded for being:

a- Unrealistically long for a Ph.D. research study;

b- Data collected would be project specific and could not easily be generalized;

c- Data collected would only represent the views of a particular category of task-organizations since, although even modest building projects have a large number of task-organizations working on them, most of the task-organizations fall in the category of sub-contractors.

Observatory: a study of a large number of litigated claims cases under different procurement strategies and an identification of their root causes. This approach was adopted for the following reasons:

a- Large number of instances from one point of view (the legal point of view) to extract pre-determined "data";
b- Treating "data" without further reference to the instances;
c- Treating "data" as elements of information in their own right.

Two options were available to collect the data:

1- **Out of court**: discarded for the following reasons:

a- Subjective: depending on the interviewed person's perception;
b- Difficulty of data collection:
    1- Not documented;
    2- People are very reluctant and embarrassed when talking about their problems and/or their bad experiences;
    3- Confidentiality in cases of arbitration or mediation.
    4- Data being sought were considered by many to be both sensitive and inaccurate.

2- **In-court (case-law - jurisprudence)**: chosen for the following reasons:

a- Documented and available in either a hardcopy and/or a computerized database format;
b- Judgement rendered by an impartial judge based on documented and proven facts;

c- Adjudication completed and outcome known;

d- Represents the worst case scenario that could ever happen to a project and;

e- Free of external influences, pressures or business environment compromises.

A consultation of available North American (US and Canada) judicial databases and law reporters[2] yielded almost 3000 general claims cases, necessitating a further process of elimination. The following criteria were adhered to in selecting and retaining cases for in-depth study and analysis:

1- Only claims pertaining to buildings were retained;

2- Cases from 1980 and onwards were considered, since a preliminary survey of available databases showed that these represent almost 95% of the litigated cases. Another reason was that alternative procurement strategies started to appear around that period of time and it is the aim of this study to compare the performance of building projects under different procurement strategies;

3- Only time-related claims (delay claims) cases were retained since, as we have explained in the previous chapter, they are the most recurrent and involve both time and cost overruns;

4- All cases had to have the owner as one party to the dispute and represent compensable delays (i.e. owner ends up paying claims and granting time extensions);

5- Adjudication completed;

6- Complete data available.

[2] Lexis legal on-line data base search in the law library of both: Université de Montréal (UdeM) and State University of New York (SUNY) at Buffalo; Construction Law Reporter (CLR); The Canadian Abridgment (2nd edition); Annuaire de Jurisprudence et de Doctrine du Quebéc; United States Reporter; Court of Claims Reporter; Federal Reporter; Federal Supplement; Atlantic Reporter; Pacific Reporter; North Eastern Reporter; North Western Reporter; Southern Reporter; South Eastern Reporter; South Western Reporter; and New York Supplement Reporter.

Based on the above criteria, 121 cases were retained for more in-depth study and analysis.

3.3.4c Definition of variables

I- Claims cases

The variables for this research are grouped under three headings (classifications): project procurement characteristics, outcomes of claims and causes of claims (Table 3.1 shows the research variables).

1- Project procurement characteristics (*categorical*) which include:

- The *project procurement strategies* adopted by owners in these litigated building projects were traditional, design-build, owner-builder, fast track, and construction management. These were later regrouped into 3 groups according to Masterman's classification:

  Separated and cooperative procurement strategy (traditional);

  Management-oriented procurement strategy (construction management);

  Integrated procurement strategy (design-build, owner-builder, and fast track).

- *Type of building* (residential, commercial, institutional, industrial and specialized industries).
- *Type of owner* (public or private).
- *Type of contract* (method of payment: lump sum, unit price, guaranteed maximum price and cost plus).

2- Claims outcomes (*numerical*) measure the claims severity in terms of:

a- cost performance:

- Percentage of cost overrun (% of claimed cost to the initial project budget and % awarded to initial project budget);
- Percentage of awarded claim to initial claim;

b- Time performance:

- Percentage time overrun (delay expressed as a % of the planned duration of the project);
- Percentage trial overrun (time before the court decision, expressed as a % of the planned duration of the project).

Table 3.1: Research variables

CATEGORY	VARIABLE	MEASURE OF	CODING	
PROJECT PROCUREMENT CHARACTERISTICS	*CATEGORY*	Type of building	Industrial Commercial Intitutional Residential Specialized industries	(1) (2) (3) (4) (5)
	STRATEGY	Project procurement strategy	Separated and cooperative Integrated Management-oriented	(1) (2) (3)
	OWNER	Ownership of project	Private owner Public owner	(1) (2)
	CONTRACT TYPE	Method of payment	Lump sum Unit price Guaranteed maximum price (G.M.P.) Cost plus	(1) (2) (3) (4)
OUTCOME OF CLAIMS	*TIME OVERRUN*	Delay / Planned duration (%)	% Time overrun	P1
	COST OVERRUN	Claimed amount / Budget (%) Awarded amount / Budget (%) Awarded amount / Claimed amount (%)	*% Claimed to budget* *% Awarded to budget* *% Awarded to claimed*	P2 P3 P4
	TRIAL OVERRUN	Trial time / Planned duration (%)	*% Trial overrun*	P5
CAUSES OF CLAIMS	*SCOPE OF THE PROJECT (X1)*	Domain consensus	CHANGES IN SCOPE OF WORK CHANGES OF SPECS BY A/E DIFFERING SITE CONDITIONS MISINTERPRETATION OF DOCS. BY A/E EXCESSIVE INTERPRETATION OF SPECIFICATIONS	X11 X12 X13 X14 X15
	AVAILABILITY AND ACCESS TO INFO. (X2)	Communication problems	AMBIGUOUS DOCUMENTS FAULTY SPECIFICATIONS INCOMPLETE DOCUMENTS LATE APPROVALS LATE DOCUMENTS LATE ISSUANCE OF DESIGN DOCUMENTS LATE RECTIFICATIONS UNTIMELY & UNCOORDINATED CHANGE ORDERS UNTIMELY DESIGN REVISIONS	X21 X22 X23 X24 X25 X26 X27 X28 X29
	COORDINATION (X3)	Interdependance of tasks	LACK OF COORDINATION RESTRICTED SITE & INTERFERENCE DELAYED SITE ACCESS ACCELERATION WINTER WORK LACK OF SITE SUPERVISION DISRUPTION BY A/E PAYMENT DELAY	X31 X32 X33 X34 X35 X36 X37 X38

3- Causes of claims (*categorical*)

Twenty-two causes of claims were cited in the 121 claims cases in 241 instances (sometimes there were more than one cause per claim). Based on the factors in organizational design theory that were found to be conflict-inducing in multi-organizations, and were proven to be deterministic to the performance of the building project (Mohsini, 1984), the causes of delays were grouped into three main categories:

> **Scope of the project (or domain consensus)**: The greater the clarity of scope of participation and the degree of specialization the better the project performance; 5 causes of claims were cited under this category;
>
> **Availability and access to information**: The more successful the exchange of information the better the project performance; 9 causes of claims were cited under this category;
>
> **Coordination (or interdependence of tasks)**: The greater the coordination and cooperation in dependent tasks the better the project performance; 8 causes were cited under this category.

The causes of claims were classified using the logical proposition (Figure 3.2) in two steps:

> **Step 1:** A synthesis of claims cases was carried out, causes of claims were identified and written down as reported. Each of the reported causes of claims was then cross-referenced to previously identified causes for logical consistency and either considered as a new cause or expressed in modified terms, if necessary. This was deemed necessary to maintain consistency with the previously-identified causes of claims, but was only confirmed after returning back to the individual case under study to verify the suitability of the new term. A final list of 22 causes of claims was produced.

Step2: The 22 causes of claims were then classified under the three headings of the determinants of building project performance (based on the inter-organizational conflict theory) into (Table 3.1):

- Scope of the project (or domain consensus);
- Availability and access to information;
- Interdependence of tasks.

(Example: if **I** is "late documents", and **J** is "availability and access to information category", we answer **YES** to the question "is **I** an aspect of **J**?")

II- Control group

Two further surveys were undertaken to establish:

1- **The control group:** as a basis to compare the spread of procurement strategies in claims cases as compared to what is the actual practice of the industry (1st Montreal survey - 1992) [Appendix A];

2- **Experts' Opinion:** to establish the perception of practitioners on the importance of the discovered causes of conflict that lead to claims and compare that perception to the incidence of these causes from the analysis of the actual claims (2nd Montreal survey - 1997) [Appendix B].

Data for both surveys were gathered from randomly selected professionals covering the whole spectrum of all the participants in the building industry (public owners, private owners, architects and engineers), in addition to claims experts (for the experts' perceptions - 2nd Montreal survey).

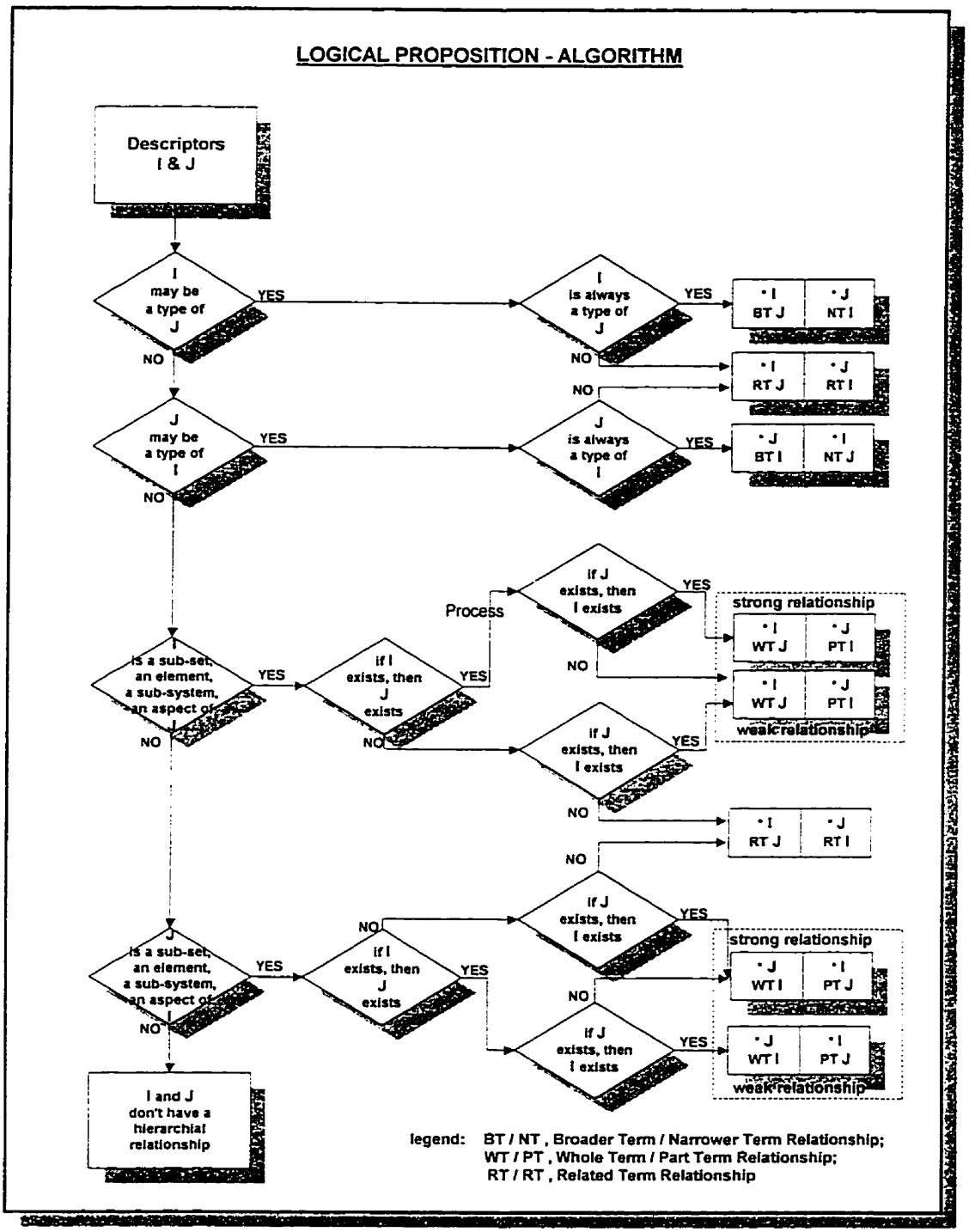


Figure 3.2: Logical proposition used to classify the causes of claims (Canadian Thesaurus of Construction Science and Technology, 1978)

3.3.5 Step 5: Conduct the Research

The research was carried out in a North American context, databases and law reporters from both Canada and the USA were consulted at the law libraries of both the Université de Montréal (UdeM) and the State University of New York (SUNY) at Buffalo. The control group surveys were done in the Metropolitan Montreal Area (which was assumed to be representative of all large North American cities).

3.3.6 Step 6: Data Analysis

Data analysis is shown in the next chapter (chapter 4) in three sections under the previously mentioned headings of data classification (project procurement characteristics, claims outcomes, and causes of claims). A fourth section is added to investigate the relationships between these classifications.

Several techniques were used to analyze the data:

- Frequency diagrams;
- Cross tabulations;
- Cluster diagrams;
- Multiple regression analyses

All hypotheses were tested using the data gathered from the case studies. Any unanswered propositions were subject to informed opinion (i.e. based on the experts' survey), and finally, conclusions are drawn from the research study.

Analysis was done at the inter-classification level, the intra-classifications level, and between claims cases and control group.

The lack of previous major research into time-related claims in relation to the influence of procurement methods make it virtually impossible to try to compare results with other researchers.

This research involves a massive amount of data, which is often in a qualitative and quantitative format, necessitating a careful choice of an appropriate analytical methodology. It would not be practical to include in the thesis an appendix containing all the transcripts of the cases together with copies of all the notes and documentation collected during the course of the research.

3.3.7 Step 7 & 8: Analysis of Results and Conclusions

Conclusions are drawn from the analyzed data based on the announced hypotheses. Partial conclusions are shown at the end of each section of the analysis in chapter 4. Final conclusions and recommendations for future work are shown in chapter 5.

3.4 SCOPE AND LIMITATIONS OF RESEARCH

The researcher realizes that disputes between project participants are quite common and can be solved: on site, by negotiation, by mediation, by arbitration, or by litigation. For the purposes of this research, only claims, which went to court (litigation), are considered, since:

a- Some sort of a compromise was reached in the other claims through the first four dispute resolution techniques (on site, negotiation, mediation and arbitration);
b- The cases that went to litigation represent the more serious claims, time and money wise, and most importantly:
c- These cases are documented and traceable.

The researcher undertakes this research from the point of view of the **OWNER**, since:

a- The building project is (or should be) a reflection of the owner's requirements;
b- The owner is the prime initiator of any building process and the one who sets the basis of all relationships between the parties to the project, since he or she is the one who decides on the procurement strategy;
c- The owner is the party who risks ending up with a lower quality project, loss of time and perhaps, money as well.

The ultimate objective of this research is to explore the appropriate building procurement strategy for a particular project that minimizes claims and, consequently, has the best record for preserving performance; to this end, the following points are considered:

a- Building processes are considered based on the Masterman's classification of the families of the procurement strategies.
b- Cases cited in litigation from 1980 onwards, representing the industry at large.

Here, performance is considered from two aspects only: time and money.

3.5 CONCLUSION

In this chapter, the methodology of the research has been set out. An appropriate research methodology is used to serve the research needs and is designed accordingly. It has been shown that surveys and case study approaches can be combined and adopted successfully at different stages of the research, depending on the research requirements. The next chapter (chapter 4) presents the results of the data analysis and their interpretation and chapter 5 presents the conclusions of this research and concludes with recommendations for future research.

CHAPTER 4:

DATA ANALYSIS AND DISCUSSION

INTRODUCTION

The data for this research are presented under the three main headings used throughout this research, namely:

1- **Project procurement characteristics** (procurement strategy, category of project, type of owner, and contract type);

2- **Claims**[1] **outcomes** (% time overrun to contract schedule, % claimed to budget, % awarded to budget, % awarded to claimed, and % trial overrun to contract schedule);

3- **Causes of claims** (22 causes of claims falling into three distinct categories, a) scope of the project (domain consensus), b) availability and access to information, and c) coordination (interdependence of tasks).

This chapter is divided into four sections, since, in addition to the first three sections which show the results of the research under the three main classes mentioned above, there is a fourth section which deals with the relationships between the data classes, based on the surveys and on the experts' opinions. Each main section comprises a data analysis, which is followed by a discussion of the factors considered separately.

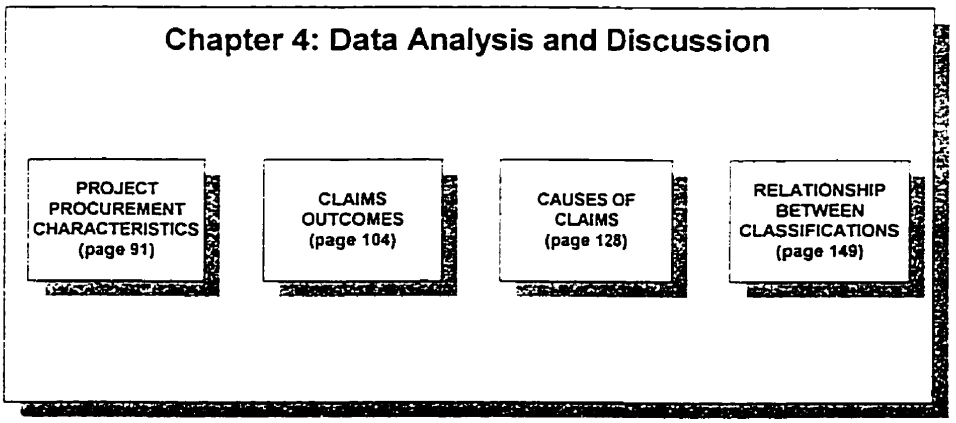


Figure 4.1: Chapter 4 (Data Analysis and Discussion) outline

[1] Henceforth, the term claim will be used to designate "time-related claims or delay claims"

SECTION 1:

PROJECT PROCUREMENT CHARACTERISTICS

4.1 PROJECT PROCUREMENT CHARACTERISTICS

Project procurement characteristics (procurement strategy, type of owner, contract type, and type of building) are presented separately and in comparison with two other surveys which constitute a control group.

4.1.a Claims Cases

A preliminary study of the 121 claims cases revealed that they were distributed amongst the different procurement strategies, the different types of owners (public and private), the different contract types (lump sum, unit price, cost-plus-fee and guaranteed maximum price-G.M.P.), and the different types of buildings (residential, commercial, industrial and institutional) as shown in Figure 4.2 and Table 4.1.

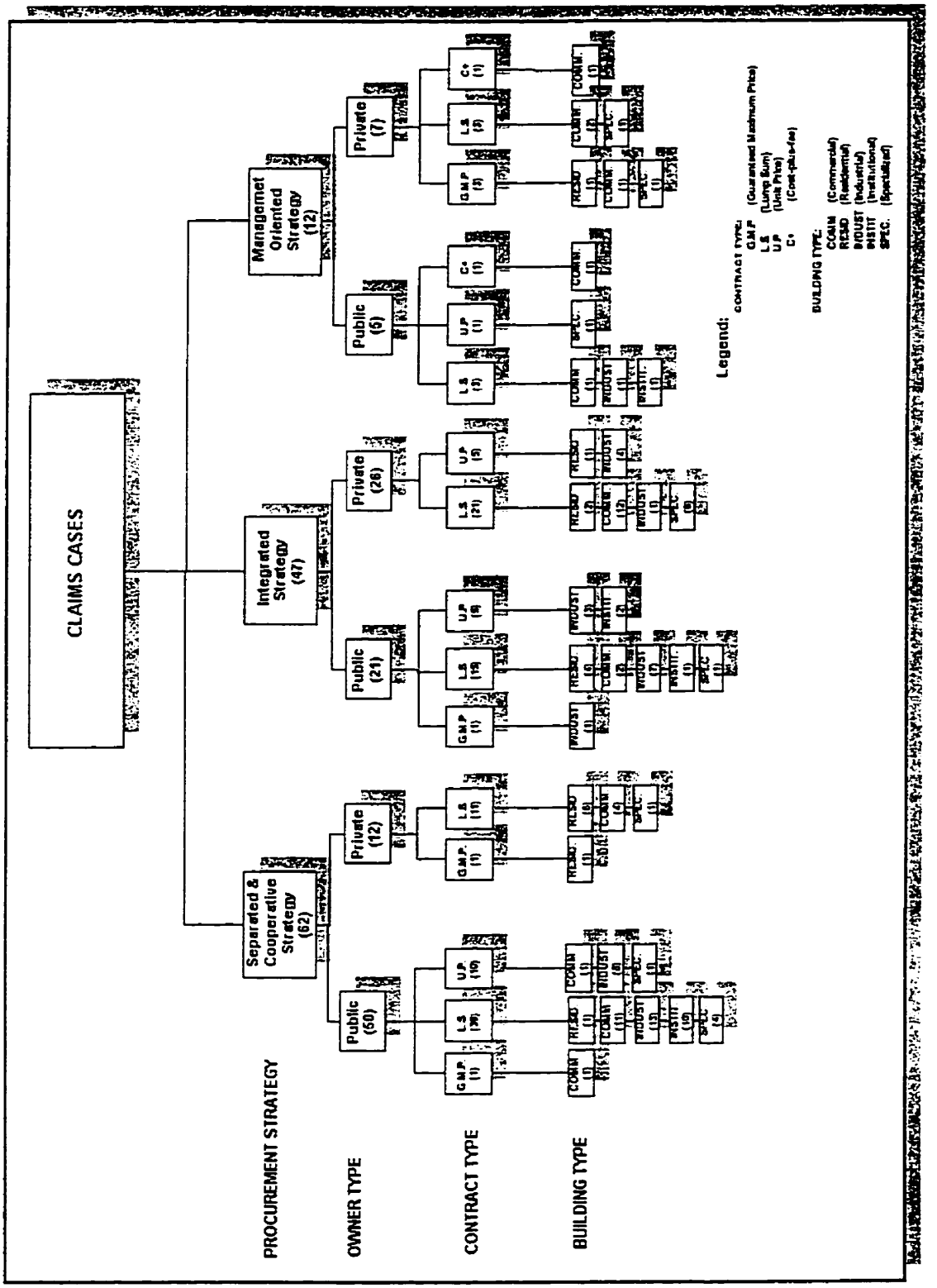


Fig 4.2: Claims Data

Table 4.1: Claims cases by strategy, type of owner and contract type.

PROCUREMENT STRATEGY	NUMBER OF CASES	% TO ALL CLAIMS	% BY STRATEGY	LUMP SUM	% LUMP SUM	COST PLUS	% COST PLUS	UNIT PRICE	% UNIT PRICE	GMP	% GMP
CLAIMS DATA											
SEPARATED & COOPERATIVE	62	51.24%	100.00%	50	80.65%	0	0.00%	10	16.13%	2	3.23%
PUBLIC	50	41.32%	80.65%	39	62.90%	0	0.00%	10	16.13%	1	1.61%
PRIVATE	12	9.92%	19.35%	11	17.74%	0	0.00%	0	0.00%	1	1.61%
INTEGRATED	47	38.84%	100.00%	36	76.60%	0	0.00%	5	10.64%	6	12.77%
PUBLIC	21	17.36%	44.68%	15	31.91%	0	0.00%	5	10.64%	1	2.13%
PRIVATE	26	21.49%	55.32%	21	44.68%	0	0.00%	0	0.00%	5	10.64%
MANAGEMENT-ORIENTED	12	9.92%	100.00%	6	50.00%	2	16.67%	1	8.33%	3	25.00%
PUBLIC	5	4.13%	41.67%	3	25.00%	1	8.33%	1	8.33%	0	0.00%
PRIVATE	7	5.79%	58.33%	3	25.00%	1	8.33%	0	0.00%	3	25.00%
TOTAL CLAIMS (PUBLIC OWNERS)	76	62.81%		57	75.00%	1	1.32%	16	21.05%	2	2.63%
TOTAL CLAIMS (PRIVATE OWNERS)	45	37.19%		35	77.78%	3	6.67%	1	2.22%	6	13.33%
TOTAL CLAIMS (CONTRACT TYPE)	121	100.00%		92	76.03%	4	3.31%	17	14.05%	8	6.61%

4.1.a.1 Claims cases and procurement strategy

Among the 121 claims cases that were selected for study, the separated and cooperative procurement strategy has the highest incidence of claims 51.24% (62 cases), followed by the integrated strategy 38.84% (47 cases). The management-oriented strategy has the least incidence of claims, 9.92% (12 cases)

4.1.a.2 Claims cases and type of owner

Public owners appear to face claims more often than private owners (62.81% public owners to 37.19% private owners). Moreover, public owners still have the highest claims incidence under the separated and cooperative procurement (traditional) strategy (80.65%). whereas private owners seem to have mastered the traditional procurement strategy and face fewer claims but they have a more pronounced tendency to face claims under the innovative procurement strategies: integrated procurement strategy (55.32%) and management-oriented strategy (58.33%).

4.1.a.3 Claims cases and contract type

Both public and private owners have a high incidence of claims under lump sum contracts (47.11% and 28.93% respectively); this accounts for 76.03% of all claims.

Unit price contracts have the second highest incidence of claims with public owners (13.22%) followed by guaranteed maximum price contracts (1.65%) and cost plus fee contracts (0.83%).

Guaranteed maximum price contracts have the second highest incidence of claims with private owners (7.44%), followed by cost plus fee contracts (0.83%). We cannot ascertain whether private owners do better with unit price contracts since no case of the incidence of claims under private owner and unit price contracts was included in the cases studied.

4.1.a.4 Claims cases and type of building

From Figure 4.1, we cannot deduce any tendency of a particular type of building to result more often in claims. It should be noted that the claims cases included 16 residential, 37 commercial, 38 industrial, 14 institutional, and 16 specialized buildings, suggesting a broad spread of claims cases across the spectrum of building types.

4.1.b Control Group

In order to establish a "control", indicating the normal breakdown of contracts by procurement strategy, owner type and contract type, comparative data were obtained from two sets of surveys in the Montreal metropolitan area. The first set was an early survey (1992) on procurement practices, and the second survey (1997) is a similar survey, placing more emphasis on practitioners' perceptions of listed causes of claims cited in case-law.

Both surveys were randomly conducted (as we have explained in the previous chapter) and are presumed to be representative of all contracts and can serve as a yardstick to compare with the data about contracts ending in claims.

The timing of the surveys should be borne in mind when making comparisons between claims cases and the control group; claims cases from case-law (1980 - 1996) derive from contracts started and finished during the period spanning from the mid-seventies to the beginning of 1990's. For this reason, the first Montreal survey (1992) will be used as a yardstick for claim cases since it coincides more closely with the same time frame as the claims cases.

The second Montreal survey (1997) will be mainly used to compare and substantiate the causes of claims - identified from case-law - with experts' perceptions as to the importance of these causes [Figure 4.3a].

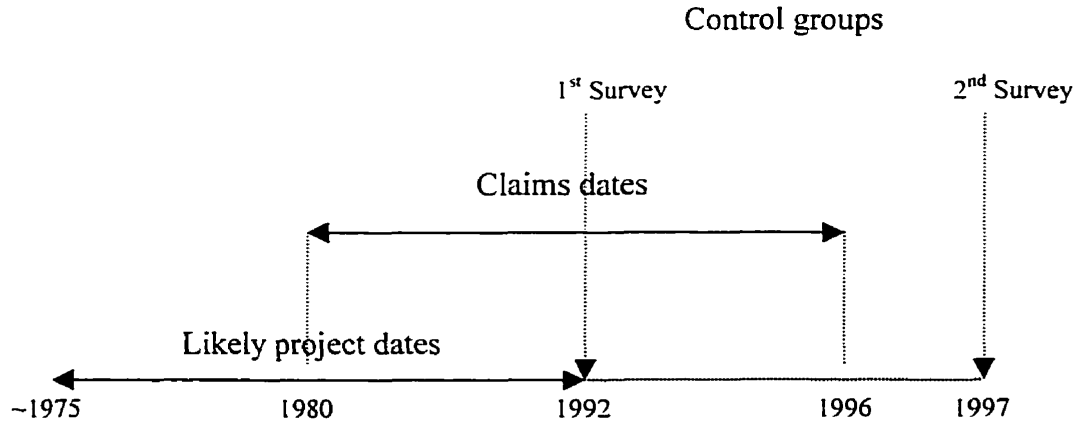


Figure 4.3a: Claims cases and control group

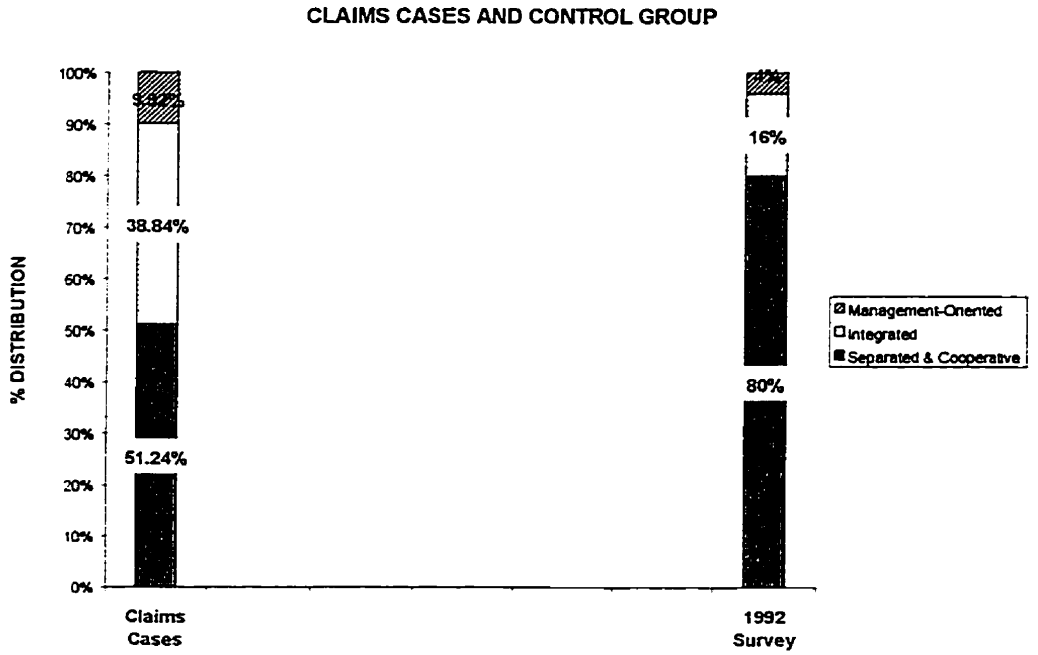


Figure 4.3b: Claims cases and control group (by procurement strategy)

Comparing data from the control groups with the claims cases [Figure 4.3b], it is obvious that the separated and co-operative procurement strategy is the preferred procurement strategy by all types of owners and proportionally leads to fewer claims (80% in the control group to 51.24% in claims).

The integrated procurement strategy is the second preferred procurement strategy (16% in the control group) but has a high incidence of claims (38.84% in claims cases, which represents almost 2.4 times its usage).

The management-oriented procurement strategy is the least preferred strategy by all owners (4% of the control group) but proportionally has the highest incidence compared to usage (9.92% in claims cases, which represents 2.48 times of usage)

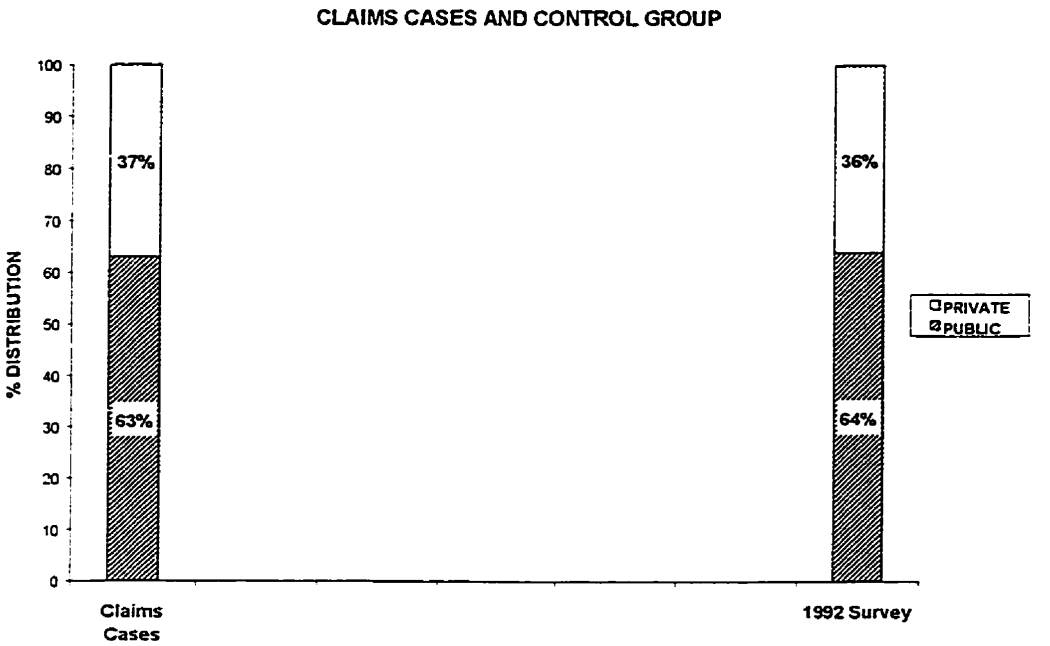


Figure 4.3c: Claims cases and control group (by type of owner)

Comparing data from the control groups with the claims cases [Figure 4.3c], it appears that the control group (the first Montreal survey - 1992) has almost the same percentage distribution of public and private owners that the claims data is showing (36% private owner and 64% public owner).

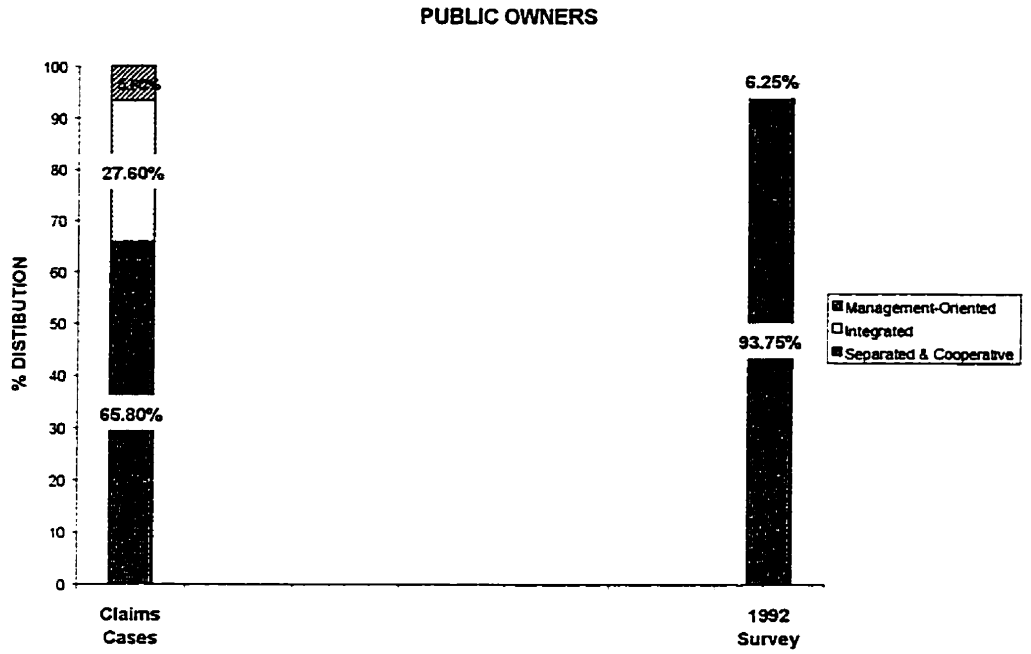


Figure 4.3d: Claims cases and control group (public owner)

Public owners show a strong inclination for traditional contracts (separated and cooperative strategy); indeed, about 93% of public projects involve "traditional" procurement strategies. However, they only represent 65.8% of all cases ending up in claims [Figure 4.3d].

On the other hand, the "non-traditional[2]" procurement strategies (6.25% of overall procurement strategies) represent a major portion of claims 34.2%, (27.6% integrated and 6.6% management-oriented), indicating that the public sector is presently ill-equipped to innovate in this area.

[2] The control group does not include any projects under the management-oriented procurement strategy.

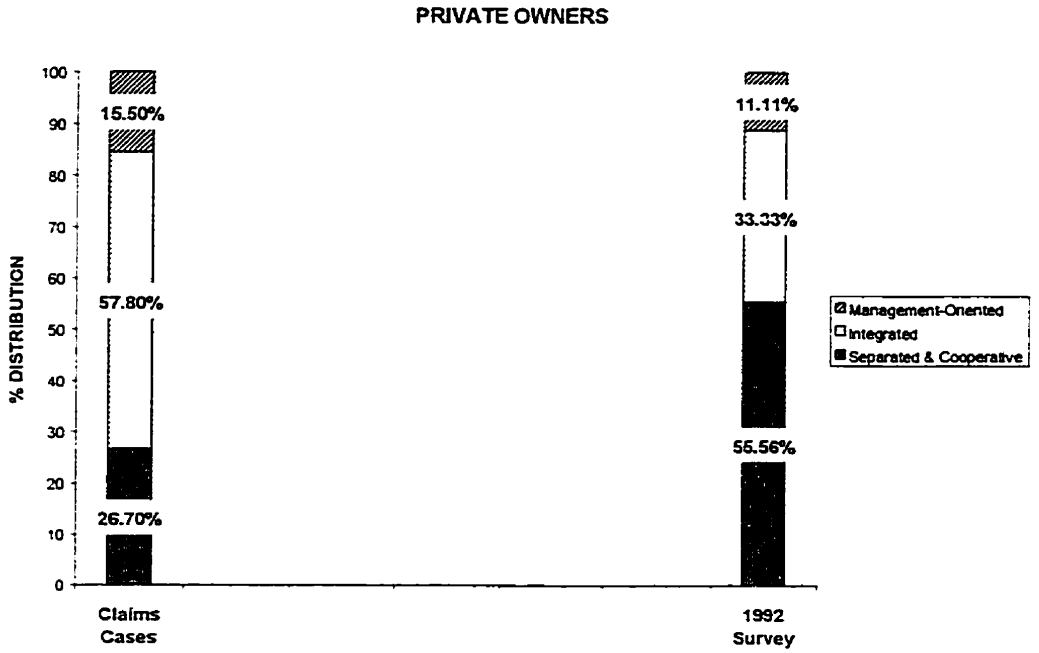


Figure 4.3e: Claims cases and control group (private owner)

Private owners appear to have mastered the traditional procurement process and fall even less into claims under this strategy (only 26.7% of claims cases). Private owners on the other hand, in their desire to exercise more control of their projects, are more ready to adopt non-traditional procurement strategies (44.44% of the control group - 33.33% integrated and 11.11% management-oriented). Once again the incidence of claims for these strategies is higher (73.3%), particularly for the integrated procurement strategy (57.8% integrated and 15.5% management-oriented) [Figure 4.3e].

Table 4.2: Comparison between claims and survey data (by owner, contract type and procurement strategy)

PROCUREMENT STRATEGY	NUMBER OF CASES	LUMP SUM	% LUMP SUM	COST PLUS	% COST PLUS	UNIT PRICE	% UNIT PRICE	GMP	% GMP	OTHER	% OTHER
CLAIMS DATA											
SEPARATED & COOPERATIVE	62	50	80.65%	0	0.00%	10	16.13%	2	3.23%	0	0.00%
PUBLIC	50	39	62.90%	0	0.00%	10	16.13%	1	1.61%	0	0.00%
PRIVATE	12	11	17.74%	0	0.00%	0	0.00%	1	1.61%	0	0.00%
INTEGRATED	47	36	76.60%	0	0.00%	5	10.64%	6	12.77%	0	0.00%
PUBLIC	21	15	31.91%	0	0.00%	5	10.64%	1	2.13%	0	0.00%
PRIVATE	26	21	44.68%	0	0.00%	0	0.00%	5	10.64%	0	0.00%
MANAGEMENT-ORIENTED	12	6	50.00%	2	16.67%	1	8.33%	3	25.00%	0	0.00%
PUBLIC	5	3	25.00%	1	8.33%	1	8.33%	0	0.00%	0	0.00%
PRIVATE	7	3	25.00%	1	8.33%	0	0.00%	3	25.00%	0	0.00%
TOTAL CLAIMS DATA	121	92	76.03%	2	1.66%	16	13.22%	11	9.09%	0	0.00%
MONTREAL SURVEY (1992)											
SEPARATED & COOPERATIVE	20	19	95.00%	0	0.00%	0	0.00%	0	0.00%	1	5.00%
PUBLIC	15	15	75.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
PRIVATE	5	4	20.00%	0	0.00%	0	0.00%	0	0.00%	1	5.00%
INTEGRATED	4	3	75.00%	1	25.00%	0	0.00%	0	0.00%	0	0.00%
PUBLIC	1	1	25.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
PRIVATE	3	2	50.00%	1	25.00%	0	0.00%	0	0.00%	0	0.00%
MANAGEMENT-ORIENTED	1	0	0.00%	1	100.00%	0	0.00%	0	0.00%	0	0.00%
PUBLIC	0	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
PRIVATE	1	0	0.00%	1	100.00%	0	0.00%	0	0.00%	0	0.00%
TOTAL SURVEY DATA	25	22	88.00%	2	8.00%	0	0.00%	0	0.00%	1	4.00%

Table 4.2 shows a detailed comparison between the claims data (upper portion) and the first Montreal survey (lower portion), broken down by strategy, type of owner, and contract type.

SECTION 1: DISCUSSION[3]

In this section, the project procurement characteristics of 121 building projects, which ended in courts of law, are presented. The analysis of these claims cases indicates that the ratio of public owners to private owners facing claims is proportional to their distribution in the control group (Figure 4.3.c).

[3] In order to facilitate the analysis of the results, a normalized presentation has been adopted in the discussion of this section and the discussions of the following sections of this chapter.

The separated and co-operative procurement strategy still appears to be the preferred strategy for public owners in procuring building projects and has a lower occurrence of claims than the other two procurement strategies. This is not surprising considering that it is the one, which has been used the longest and that contract documents have been fine-tuned and standardized for its usage. The private owners appear to have mastered the separated and co-operative procurement strategy and face even fewer claims under this strategy than public owners (Figures 4.3d and 4.3e).

We have explained in chapter 1 the shortcomings of the separated and co-operative procurement strategy and the reasons why alternative procurement strategies have appeared. These reasons, it should be noted, are independent of the claims issue we are studying here; consequently, it would be unwise to draw any immediate conclusions from (a) their introduction and (b) the higher incidence of claims they represent.

While the integrated procurement strategy, with its main variant design-build, has been gaining much support lately and is being presented as the panacea to all the problems of the construction industry, *our findings prove the opposite*. Both public and private owners have a high incidence of claims under this procurement strategy. Combined, both owners face twice as many claims compared to usage than the other two procurement strategies (Figure 4.3b).

The public owner under the integrated procurement strategy has a higher claims to usage ratio than the private owner (4.4 to 1.7 - Figures 4.3d and 4.3e). This is not surprising; indeed one might expect it considering the constraints public owners operate under (public accountability, bureaucracy and open bid/lowest bidder requirements). Public owners are in an awkward situation when adopting this strategy since, while they have a pronounced risk aversion profile and are ready to pass the responsibility to another party, they are still tied by the bureaucratic nature of their office, thus causing more conflict.

The management-oriented procurement strategy under the private owner appears more often in claims cases than its usage (Figure 4.3.e).

Insufficiency of information in the control group about the distribution of management-oriented procurement strategy under the public owner prevents us from proposing any informed opinion.

Our findings point to the consequences (in terms of claims occurrences) of the constraints within which public sector owners operate. They also throw an unexpected light on the likelihood of all types of owners running into trouble when non-traditional procurement strategies are adopted, suggesting the need to fine-tune the practicalities of these strategies.

The method of payment preferred by all owners is the lump sum contract, this highlights the expected difficulties of managing any other form of payment.

In the next section (section 2), the claims outcomes are presented under the three families of procurement strategies. Analysis of outcomes is carried out, comparisons performed and conclusions drawn are discussed at the end of section 2.

SECTION 2:

CLAIMS OUTCOMES

4.2. CLAIMS OUTCOMES

For the purpose of quantifying the effect of procurement strategies on the duration and cost of resolving claims, the "claims outcomes" are identified in two groups - compared to project schedule and to project budget. The first group deals with the time-related outcomes of claims (i.e. % time overrun and % trial overrun - both compared to the contract duration); the second group deals with the cost-related outcomes of claims (i.e. % claimed to budget, % awarded to budget, and % awarded to claimed). All outcomes for all claims cases are expressed as percentages of project schedule and project budget, in order to have a normalized comparison free of the impact of the project's size, budget and duration.

4.2.1 Analysis of Claims Outcomes

Analysis of claims outcomes shows that they vary in each procurement strategy and with each type of ownership as follows (Tables 4.3a - 4.3j)

Table 4.3a: Variable P1 - % of Time Overrun (private owners)

Procurement Strategy	Range	Average	Std. Deviation
Separated & Co-operative	16.36% - 260.00%	70.84%	67.97%
Integrated	4.45% - 712.22%	107.54%	177.21%
Management - Oriented	5.81% - 166.55%	59.80%	53.82%

Table 4.3b: Variable P1 - % of Time Overrun (public owners)

Procurement Strategy	Range	Average	Std. Deviation
Separated & Co-operative	1.37% - 274.19%	56.99%	57.13%
Integrated	3.52% - 131.51%	45.90%	43.70%
Management - Oriented	3.16% - 119.67%	63.56%	51.62%

Table 4.3c: Variable P2 - % of Claimed to Budget (private owners)

Procurement Strategy	Range	Average	Std. Deviation
Separated & Co-operative	2.00% - 178.98%	32.71%	48.36%
Integrated	4.93% - 325.94%	44.77%	71.24%
Management - Oriented	3.69% - 100.00%	57.24%	35.79%

Table 4.3d: Variable P2 - % of Claimed to Budget (public owners)

Procurement Strategy	Range	Average	Std. Deviation
Separated & Co-operative	0.08% - 214.23%	27.26%	38.75%
Integrated	0.70% - 93.78%	19.72%	23.98%
Management - Oriented	4.31% - 84.71%	54.45%	39.07%

Table 4.3e: Variable P3 - % of Awarded to Budget (private owners)

Procurement Strategy	Range	Average	Std. Deviation
Separated & Co-operative	0.22% - 19.43%	9.03%	7.21%
Integrated	0.04% - 83.79%	14.73%	23.32%
Management - Oriented	1.55% - 85.07%	26.76%	30.23%

Table 4.3f: Variable P3 - % of Awarded to Budget (public owners)

Procurement Strategy	Range	Average	Std. Deviation
Separated & Co-operative	0.03% - 170.99%	11.82%	25.24%
Integrated	0.40% - 73.53%	11.69%	17.24%
Management - Oriented	1.51% - 33.06%	15.27%	14.22%

Table 4.3g: Variable P4 - % of Awarded to Claimed (private owners)

Procurement Strategy	Range	Average	Std. Deviation
Separated & Co-operative	10.71% - 76.38%	37.24%	21.69%
Integrated	0.79% - 93.28%	41.16%	29.63%
Management - Oriented	10.72% - 100.00%	44.14%	32.52%

Table 4.3h: Variable P4 - % of Awarded to Claimed (public owners)

Procurement Strategy	Range	Average	Std. Deviation
Separated & Co-operative	0.56% - 100.00%	44.40%	29.95%
Integrated	6.05% - 100.00%	58.00%	29.30%
Management - Oriented	7.55% - 46.17%	28.44%	16.21%

Table 4.3i: Variable P5 - % of Trial Overrun (private owners)

Procurement Strategy	Range	Average	Std. Deviation
Separated & Co-operative	337.54% - 10093.33%	1599.86%	2728.42%
Integrated	242.47% - 4867.78%	1142.925	1097.46%
Management - Oriented	247.29% - 1948.78%	659.79%	611.87%

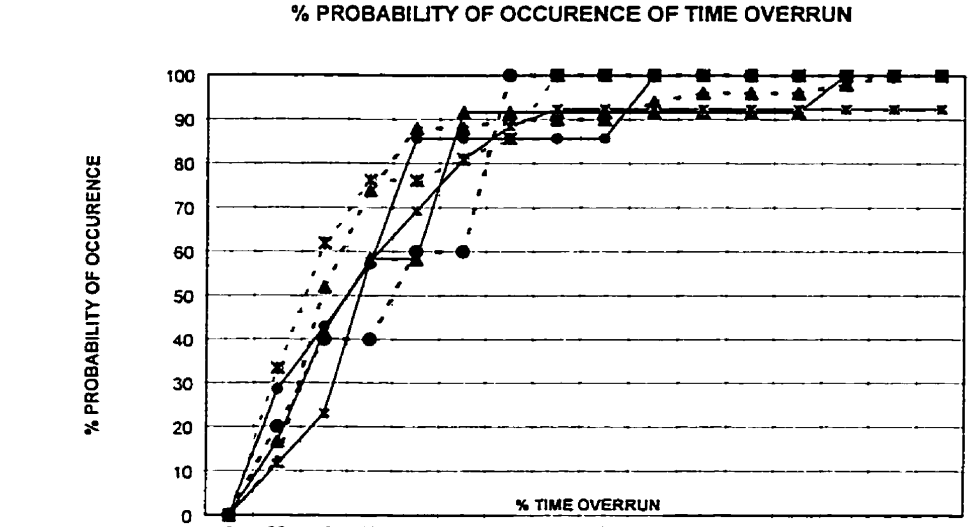
Table 4.3j: Variable P5 - % of Trial Overrun (public owners)

Procurement Strategy	Range	Average	Std. Deviation
Separated & Co-operative	151.30% - 11075.00%	1033.49%	1605.72%
Integrated	257.27% - 2092.12%	769.32%	468.89%
Management - Oriented	315.72% - 1933.06%	847.83%	644.18%

A more detailed analysis of each of the claims outcomes is given below:

4.2.1a % Time overrun

Overall, the *public owner* seems to have a lower probability of occurrence of a high percentage of time overrun under the integrated procurement strategy while having higher probability of occurrence of a high percentage of time overrun under the management-oriented procurement strategy; the separated and co-operative procurement strategy lies between the two (see Figure 4.4a).



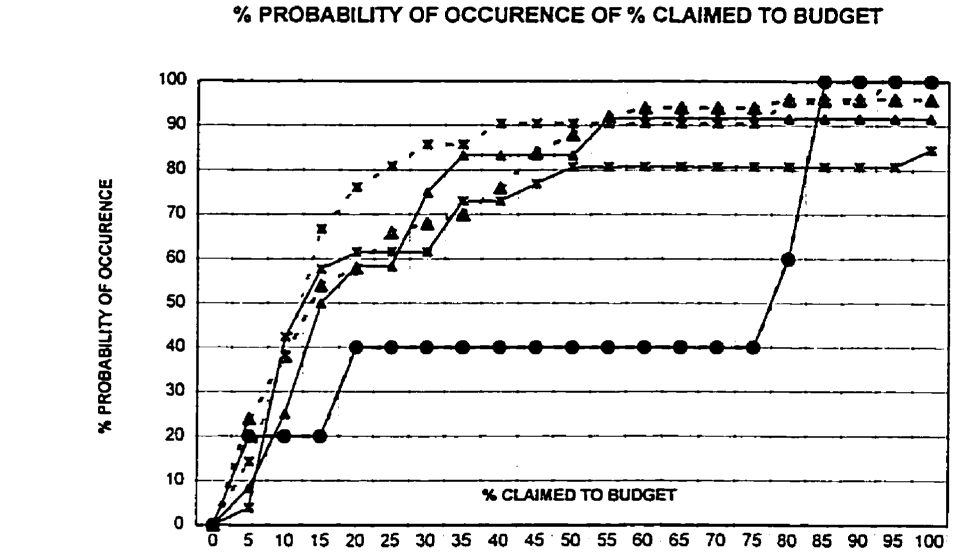
PUBLIC S&C	0	12	52	74	88	88	90	90	90	94	96	96	96	98	100	100
PRIVATE S&C	0	16.7	41.7	58.3	58.3	91.7	91.7	91.7	91.7	91.7	91.7	91.7	91.7	100	100	100
PUBLIC INT.	0	33.3	61.9	76.2	76.2	81	85.7	100	100	100	100	100	100	100	100	100
PRIVATE INT.	0	11.5	23.1	57.7	69.2	80.8	88.5	92.3	92.3	92.3	92.3	92.3	92.3	92.3	92.3	92.3
PUBLIC MGT.	0	20	40	40	60	60	100	100	100	100	100	100	100	100	100	100
PRIVATE MGT.	0	28.6	42.9	57.1	85.7	85.7	85.7	85.7	85.7	100	100	100	100	100	100	100

Figure 4.4a: Cumulative probability of occurrence of % time overrun

Specifically, the *public owner* adopting the integrated procurement strategy has the lowest percentage of time overrun, followed by the separated and cooperative procurement strategy then by the management-oriented procurement strategy. On the other hand, the *private owner* adopting the separated and cooperative procurement strategy has the lowest percentage of time overrun, followed by the integrated procurement strategy then by the management-oriented procurement strategy.

4.2.1b % Claimed to budget

Overall, the *public owner* seems to have the lowest probability of occurrence of a high percentage of claimed to budget under the integrated procurement strategy, while having the highest probability of occurrence of a high percentage of claimed to budget under the management-oriented procurement strategy (see Figure 4.4b).



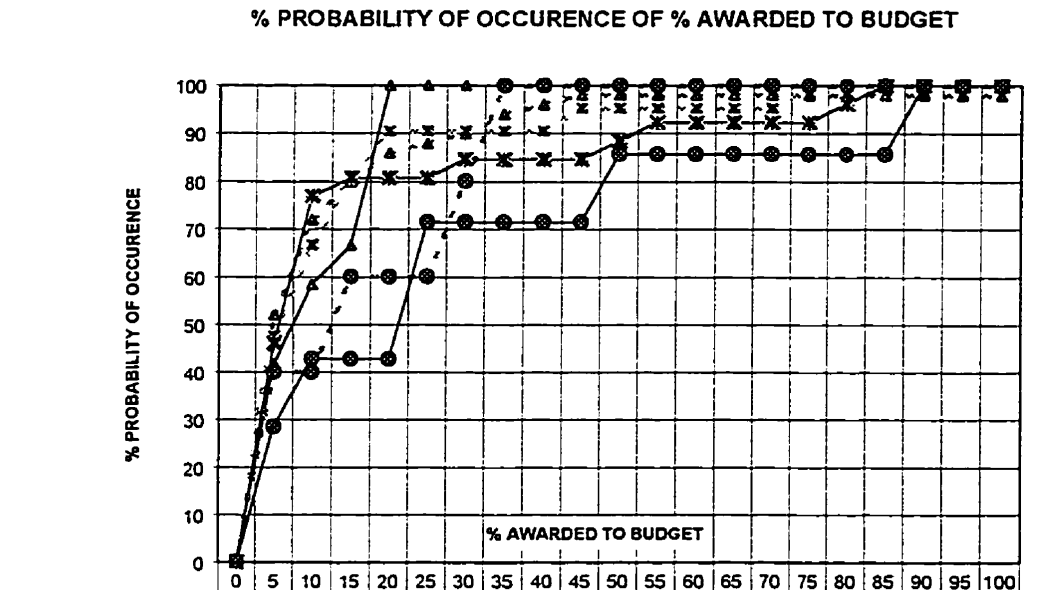
PUBLIC S&C	0	24	38	54	58	66	68	70	76	84	88	92	94	94	94	94	96	96	96	96	96
PRIVATE S&C	0	8.3	25	50	58	58	75	83	83	83	83	92	92	92	92	92	92	92	92	92	92
PUBLIC INT.	0	14	38	67	76	81	86	86	90	90	90	90	90	90	90	90	95	95	95	100	100
PRIVATE INT.	0	3.9	42	58	62	62	62	73	73	77	81	81	81	81	81	81	81	81	81	81	85
PUBLIC MGT.	0	20	20	20	40	40	40	40	40	40	40	40	40	40	40	40	60	100	100	100	100
PRIVATE MGT.	0	20	20	20	40	40	40	40	40	40	40	40	40	40	40	40	60	100	100	100	100

Figure 4.4b: Cumulative probability of occurrence of % claimed to budget

Specifically, the *public owner* adopting the integrated procurement strategy has the lowest percentage of claimed to budget, followed by the separated and cooperative procurement strategy then by the management-oriented procurement strategy. On the other hand, the *private owner* adopting the integrated procurement strategy has the lowest percentage of claimed to budget, followed by the separated and cooperative procurement strategy then by the management-oriented procurement strategy.

4.2.1c % Awarded to budget

Overall, the *private owner* seems to have the lowest probability of occurrence of a high percentage of awarded to budget under the separated and cooperative procurement strategy. The private owner under the management-oriented procurement strategy has the highest probability of occurrence of a high percentage of awarded to budget (see Figure 4.4c).



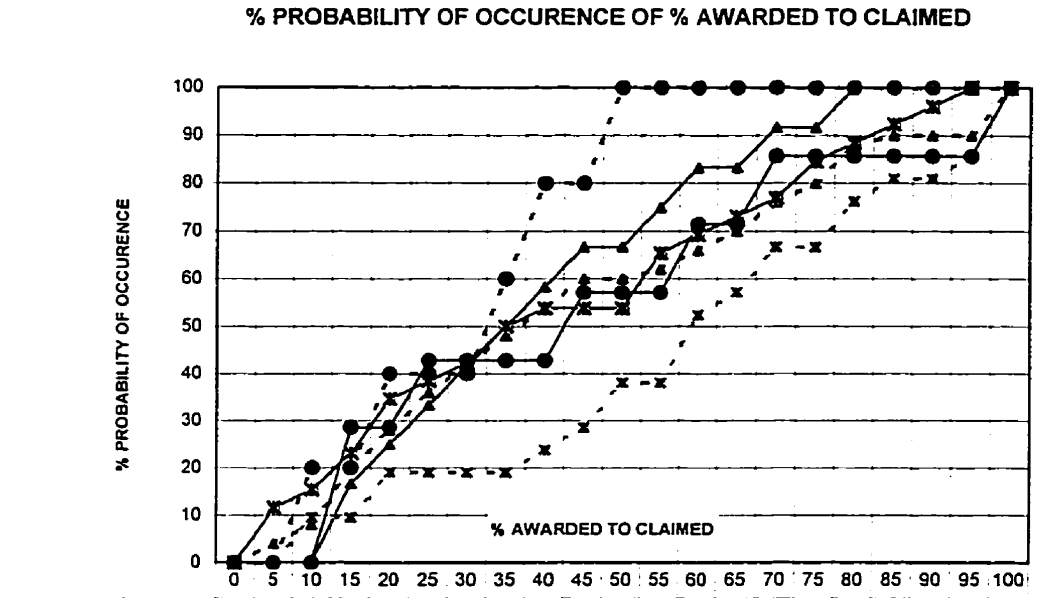
% AWARDED TO BUDGET	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
PUBLIC S&C	0	52	72	80	86	88	90	94	96	98	98	98	98	98	98	98	98	98	98	98	98
PRIVATE S&C	0	42	58	67	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
PUBLIC INT.	0	48	67	81	90	90	90	90	90	95	95	95	95	95	95	100	100	100	100	100	100
PRIVATE INT.	0	46	77	81	81	81	85	85	85	85	88	92	92	92	92	92	96	100	100	100	100
PUBLIC MGT.	0	40	40	60	60	60	80	100	100	100	100	100	100	100	100	100	100	100	100	100	100
PRIVATE MGT.	0	29	43	43	43	71	71	71	71	71	86	86	86	86	86	86	86	86	100	100	100

Figure 4.4c: Cumulative probability of occurrence of % awarded to budget

Specifically, the *public owner* adopting the integrated procurement strategy has the lowest percentage of awarded to budget, followed by the separated and cooperative procurement strategy then by the management-oriented procurement strategy. On the other hand, the *private owner* adopting the separated and cooperative procurement strategy has the lowest percentage of awarded to budget, followed by the integrated procurement strategy then by the management-oriented procurement strategy.

4.2.1d % Awarded to claimed

Overall, the *public owner* seems to have the least probability of occurrence of a high percentage of awarded to claimed under the management-oriented procurement strategy while having the highest probability of occurrence of a high percentage of awarded to claimed under the integrated procurement strategy (see Figure 4.4d).



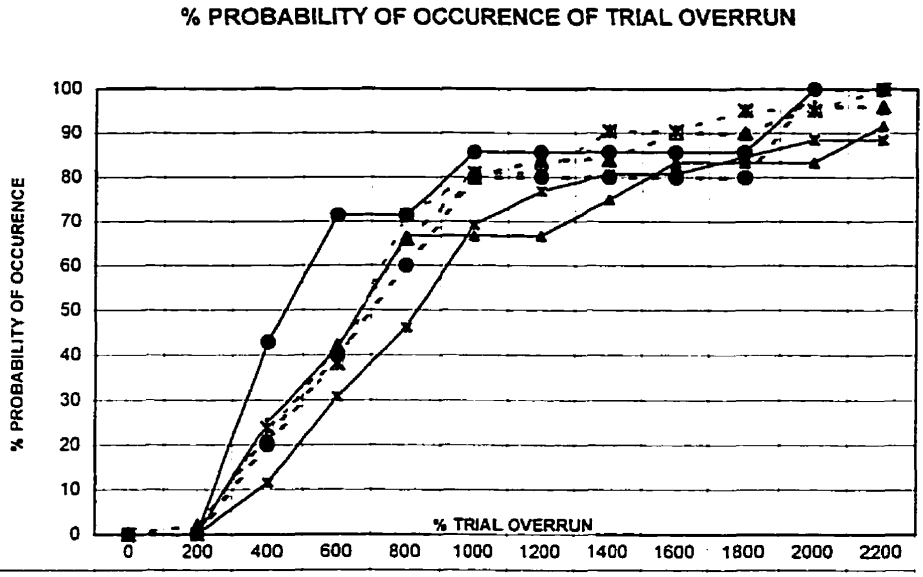
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
PUBLIC S&C	0	4	8	20	28	36	42	48	54	60	60	62	66	70	76	80	88	90	90	90	100
PRIVATE S&C	0	0	0	17	25	33	42	50	58	67	67	75	83	83	92	92	100	100	100	100	100
PUBLIC INT.	0	0	9.5	9.5	19	19	19	19	24	29	38	38	52	57	67	67	76	81	81	86	100
PRIVATE INT.	0	12	15	23	35	38	42	50	54	54	54	65	69	73	77	85	88	92	96	100	100
PUBLIC MGT.	0	0	20	20	40	40	40	60	80	80	100	100	100	100	100	100	100	100	100	100	100
PRIVATE MGT.	0	0	0	29	29	43	43	43	43	57	57	57	71	71	86	86	86	86	86	86	100

Figure 4.4d: Cumulative probability of occurrence of % awarded to claimed

Specifically, the *public owner* adopting the management-oriented procurement strategy has the lowest percentage of awarded to claimed, followed by the separated and cooperative procurement strategy then by the integrated procurement strategy. On the other hand, the *private owner* adopting the separated and cooperative procurement strategy has the lowest percentage of awarded to claimed, followed by the integrated procurement strategy then by the management-oriented procurement strategy.

4.2.1e % Trial overrun

Overall, the *private owner* seems to have the least probability of occurrence of a high percentage of trial overrun under the management-oriented procurement strategy while having the highest probability of occurrence of a high percentage of trial overrun under the integrated procurement strategy (see Figure 4.4e).



	0	200	400	600	800	1000	1200	1400	1600	1800	2000	2200
PUBLIC S&C	0	2	22	42	66	80	84	84	90	90	96	96
PRIVATE S&C	0	0	25	41.67	66.67	66.67	66.67	75	83.33	83.33	83.33	91.67
PUBLIC INT.	0	0	23.81	38.1	71.43	80.95	80.95	90.47	90.47	95.23	95.23	100
PRIVATE INT.	0	0	11.54	30.77	46.15	69.22	76.91	80.76	80.76	84.61	88.46	88.46
PUBLIC MGT.	0	0	20	40	60	80	80	80	80	80	100	100
PRIVATE MGT.	0	0	42.85	71.42	71.42	85.7	85.7	85.7	85.7	85.7	100	100

Figure 4.4e: Cumulative probability of occurrence of % trial overrun

Specifically, the *public owner* adopting the integrated procurement strategy has the lowest percentage of trial overrun, followed by the separated and cooperative procurement strategy then by the management-oriented procurement strategy. On the other hand, the *private owner* adopting the management-oriented procurement strategy has the lowest percentage of trial overrun, followed by the separated and cooperative procurement strategy then by the integrated procurement strategy.

4.2.2 Overall Performance of Claims Outcomes

The *separated and cooperative* procurement strategy proved to be the best strategy in terms of all the claims outcomes for the private owner while being the second best strategy in terms of all the claims outcomes for the public owner. Furthermore, we note that the private owner is better able to manage the number of occurrences of claims as well as their outcomes under the separated and co-operative procurement strategy (compare Figure 4.3e to Table 4.4b).

Table 4.4a: Consequences for *public owners* under different procurement strategies (from the owner's point of view)

PROCUREMENT STRATEGY	% Time Overrun			% Claimed to Budget			% Awarded to Budget			% Awarded to Claimed			% Trial Overrun		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High
Separated and cooperative Strategy		■			■			■			■			■	
Integrated Strategy	■			■			■					▒	■		
Management-Oriented Strategy			▒			▒			▒	■					▒

Table 4.4b: Consequences for *private owners* under different procurement strategies (from the owner's point of view)

PROCUREMENT STRATEGY	% Time Overrun			% Claimed to Budget			% Awarded to Budget			% Awarded to Claimed			% Trial Overrun		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High
Separated and cooperative Strategy	■				■		■			■				■	
Integrated Strategy		■		■				■			■				▒
Management-Oriented Strategy			▒			▒			▒			▒	■		

The *integrated* procurement strategy proved to be the best strategy in terms of all the claims outcomes for the public owner except for the % awarded to claimed (see Table 4.4a - this does not have any significant negative impact since both the % claimed to budget and the % awarded to budget outcomes are low and to the public owner's advantage). We note

that the integrated strategy, for the public owner, has a high occurrence of claims compared to the control group (see Figure 4.3d). The integrated procurement strategy is the second best strategy in terms of all the claims outcomes for the private owner except the % trial overrun.

The *management-oriented procurement strategy* proved to be the worst strategy in terms of all the claims outcomes for both the public and the private owners except that it has the lowest % awarded to claimed under the public owner and the least % trial overrun under the private owner. Again, this does not have any negative impact since both the % claimed to budget and the % awarded to budget outcomes are high and to the public owner's disadvantage).

Overall, the separated and cooperative procurement strategy still appears to be holding its place. This is not surprising since it is the strategy that has been used for the longest time (indeed, it is often referred to as "traditional procurement").

Note that, as we have stated, this analysis is from the owner's perspective (a contractor's perspective will be different in the monetary side only since they both desire to minimize delays and trial time); in contrast, it is to the contractor's advantage to claim more and to have the owner be obliged to award him more.

4.2.3 Relationship between Claims Outcomes

The relationships between all claims outcomes have been plotted as scatter diagrams (Figure 4.5) and although skewness of data was detected due to the uneven distribution of data over the ranges recorded, some preliminary conclusions can be drawn by visually comparing these relationships under the three identified procurement strategies.

4.2.3a % Time overrun and % claimed to budget

Time overrun does not appear to systematically influence the amount *claimed.* Indeed, we notice that for low % of time overruns, there is a higher incidence of % claimed to budget in both separated and cooperative, and integrated procurement strategies. In the management-oriented strategy, on the other hand, there are higher amounts of % claimed to budget at low % of time overruns.

4.2.3b % Time overrun and % awarded to budget

Time overrun does not appear to influence the amount *awarded.* Indeed, we notice that for low % of time overruns, there is a higher incidence of % awarded to budget in both separated and cooperative and management-oriented procurement strategies. In the integrated procurement strategy, on the other hand, there are higher amounts of % claimed to budget at low % of time overruns.

4.2.3c % Time overrun and % awarded to claimed

Time overrun does not appear to influence the ratio of awarded to claimed amounts. Indeed, we notice that for low % of time overruns, there is a higher incidence of % awarded to claimed in all procurement strategies.

4.2.3d % Time overrun and % trial overrun

Time overrun does not appear to influence the % of trial overrun. Indeed, we notice that most of the instances of high % trial overrun happen at low % of time overruns in all procurement strategies.

4.2.3e % Trial overrun and % awarded to claimed

% Awarded to claimed does not appear to be influenced by the % of trial overrun. Indeed, we notice that most of the incidences happened at low % of trial overruns in all the procurement strategies (and as a matter of fact all of the incidences of high % awarded to claimed).

4.2.3f % Claimed to budget and % awarded to budget

A pattern appears to exist in this relationship for each of the procurement strategies. This has been further investigated and a strong correlation was found and plotted (see Figure 4.6).

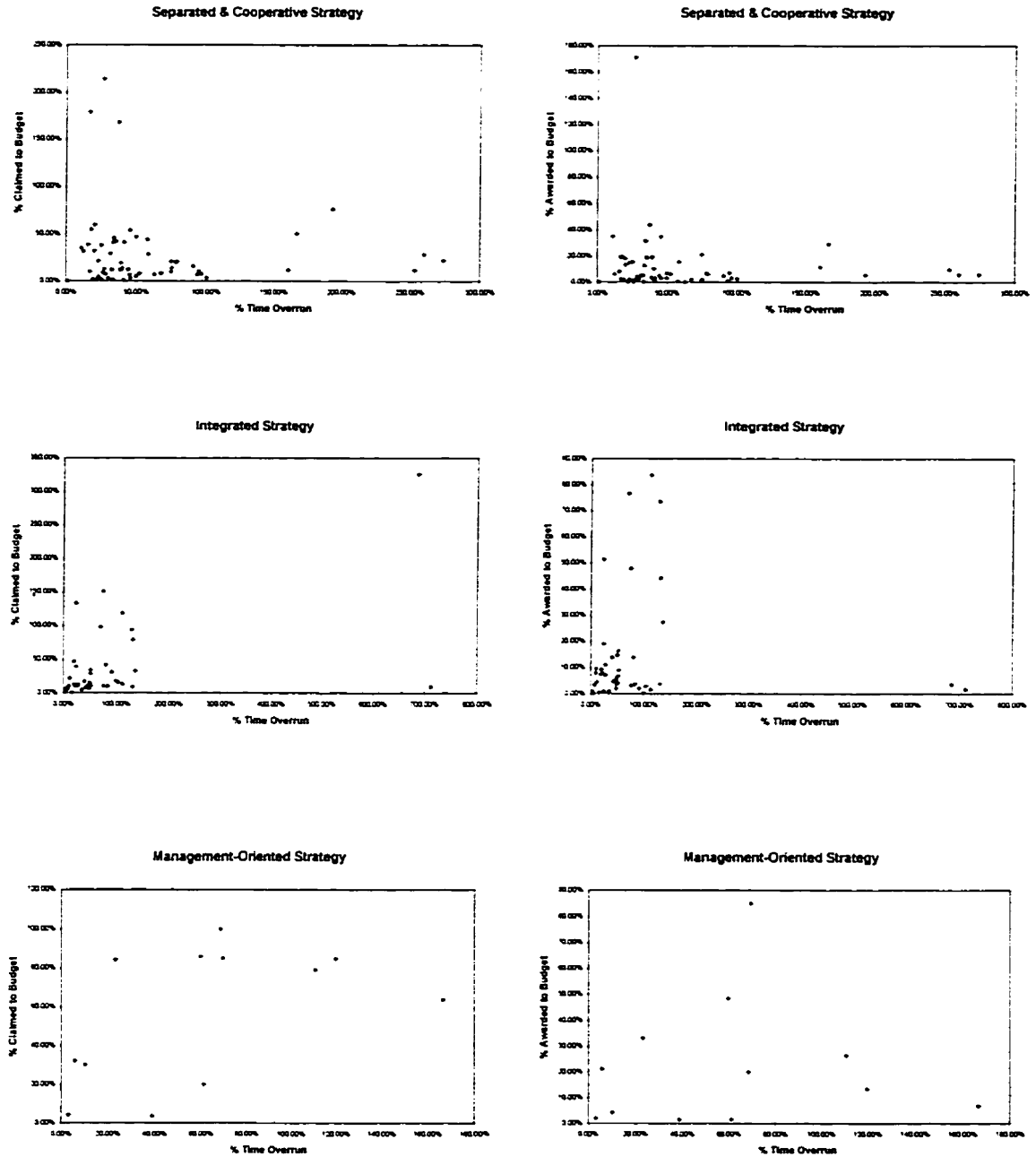


Figure 4.5: Relationships between claims outcomes by strategy (continued)

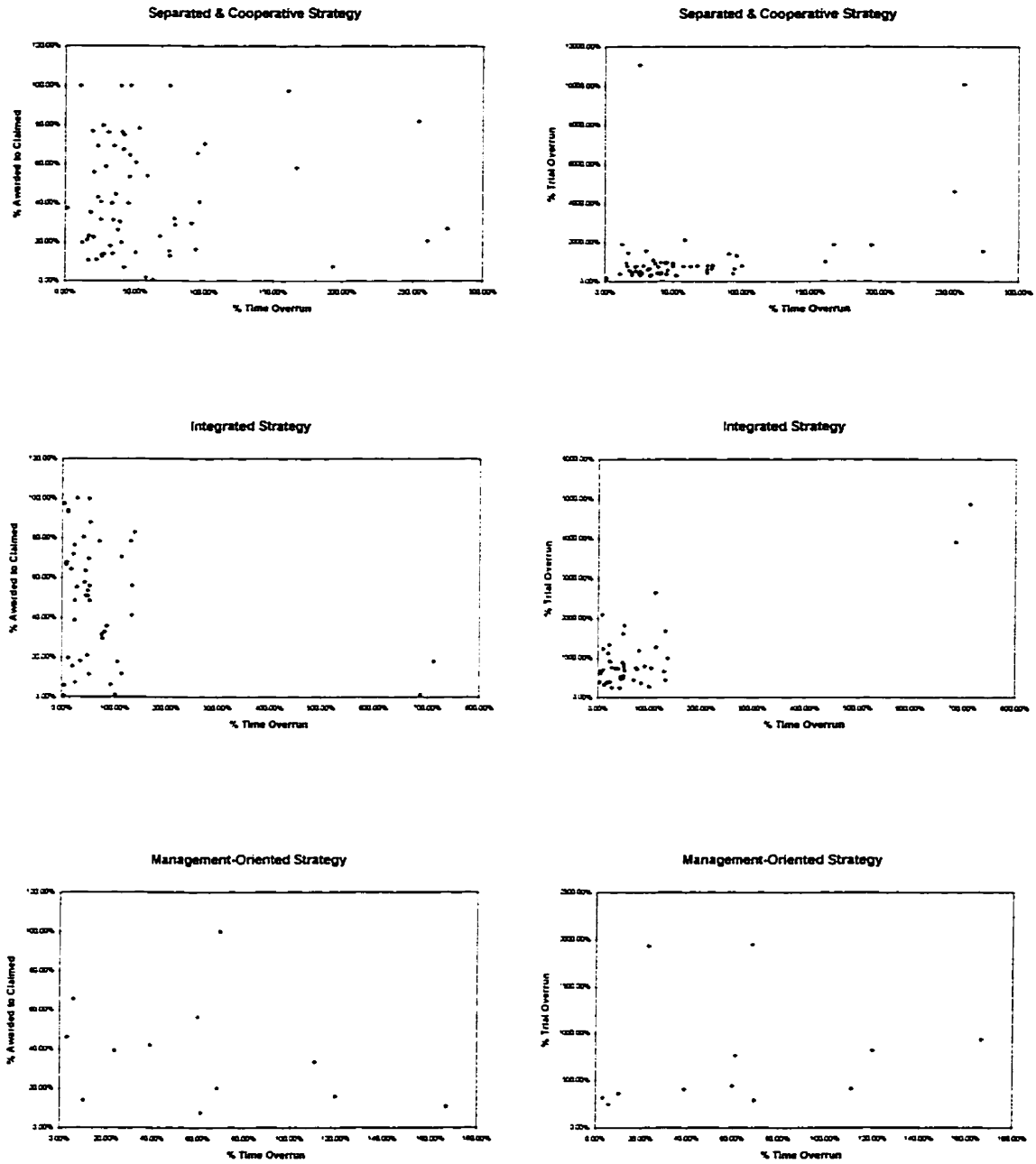


Figure 4.5: Relationships between claims outcomes by strategy (continued)

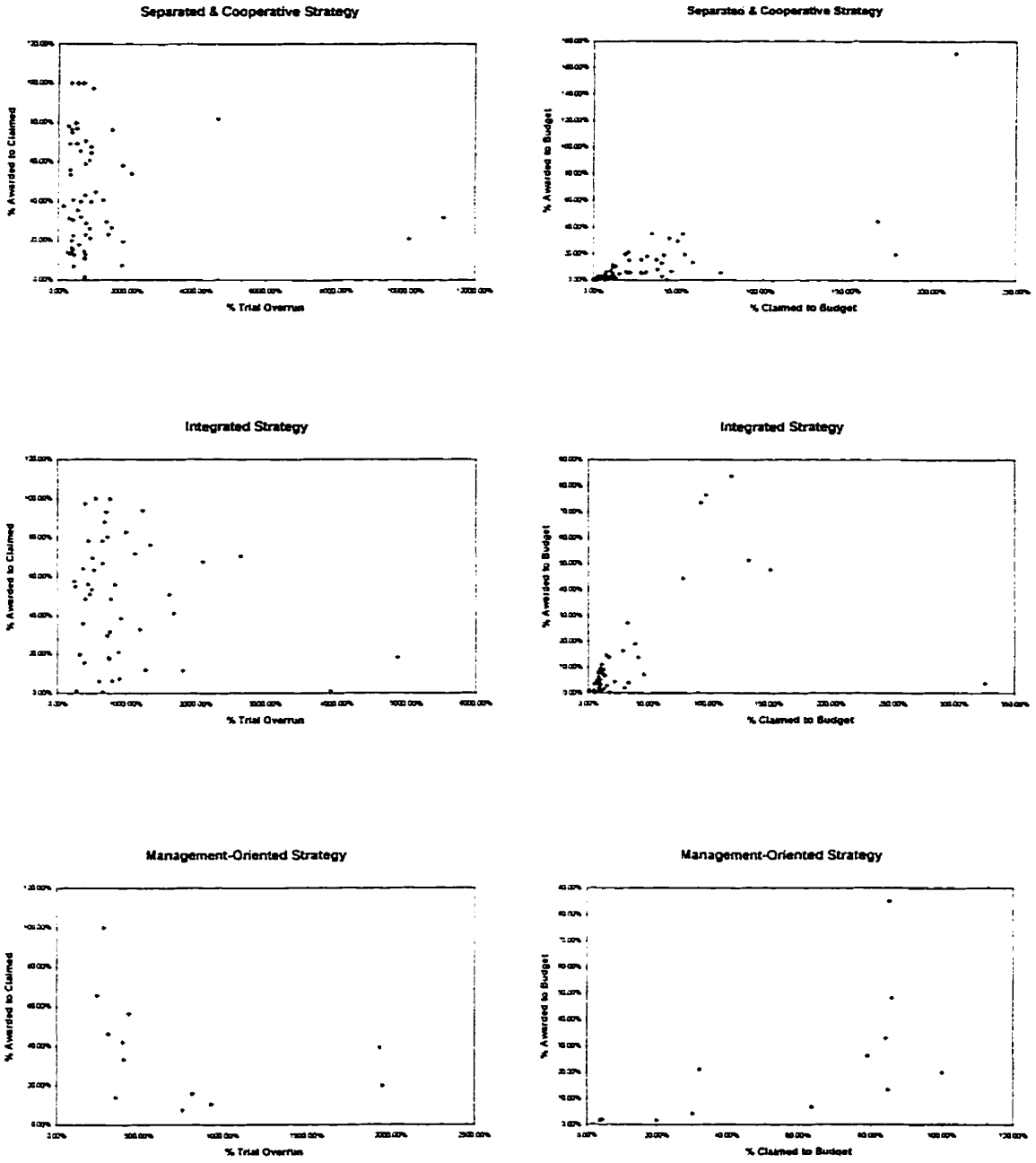


Figure 4.5: Relationships between claims outcomes by strategy

4.2.4 Regression Analysis

From the previous analyses, it was noticed that the variables are skewed in statistical terms, so that most of whatever is interesting in the plots is obscured by the few large values. There are several ways of remedying this situation, one of which is to start eliminating outlying observations. The other, which is commonly used, is to transform (normalize) the data. A common transformation used for data of this sort is the log-linear transformation.

A log-linear transformation was carried out for all variables. A linear pattern of relationships between the % awarded to claimed (P3) on the one hand, and the % claimed to budget (P2) on the other (both variables in log scale), for all three procurement strategies was observed.

Regression analysis was conducted between these two variables for each of the procurement strategies. A strong and highly significant correlation (Sign F <0.05) was found to exist, and can be represented by the regression equation:

$$\text{Log } P3 = A + B \text{ (Log } P2)$$

Where P3 = % award to budget;
P2 = % claimed to budget;
A = Constant;
B = Coefficient of regression.

The regression equation for these two variables for each of the procurement strategies is as follows:

4.2.4a Separated and cooperative procurement strategy:

$$\text{Log P3} = -0.426 + 0.931(\text{Log P2})$$

$R=0.804$, $R^2=0.647$, significance level = 0.000 (highly significant)

Regression (Separated and Cooperative Strategy)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.804[a]	.647	.641	.4209

a. Predictors: (Constant), LOGP2

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	19.480	1	19.480	109.962	.000[a]
	Residual	10.629	60	.177		
	Total	30.109	61			

a. Predictors: (Constant), LOGP2

b. Dependent Variable: LOGP3

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.426	.113		-3.763	.000
	LOGP2	.931	.089	.804	10.486	.000

a. Dependent Variable: LOGP3

4.2.4b Integrated procurement strategy:

$$\text{Log P3} = -0.300 + 0.843(\text{Log P2})$$

$R=0.653$, $R^2=0.427$, significance level = 0.000 (highly significant)

Regression (Integrated Strategy)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.653[a]	.427	.414	.5169

a. Predictors: (Constant), LOGP2

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.956	1	8.956	33.523	.000[a]
	Residual	12.022	45	.267		
	Total	20.978	46			

a. Predictors: (Constant), LOGP2

b. Dependent Variable: LOGP3

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-.300	.189		-1.582	.121
	LOGP2	.843	.146	.653	5.790	.000

a. Dependent Variable: LOGP3

4.2.4c Management-oriented procurement strategy:

$$\text{Log P3} = -0.491 + 0.970(\text{Log P2})$$

$R=0.819$, $R^2=0.671$, significance level = 0.001 (highly significant)

Regression (Management-Oriented Strategy)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.819[a]	.671	.638	.3614

a. Predictors: (Constant), LOGP2

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.659	1	2.659	20.361	.001[a]
	Residual	1.306	10	.131		
	Total	3.965	11			

a. Predictors: (Constant), LOGP2

b. Dependent Variable: LOGP3

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.491	.354		-1.387	.196
	LOGP2	.970	.215	.819	4.512	.001

a. Dependent Variable: LOGP3

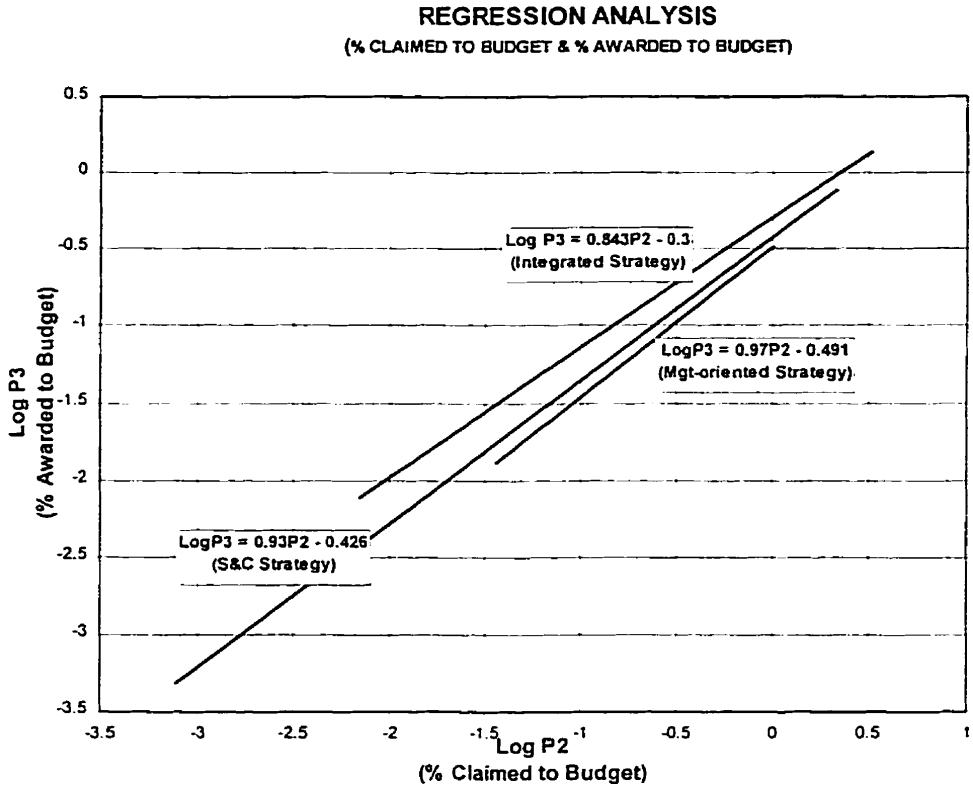


Figure 4.6: Comparison between the performances of the procurement strategies (% claimed to budget and % awarded to budget, **log - log**[1] scale)

Plotting these equations, we can clearly see that the management-oriented procurement strategy has the lowest % of *awarded* amount followed by the separated and cooperative procurement strategy and then by the integrated procurement strategy; this is in conformity with the findings depicted in Figure 4.4.d. It is interesting to note that when compared to the cumulative probability of occurrences for both the % claimed to budget and the % awarded to budget (Figures 4.4b and 4.4c), the exact inverse in the ranking of the management-oriented procurement strategy, for the overall performances of claims outcomes, is observed (indeed, the management-oriented procurement strategy is the least

[1] Since both the dependent and independent variables are in log units, the coefficients can be approximately interpreted in percentage terms (Norusis, 1990).

performing of all procurement strategies and for both types of owners). We should also bear in mind that linearity cannot be assumed beyond the limits of the data since these equations were derived from the ranges of claims data shown on tables 4.2c to 4.2f.

This is a very useful tool for the project owners when they assess the procurement strategies up front, since they would know beforehand what to expect if things go wrong and they become involved in a legal claim situation (likewise, it is also useful for the contractors since it enables them to define their claims strategy in accordance to the project's procurement strategy).

SECTION 2: DISCUSSION

In this section, a detailed analysis was presented for the different outcomes of claims (% time overrun, % claimed to budget, % awarded to budget, % awarded to claimed and % trial overrun) under the three families of procurement strategies (the separated and co-operative procurement strategy, the integrated procurement strategy and the management-oriented procurement strategy). The synthesis of this analysis is presented in Tables 4.4a and 4.4b.

From the owner's point of view, we note that overall, the performance of the separated and co-operative procurement strategy has proven to be the best performance for all claims outcomes under the private owner [whether, from low occurrences of claims (Figure 4.3e) or from better claims outcomes (Table 4.4b)]. The private owner appears to have mastered the separated and co-operative procurement strategy

The public owner appears to fall less into claims under the separated and co-operative procurement strategy but has the second best performance of all claims outcomes after the integrated procurement strategy (see Table 4.4a).

The management-oriented procurement strategy proved to be the worst procurement strategy in claims outcomes for both types of owners, with the exception of % awarded to claimed under the public owner (but as we have indicated previously, this does not have any significance since it has the worst % claimed to budget and the worst % awarded to budget). The private owner has the highest probability of % trial overrun under this strategy.

The integrated procurement strategy proved to be the best strategy in the performance of all the claims outcomes for the public owner, except for the % awarded to claimed (see Table 4.4a - this does not have any impact since both the % claimed to budget and the % awarded to budget outcomes are low and to the public owner's advantage). The integrated procurement strategy is the second best strategy in terms of all the claims outcomes for the private owner except the % trial overrun.

We note that the integrated strategy under both types of owner has a high occurrence of claims compared to the control group (see Figures 4.3b, 4.3d and 4.3e).

A synthesis of the consequences for each type of owner under each of the three families of procurement strategies is shown in Table 4.5.

Table 4.5: Overall performance of the different procurement strategies, from the owner's point of view (claims occurrences data from section 1 and claims outcomes data from this section)

PROCUREMENT STRATEGY	PUBLIC OWNER						PRIVATE OWNER					
	Claims Occurrence			Claims Outcomes			Claims Occurrence			Claims Outcomes		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High
Separated and cooperative Strategy	■				■		■			■		
Integrated Strategy			■	■					■		■	
Management-Oriented Strategy		■				■		■				■

An examination of the synthesis shown in Table 4.5 indicates that there is a divergence between the occurrences of claims and their outcomes (e.g. the public owner under the integrated procurement strategy has a high claims occurrences but has low claims outcomes). This necessitates an in-depth study of the root causes of claims to be able to give an informed opinion about the consequences of the three families of procurement strategies.

The relationship shown in Figure 4.6 is useful in the sense that it gives both owners and contractors a general idea of what to expect regarding awards when faced with a claims situation under the three families of procurement strategies. Although the regression analysis is not in conformity with the syntheses shown in Tables 4.4a and 4.4b, it is useful as a general guidance to both owners and contractors on the consequences of each type of procurement strategy and what to expect as a reward in a "claims situation". We have to bear in mind that the regression analysis was performed for each procurement strategy regardless of type of owner since it would have been impossible to perform this analysis for each type of owner due to the smallness of the sample sizes if so divided.

The next section (section 3) identifies and discusses the causes of claims found in our study, their frequency, their importance, and their severity under each procurement strategy.

SECTION 3:

CAUSES OF CLAIMS

4.3.CAUSES OF CLAIMS

Twenty-two causes of claims were cited in the 121 claims cases in 241 instances (sometimes there were more than one cause per claim).. Based on the factors in organizational design theory that were found to be conflict-inducing in multi-organizations, and were proven to be deterministic to the performance of the building project (Mohsini, 1984), the causes of delays were grouped into three main categories:

1. **Scope of the project (or domain consensus)**: 5 causes of claims were cited under this category in 26 instances (evenly distributed among public and private owners - 13 instances each);
2. **Availability and access to information**: 9 causes of claims were cited under this category in 142 instances (92 instances for public owners and 50 instances for private owners);
3. **Coordination (or interdependence of tasks)**: 8 causes in 73 citations (46 instances for public owners and 27 instances for private owners).

In the following presentation, the causes of claims will be treated as if they all happened separately since it is impossible to isolate the effect of each cause of delay because of the ripple effect of concurrent causes.

Generally speaking, availability and access to information proved to be the most critical category in claims' causation factors (58.92%) followed by coordination (30.29%) and then scope of the project (10.79%). Figures (4.7&4.8).

In the availability and information category, uncoordinated change orders (X28) and late approvals (X24) are the most crucial factors.

In the coordination category, lack of coordination (X31) and restricted site access and interference (X32) are the most crucial factors.

In the scope of the project category, changes in scope of work (X11) and differing site conditions (X13) are the most crucial.

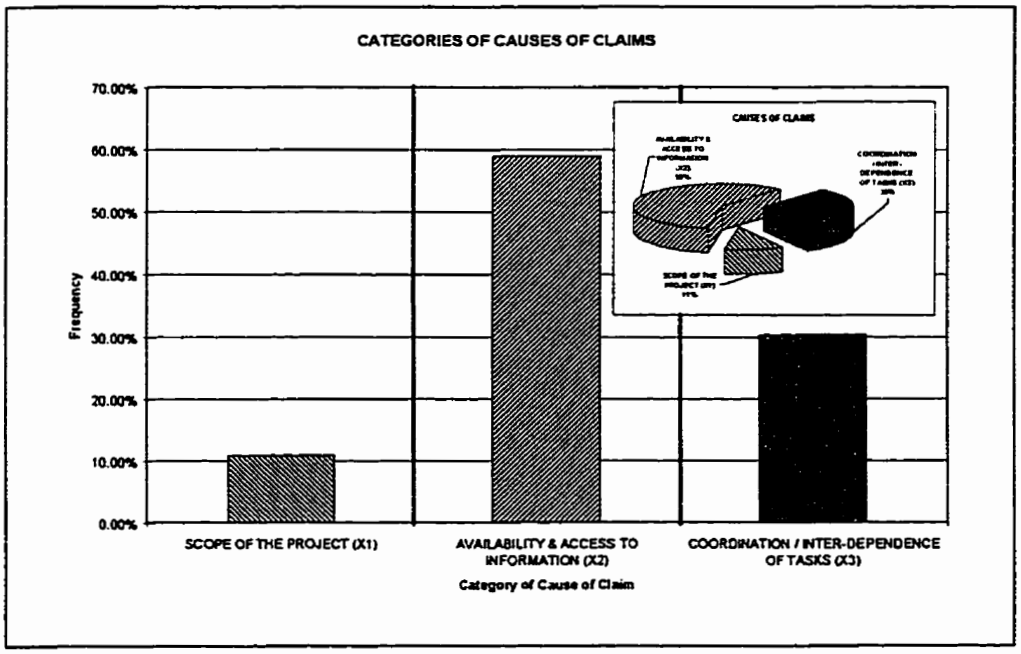


Figure 4.7: Causes of claims by category (for all strategies)

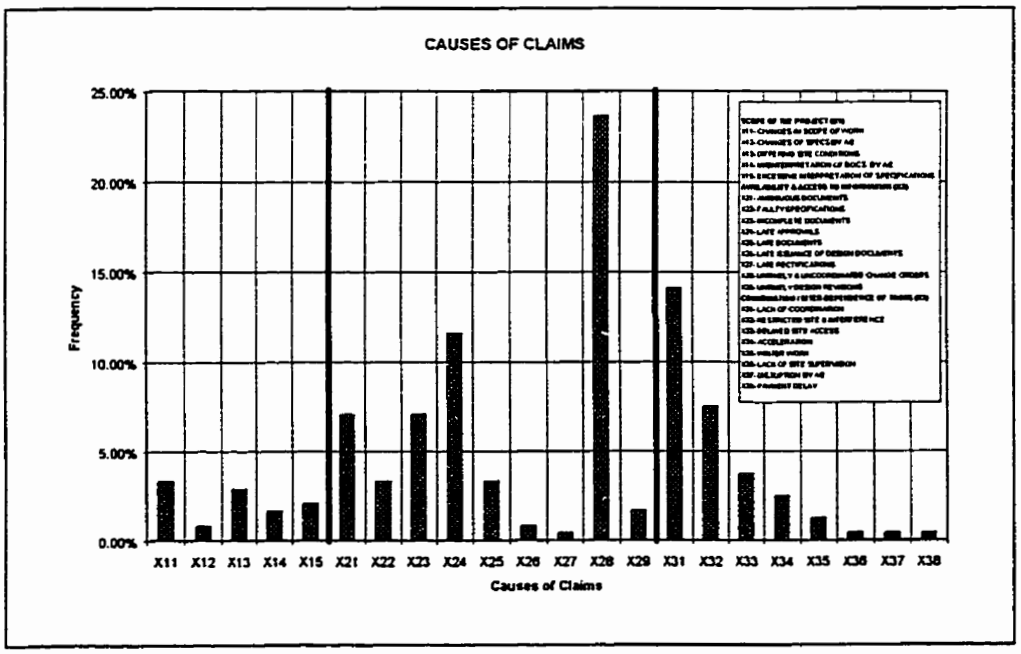


Figure 4.8: Individual causes of claims (for all strategies)

Availability and access to information is the worst cause of claims category for all procurement strategies with the worst impact on the separated and co-operative procurement strategy under the private owner (73.08%), then under the public owner (64.36%). The public owner and the private owner in the management-oriented procurement strategy follow closely (60% and 56.25%) (see Table 4.6).

Table 4.6: Individual causes of claims (by procurement strategy and owner)

CAUSES OF DELAY CLAIMS	# OF TIMES	% CAUSES	SEPARATED & CO-OPERATIVE				INTEGRATED SYSTEM				MANAGEMENT ORIENTED			
			#RECUR	%RECUR	#RECUR	%RECUR	#RECUR	%RECUR	#RECUR	%RECUR	#RECUR	%RECUR	#RECUR	%RECUR
SCOPE OF THE PROJECT (X1)														
X11- CHANGES IN SCOPE OF WORK	8	3.32%	3	2.97%	1	3.85%					2	20.00%	2	12.50%
X12- CHANGES OF SPECS BY A/E	2	0.83%	2	1.98%										
X13- OFFERING SITE CONDITIONS	7	2.90%	1	0.99%			1	2.50%	4	8.33%	1	10.00%		
X14- MISINTERPRETATION OF DOCS. BY A/E	4	1.66%	2	1.98%	1	3.85%			1	2.08%				
X15- EXCESSIVE INTERPRETATION OF SPECIFICATIONS	5	2.07%					1	2.50%	4	8.33%				
AVAILABILITY AND ACCESS TO INFO. (X2)														
X21- AMBIGUOUS DOCUMENTS	17	7.05%	8	7.92%	3	11.54%	4	10.00%	2	4.17%				
X22- FAULTY SPECIFICATIONS	8	3.32%	5	4.95%	1	3.85%	2	5.00%						
X23- INCOMPLETE DOCUMENTS	17	7.05%	7	6.93%	2	7.69%	6	15.00%	2	4.17%				
X24- LATE APPROVALS	28	11.62%	22	21.78%	5	19.23%			1	2.08%				
X25- LATE DOCUMENTS	8	3.32%	4	3.96%			1	2.50%	3	6.25%				
X26- LATE ISSUANCE OF DESIGN DOCUMENTS	2	0.83%											2	12.50%
X27- LATE RECTIFICATIONS	1	0.41%					1	2.50%						
X28- UNTIMELY & UNCOORDINATED CHANGE ORDERS	57	23.65%	18	17.82%	8	30.77%	7	17.50%	14	29.17%	5	50.00%	5	31.25%
X29- UNTIMELY DESIGN REVISIONS	4	1.66%	1	0.99%							1	10.00%	2	12.50%
COORDINATION (X3)														
X31- LACK OF COORDINATION	34	14.11%	13	12.87%	3	11.54%	9	22.50%	7	14.58%			2	12.50%
X32- RESTRICTED SITE & INTERFERENCE	18	7.47%	7	6.93%	1	3.85%	1	2.50%	6	12.50%	1	10.00%	2	12.50%
X33- DELAYED SITE ACCESS	9	3.73%	5	4.95%			3	7.50%	1	2.08%				
X34- ACCELERATION	6	2.49%					3	7.50%	3	6.25%				
X35- WINTER WORK	3	1.24%	1	0.99%	1	3.85%	1	2.50%						
X36- LACK OF SITE SUPERVISION	1	0.41%	1	0.99%										
X37- DISRUPTION BY A/E	1	0.41%	1	0.99%										
X38- PAYMENT DELAY	1	0.41%											1	6.25%
TOTAL CAUSES BY STRATEGY AND OWNER	241		101	100%	26	100%	40	100%	48	100%	10	100%	16	100%

This scope of the project category of causes of claims proved to be the least important for all strategies and owners except for the public owner under the management-oriented procurement strategy where it assumes the second place of importance after the availability and access to information category.

Looking more closely at the procurement strategies and the causes of claims categories, more or less the same order of importance in the claims-causing categories was noticed, with the exception of the management-oriented procurement strategy under the public owner where the scope of the project category takes second place of importance, instead of the coordination category (30% to 10%) (see Table 4.7).

Table 4.7: Categorized causes of claims (by procurement strategy and owner)

CAUSES OF DELAY CLAIMS	# OF TIMES X (CAUSED)		SEPARATED & CO-OPERATIVE				INTEGRATED SYSTEM				MANAGEMENT ORIENTED			
			#RECUR	%RECUR	#RECUR	%RECUR	#RECUR	%RECUR	#RECUR	%RECUR	#RECUR	%RECUR	#RECUR	%RECUR
SCOPE OF THE PROJECT (X1)														
X11- CHANGES IN SCOPE OF WORK	8	30.77%	3	37.50%	1	50.00%					2	66.67%	2	100.00%
X12- CHANGES OF SPECS BY A/E	2	7.69%	2	25.00%										
X13- OFFERING SITE CONDITIONS	7	26.92%	1	12.50%			1	50.00%	4	44.44%	1	33.33%		
X14- MISINTERPRETATION OF DOCS. BY A/E	4	15.38%	2	25.00%	1	50.00%			1	11.11%				
X15- EXCESSIVE INTERPRETATION OF SPECIFICATIONS	5	19.23%					1	50.00%	4	44.44%				
AVAILABILITY AND ACCESS TO INFO. (X2)														
X21- AMBIGUOUS DOCUMENTS	17	11.97%	8	12.31%	3	15.79%	4	19.05%	2	9.09%				
X22- FAULTY SPECIFICATIONS	8	5.63%	5	7.69%	1	5.26%	2	9.52%						
X23- INCOMPLETE DOCUMENTS	17	11.97%	7	10.77%	2	10.53%	6	28.57%	2	9.09%				
X24- LATE APPROVALS	28	19.72%	22	33.85%	5	26.32%			1	4.55%				
X25- LATE DOCUMENTS	8	5.63%	4	6.15%			1	4.76%	3	13.64%				
X26- LATE ISSUANCE OF DESIGN DOCUMENTS	2	1.41%											2	22.22%
X27- LATE RECTIFICATIONS	1	0.70%					1	4.76%						
X28- UNTIMELY & UNCOORDINATED CHANGE ORDERS	57	40.14%	18	27.69%	8	42.11%	7	33.33%	14	63.64%	5	83.33%	5	55.56%
X29- UNTIMELY DESIGN REVISIONS	4	2.82%	1	1.54%							1	16.67%	2	22.22%
COORDINATION (X3)														
X31- LACK OF COORDINATION	34	46.58%	13	48.43%	3	60.00%	9	52.94%	7	41.18%			2	40.00%
X32- RESTRICTED SITE & INTERFERENCE	18	24.66%	7	25.00%	1	20.00%	1	5.88%	6	35.29%	1	100.00%	2	40.00%
X33- DELAYED SITE ACCESS	9	12.33%	5	17.86%			3	17.65%	1	5.88%				
X34- ACCELERATION	6	8.22%					3	17.65%	3	17.65%				
X35- WINTER WORK	3	4.11%	1	3.57%	1	20.00%	1	5.88%						
X36- LACK OF SITE SUPERVISION	1	1.37%	1	3.57%										
X37- DISRUPTION BY A/E	1	1.37%	1	3.57%										
X38- PAYMENT DELAY	1	1.37%											1	20.00%
TOTAL OCCURRENCES	73		27		5		17		22		6		9	
TOTAL CAUSES BY STRATEGY/OWNER	21		10		5		7		11		3		5	

For a detailed analysis of the occurrence of claims causes under each procurement strategy and for each type of owner, the following observations were made:

4.3.1 For all Procurement Strategies

a) **Public owner:** Untimely and uncoordinated change orders (X28) - 20% occurrences, late approvals (X24) and lack of coordination (X31) (14.5% occurrences each) have the highest frequency of occurrence, followed by incomplete documents (X23) - 8.6% occurrences, and ambiguous documents (X21) - 8% occurrences (see Figure 4.9).

The causes with the least occurrence (one occurrence each) were: excessive interpretation of specifications (X15), late rectification (X27), lack of site supervision (X36), and disruption by A/E (X37).

Late issuance of design documents (X26), and payment delay (X38) do not represent a cause of claim for the public owner in any of the procurement strategies.

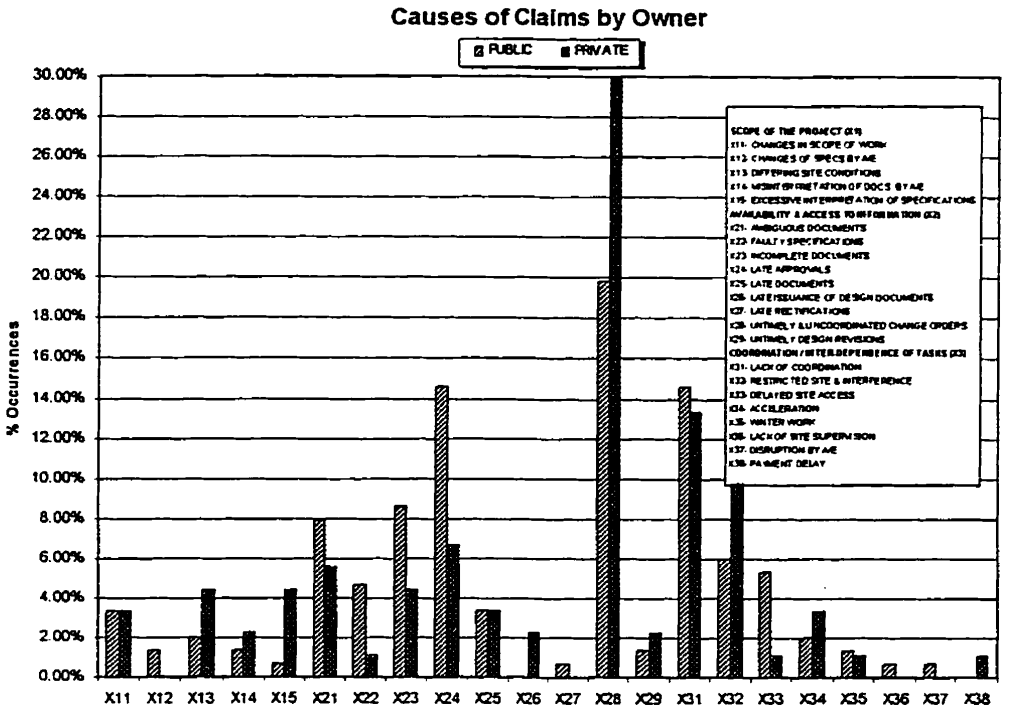


Figure 4.9: Causes of claims by owner

b) **Private owner:** Untimely and uncoordinated change orders (X28) has the highest overall frequency of occurrence (30%, which is even worse than for the public owner) followed by: lack of coordination (X31) - 13.33% occurrences, restricted site and interference (X32) - 10% occurrences, late approvals (X24) - 6.67% occurrences, and ambiguous documents (X21) - 5.5% occurrences (see Figure 4.9).

The causes with the least occurrence (one occurrence each) were: faulty specifications (X22), delayed site access (X33), winter work (X35), and payment delay (X38). Changes of specifications by A/E (X12), late rectification (X27), lack of site supervision (X36), and disruption by A/E (X37) do not represent a cause of claim for the private owner in any of the procurement strategies.

4.3.2 Between Procurement Strategies

a) **Public owner:** Comparing the three procurement strategies under the *public owner*, it can be seen that they do not have any instances for late issuance of design documents (X26), and payment delay (X38) (see Figure 4.10).

1. ***Separated and co-operative procurement strategy***: is characterized by a high occurrence of late approvals (X24) - 21.78% occurrences which, by the way, is absent in both integrated procurement strategy and management-oriented procurement strategy, followed by untimely and uncoordinated change orders (X28) - 17.82 % occurrences, and lack of coordination (X31) - 12.87% occurrences.

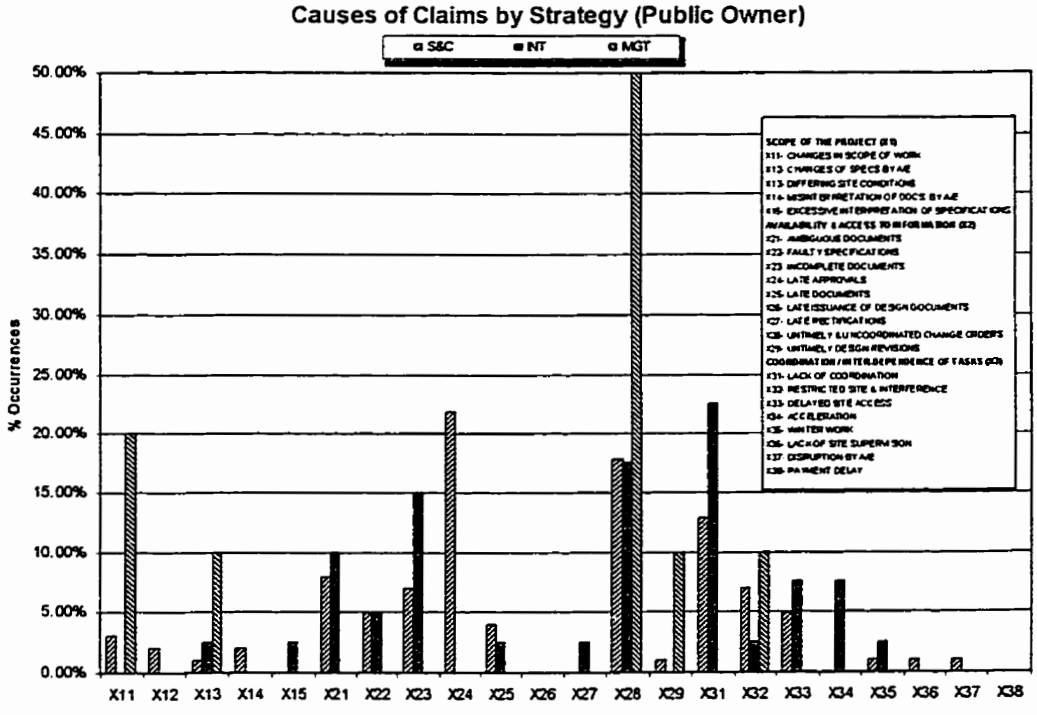


Figure 4.10: Causes of claims by strategy (public owner)

Separated and co-operative procurement strategy has the only occurrence of changes of specifications by A/E (X12), misinterpretation of documents by A/E

(X14), late approvals (X24), lack of site supervision (X36), and payment delay (X37). It has no occurrences of excessive interpretation of specifications (X15), late issuance of design documents (X26), late rectifications (X27), acceleration (X34), and payment delay (X38).

2. ***Integrated procurement strategy:*** is, somewhat surprisingly, characterized by the highest occurrence of lack of coordination (X31) - 22.50% occurrences (higher than the separated and co-operative procurement strategy).

   Integrated procurement strategy has the only occurrence of excessive interpretation of specifications (X15), late rectifications (X27), and acceleration (X34). It has no occurrences of late approvals (X24), late issuance of design documents (X26), untimely design revisions (X29), lack of site supervision (X36), disruption by A/E (X37), and payment delay (X38).

3. ***Management-oriented procurement strategy:*** is characterized by the highest occurrence of untimely and uncoordinated change orders (X28) - 50% occurrences (higher even than the other two procurement strategies).

   Management-oriented procurement strategy has no other single occurrence at a higher level than the other two procurement strategies. It has no occurrences of changes of specifications by A/E (X12), or misinterpretation of documents by A/E (X14). It also has no occurrences for all of the availability and access to information category (except for untimely and uncoordinated change orders (X28) and untimely design revisions (X29)), nor for all of the coordination category (except for restricted site and interference (X32)).

b) **Private owner:** Comparing the three procurement strategies under the *private owner,* it can be seen that while they do not have any instances of changes of specifications by A/E (X12), late rectifications (X27), lack of site supervision (X36), and disruption by

A/E (X37), they all share the highest occurrence of untimely and uncoordinated change orders (X28) (around 30% in each procurement strategy) (see Figure 4.11).

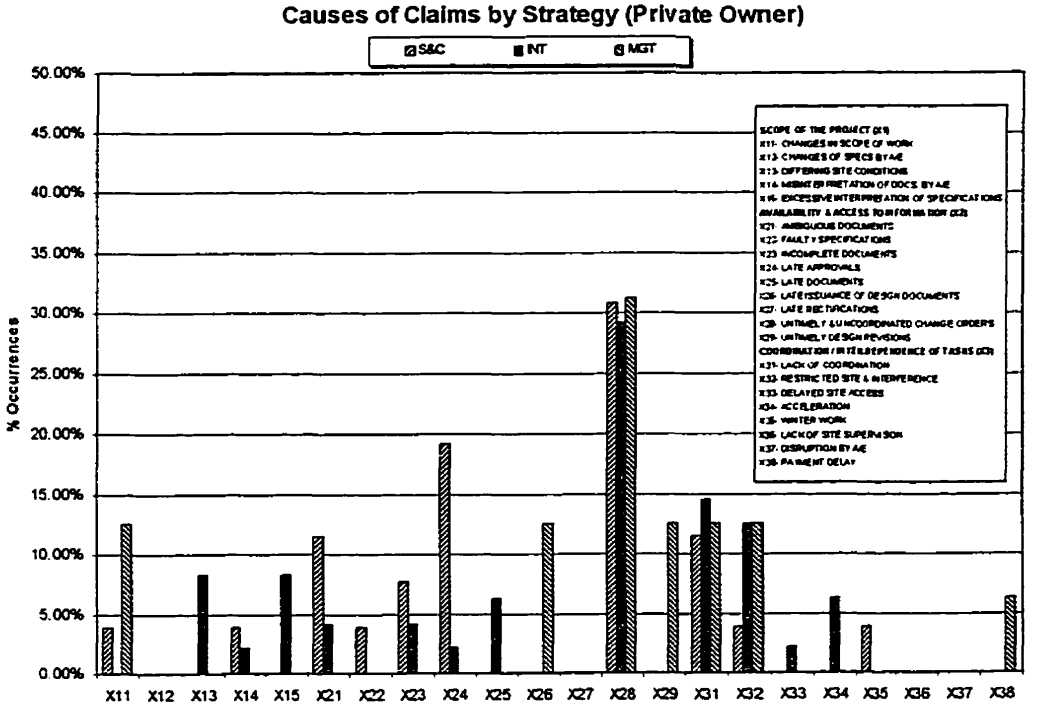


Figure 4.11: Causes of claims by strategy (private owner)

1. ***Separated and co-operative procurement strategy*:** is characterized by a high occurrence of untimely and uncoordinated change orders (X28) - 30.77% occurrences.

   Separated and co-operative procurement strategy has the only occurrence of faulty specifications (X22), and winter work (X35) - 1 occurrence each. It has no occurrences of changes of specs by A/E (X12), differing site conditions (X13), excessive interpretation of specifications (X15), late documents (X25), late issuance of design documents (X26), late rectifications (X27), untimely design revisions (X29), delayed site access (X33), acceleration (X34), lack of site supervision, disruption by A/E, and payment delay (X38).

2. ***Integrated procurement strategy:*** is characterized by the highest and most frequent occurrences of most causes compared to other procurement strategies. Untimely and uncoordinated change orders (X28) - 29.17% occurrences, was the most frequent cause for claims, followed by lack of coordination (X31) - 14.58% occurrences, restricted site and interference (X32) - 12.50% occurrences, and both differing site conditions (X13) and excessive interpretation of specifications (X15) - 8.33% occurrences each.

   Integrated procurement strategy has the only occurrence of differing site conditions (X13), excessive interpretation of specifications (X15), late documents (X25), delayed site access (X33), and acceleration (X34). It has no occurrences of changes in scope of the project (X11), changes of specifications by A/E (X12), faulty specifications (X22), late issuance of design documents (X26), late rectifications (X27), untimely design revisions (X29), winter work (X35), lack of site supervision (X36), and disruption by A/E (X37), and payment delay (X38).

3. ***Management-oriented procurement strategy:*** is characterized by a high occurrence of untimely and uncoordinated change orders (X28) - 31.25% occurrences (similar to the other two procurement strategies).

   Management-oriented procurement strategy has the only occurrences of late issuance of design documents (X26), untimely design revisions (X29), and payment delay (X38). It has no occurrences of changes of specifications by A/E (X12), differing site conditions (X13), misinterpretation of documents by A/E (X14), excessive interpretation of specifications (X15). It also has no occurrences for all the availability and access to information category except for untimely and uncoordinated change orders (X28) and untimely design revisions (X29), all the coordination category except for lack of coordination (X31), restricted site and interference (X32), and payment delay (X38).

4.3.3 By Procurement Strategies

a) **Separated and co-operative procurement strategy:** under this strategy, the private owner has a high occurrence of untimely and uncoordinated change orders (X28) - 30.77% occurrences (even higher than the public owner), followed by late approvals (X24) - 19.23% and by both ambiguous documents (X21) and lack of coordination (X31) - 11.54% occurrences each. The public owner has a higher occurrence of late approvals (X24) - 21.78% occurrences, untimely and uncoordinated change orders (X28) - 17.82% occurrences, and lack of coordination (X31) - 12.87% occurrences (see Figure 4.12).

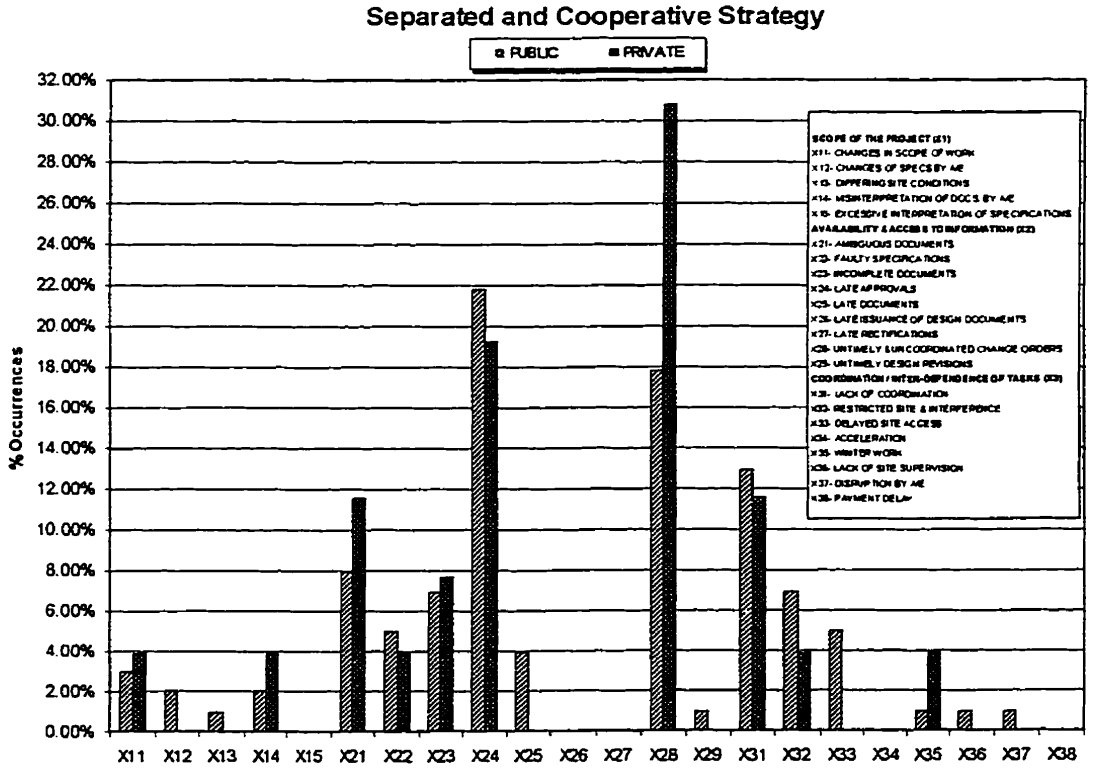


Figure 4.12: Causes of claims under the separated and cooperative procurement strategy

b) **Integrated procurement strategy:** under this strategy, the private owner has the higher occurrence of untimely and uncoordinated change orders (X28) - 29.17% occurrences, and appears to be having more problems with the availability and access to information and the coordination categories (see Figure 4.13).

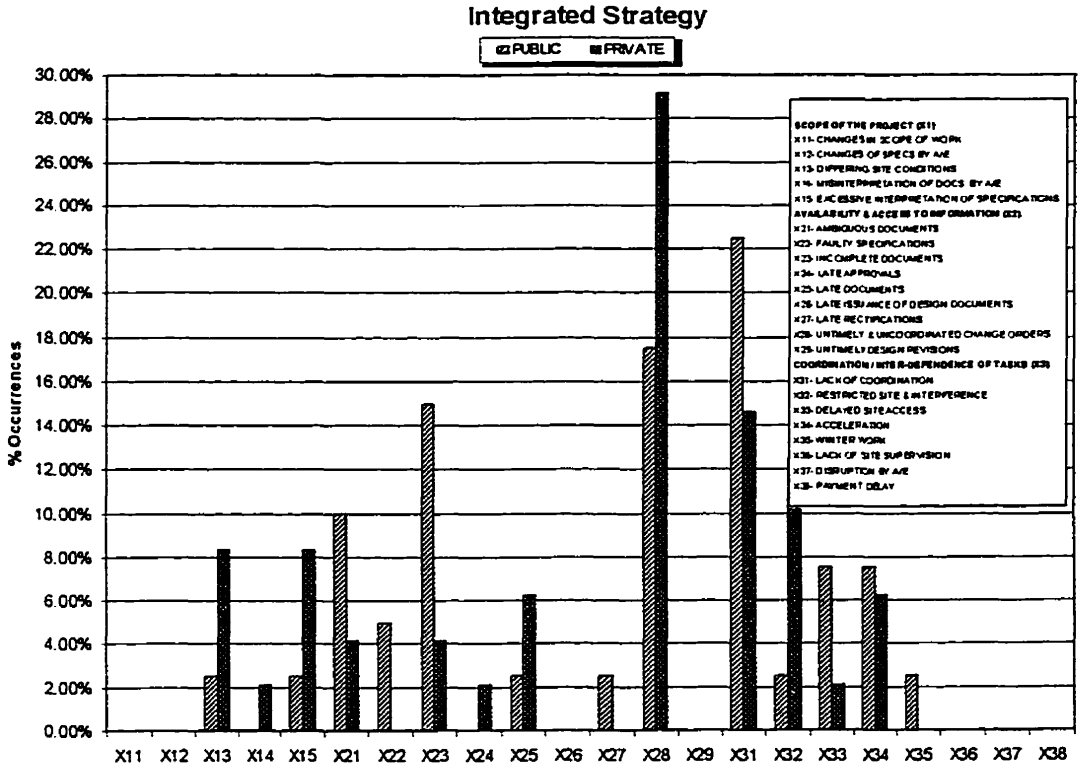


Figure 4.13: Causes of claims under the integrated procurement strategy

c) **Management-oriented procurement strategy:** under this strategy, the private owner has the higher occurrence of causes of claims, although both the private and the public owners have the same problem with untimely and uncoordinated change orders (X28); its occurrence is very high with the public owner (50 % occurrence with the public owner compared to 31.25% occurrence with the private owner). Private owner appears to be having problems in the availability and access to information and the coordination categories (see Figure 4.14).

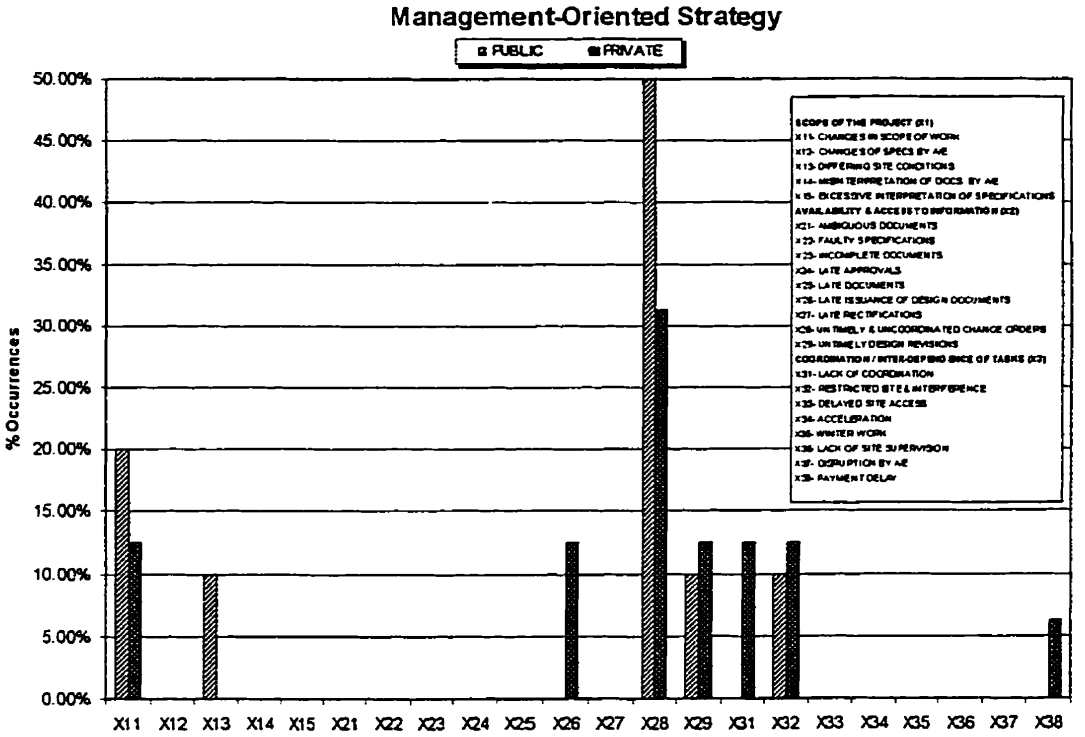


Figure 4.14: Causes of claims under the management-oriented procurement strategy

4.3.4 Experts' Perceptions

The analysis presented above suggests that, if the frequency of occurrences of the causes of claims for each strategy and for each type of owner can be indexed and ranked, a methodology can be developed to select a "best fit" procurement strategy that meets an owner's project procurement characteristics and constraints. This methodology should yield the required yardstick to measure the performance of each project procurement strategy before a commitment is made.

Since we had no way of assessing the impact of each cause of claim on that particular claim's outcomes (especially in cases where more than one cause was cited), experts' opinions were sought to indicate their perception of the importance of each cause of claim.

A survey - in the form of a structured questionnaire - was conducted in the Montreal metropolitan area. Fifteen experts representing all parties to the building process (public owners, private owners, architects, engineers, contractors, construction managers, and claims experts) were asked about their perceptions of the importance of the twenty-two pre-identified causes of claims that were found to be deterministic in the litigated claims cases (as described previously in the causes of claims section).

The questionnaire was designed in such a way as to record the experts' perceptions of the importance of each cause of claims for each of the three building procurement strategies (separated and cooperative, integrated, and management-oriented procurement strategies) and for each type of owner (public and private).

The weighted-average of each of these opinions was then calculated to represent the importance index for each of these causes of claims as derived from the experts' stated opinions.

$$I = \frac{\sum_{1}^{n} P_i^2}{\sum_{1}^{n} P_i}$$

Where I = *Importance index*

P = *Experts' perception (from a scale of 1-5, where 1 is the least important and 5 the most important)*

n = *Number of experts (15)*

Tables 4.8a and **4.8b** show a compilation of the claims *Frequency indexes* and their ranking (based on the analysis of the claims cases - see Table 4.6), the *Importance indexes* and their ranking (from the survey of experts), and overall *Severity indexes* of causes of claims (obtained by multiplying the claims Frequency index by the Importance index) and ranking them for both the private and public owners.

It is interesting to note that the ranking of the overall Severity index of causes is in the same range as the Frequency index of causes of claims ranking even after taking into consideration the experts' Importance index.

Table 4.8a: Frequency, Importance and Severity Indexes for causes of claims (public owner)

CAUSES OF CLAIMS / INDICES	SEPARATED & COOPERATIVE STRATEGY (Public)						INTEGRATED STRATEGY (Public)						MANAGEMENT-ORIENTED STRATEGY (Public)					
	Claims Frequency		Experts' Importance		Overall Severity		Claims Frequency		Experts' Importance		Overall Severity		Claims Frequency		Experts' Importance		Overall Severity	
	Index	Rank	Index	Rank	Index	Rank	Index	Rank	Index	Rank	Index	Rank	Index	Rank	Index	Rank	Index	Rank
SCOPE CATEGORY																		
X11- CHANGES IN SCOPE OF WORK	0.030	10	0.720	13	0.021	10	ND	ND	0.720	13	ND	ND	0.200	2	0.620	12	0.124	2
X12- CHANGES OF SPECS BY A/E	0.020	11	0.800	4	0.016	11	ND	ND	0.800	4	ND	ND	ND	ND	0.620	12	ND	ND
X13- DIFFERING SITE CONDITIONS	0.010	13	0.740	11	0.007	15	0.025	8	0.740	11	0.019	9	0.100	3	0.640	11	0.064	3
X14- MISINTERPRETATION OF DOCS. BY A/E	0.020	11	0.650	17	0.013	12	ND	ND	0.650	17	ND	ND	ND	ND	0.660	9	ND	ND
X15- EXCESSIVE INTERPRETATION OF SPECIFICATIONS	ND	ND	0.720	13	ND	ND	0.025	8	0.720	13	0.018	10	ND	ND	0.540	20	ND	ND
Scope category average Ranking		*11.250*		*11.000*		*12.000*		*8.000*		*11.000*		*9.500*		*2.500*		*12.000*		*2.500*
INFORMATION CATEGORY																		
X21- AMBIGUOUS DOCUMENTS	0.079	4	0.920	1	0.073	4	0.100	4	0.920	1	0.092	4	ND	ND	0.760	2	ND	ND
X22- FAULTY SPECIFICATIONS	0.050	7	0.840	2	0.042	7	0.050	7	0.840	2	0.042	7	ND	ND	0.760	2	ND	ND
X23- INCOMPLETE DOCUMENTS	0.069	5	0.820	3	0.057	5	0.150	3	0.820	3	0.123	3	ND	ND	0.700	6	ND	ND
X24- LATE APPROVALS	0.218	1	0.780	6	0.170	1	ND	ND	0.780	6	ND	ND	ND	ND	0.600	14	ND	ND
X25- LATE DOCUMENTS	0.040	9	0.760	9	0.030	9	0.025	8	0.760	9	0.019	8	ND	ND	0.660	9	ND	ND
X26- LATE ISSUANCE OF DESIGN DOCUMENTS	ND	ND	0.780	6	ND	ND	ND	ND	0.780	6	ND	ND	ND	ND	0.680	8	ND	ND
X27- LATE RECTIFICATIONS	ND	ND	0.680	21	ND	ND	0.025	8	0.680	21	0.015	12	ND	ND	0.560	16	ND	ND
X28- UNTIMELY & UNCOORDINATED CHANGE ORDERS	0.178	2	0.760	9	0.135	2	0.175	2	0.760	9	0.133	2	0.500	1	0.800	1	0.400	1
X29- UNTIMELY DESIGN REVISIONS	0.010	13	0.800	4	0.008	13	ND	ND	0.800	4	ND	ND	0.100	3	0.600	14	0.060	4
Information category average Ranking		*5.857*		*6.778*		*5.857*		*5.333*		*6.778*		*6.000*		*2.000*		*8.000*		*2.500*
COORDINATION CATEGORY																		
X31- LACK OF COORDINATION	0.129	3	0.740	11	0.095	3	0.225	1	0.740	11	0.167	1	0.000	6	0.760	2	0.000	6
X32- RESTRICTED SITE & INTERFERENCE	0.069	5	0.640	18	0.044	6	0.025	8	0.640	18	0.016	11	0.100	3	0.560	16	0.056	5
X33- DELAYED SITE ACCESS	0.050	7	0.700	15	0.035	8	0.075	5	0.700	15	0.053	5	ND	ND	0.560	16	ND	ND
X34- ACCELERATION	ND	ND	0.640	18	ND	ND	0.075	5	0.640	18	0.048	6	ND	ND	0.660	16	ND	ND
X35- WINTER WORK	0.010	13	0.520	22	0.005	17	0.025	8	0.520	22	0.013	13	ND	ND	0.440	22	ND	ND
X36- LACK OF SITE SUPERVISION	0.010	13	0.780	6	0.008	13	ND	ND	0.780	6	ND	ND	ND	ND	0.740	6	ND	ND
X37- DISRUPTION BY A/E	0.010	13	0.640	18	0.006	16	ND	ND	0.640	18	ND	ND	ND	ND	0.520	21	ND	ND
X38- PAYMENT DELAY	ND	ND	0.680	16	ND	ND	ND	ND	0.680	16	ND	ND	ND	ND	0.700	6	ND	ND
Coordination category average Ranking		*9.000*		*15.500*		*10.500*		*4.500*		*15.500*		*6.000*		*1.500*		*13.000*		*1.833*

Table 4.8b: Frequency, Importance and Severity Indexes for causes of claims (private owner)

CAUSES OF CLAIMS / INDICES	SEPARATED & COOPERATIVE STRATEGY (Private)						INTEGRATED STRATEGY (Private)						MANAGEMENT-ORIENTED STRATEGY (Private)					
	Claims Frequency		Experts' Importance		Overall Severity		Claims Frequency		Experts' Importance		Overall Severity		Claims Frequency		Experts' Importance		Overall Severity	
	Index	Rank	Index	Rank	Index	Rank	Index	Rank	Index	Rank	Index	Rank	Index	Rank	Index	Rank	Index	Rank
SCOPE CATEGORY																		
X11- CHANGES IN SCOPE OF WORK	0.039	6	0.700	12	0.027	7	ND	ND	0.700	6	ND	ND	0.125	2	0.640	8	0.080	3
X12- CHANGES OF SPECS BY A/E	ND	ND	0.760	6	ND	ND	ND	ND	0.700	6	ND	ND	ND	ND	0.620	13	ND	ND
X13- DIFFERING SITE CONDITIONS	ND	ND	0.660	15	ND	ND	0.083	4	0.600	16	0.050	6	ND	ND	0.640	8	ND	ND
X14- MISINTERPRETATION OF DOCS. BY A/E	0.039	6	0.660	15	0.025	8	0.021	10	0.640	12	0.013	11	ND	ND	0.640	8	ND	ND
X15- EXCESSIVE INTERPRETATION OF SPECIFICATIONS	ND	ND	0.680	13	ND	ND	0.083	4	0.620	15	0.052	4	ND	ND	0.480	22	ND	ND
Scope category average Ranking		*6.000*		*12.200*		*7.500*		*6.000*		*11.000*		*6.667*		*2.000*		*11.000*		*3.000*
INFORMATION CATEGORY																		
X21- AMBIGUOUS DOCUMENTS	0.115	3	0.850	1	0.098	3	0.042	8	0.800	1	0.033	8	ND	ND	0.820	1	ND	ND
X22- FAULTY SPECIFICATIONS	0.039	6	0.800	2	0.031	6	ND	ND	0.800	1	ND	ND	ND	ND	0.800	2	ND	ND
X23- INCOMPLETE DOCUMENTS	0.077	5	0.760	6	0.058	5	0.042	8	0.680	9	0.028	9	ND	ND	0.680	5	ND	ND
X24- LATE APPROVALS	0.192	2	0.740	10	0.142	2	0.021	10	0.640	12	0.013	11	ND	ND	0.600	14	ND	ND
X25- LATE DOCUMENTS	ND	ND	0.740	10	ND	ND	0.063	6	0.600	16	0.038	6	ND	ND	0.600	14	ND	ND
X26- LATE ISSUANCE OF DESIGN DOCUMENTS	ND	ND	0.760	6	ND	ND	ND	ND	0.640	12	ND	ND	0.125	2	0.640	8	0.080	3
X27- LATE RECTIFICATIONS	ND	ND	0.560	20	ND	ND	ND	ND	0.580	19	ND	ND	0.000	8	0.640	17	0.000	8
X28- UNTIMELY & UNCOORDINATED CHANGE ORDERS	0.308	1	0.800	2	0.246	1	0.292	1	0.780	3	0.228	1	0.313	1	0.800	2	0.250	1
X29- UNTIMELY DESIGN REVISIONS	ND	ND	0.800	2	ND	ND	ND	ND	0.600	16	ND	ND	0.125	2	0.640	8	0.080	3
Information category average Ranking		*3.400*		*6.556*		*3.400*		*6.600*		*9.889*		*7.000*		*3.250*		*7.889*		*3.750*
COORDINATION CATEGORY																		
X31- LACK OF COORDINATION	0.115	3	0.760	6	0.088	4	0.146	2	0.660	11	0.096	2	0.125	2	0.760	4	0.095	2
X32- RESTRICTED SITE & INTERFERENCE	0.039	6	0.520	22	0.020	10	0.125	3	0.680	9	0.085	3	0.125	2	0.540	17	0.068	6
X33- DELAYED SITE ACCESS	ND	ND	0.680	13	ND	ND	0.021	10	0.720	5	0.015	10	ND	ND	0.540	17	ND	ND
X34- ACCELERATION	ND	ND	0.600	18	ND	ND	0.063	6	0.560	20	0.035	7	ND	ND	0.620	20	ND	ND
X35- WINTER WORK	0.039	6	0.560	20	0.022	9	ND	ND	0.440	22	ND	ND	ND	ND	0.520	20	ND	ND
X36- LACK OF SITE SUPERVISION	ND	ND	0.780	5	ND	ND	ND	ND	0.700	6	ND	ND	ND	ND	0.680	5	ND	ND
X37- DISRUPTION BY A/E	ND	ND	0.580	19	ND	ND	ND	ND	0.560	20	ND	ND	ND	ND	0.580	16	ND	ND
X38- PAYMENT DELAY	ND	ND	0.640	17	ND	ND	ND	ND	0.740	4	ND	ND	0.063	7	0.680	5	0.043	7
Coordination category average Ranking		*5.000*		*15.000*		*7.667*		*5.250*		*12.125*		*5.500*		*3.667*		*13.000*		*5.000*

SECTION 3: DISCUSSION

a) Causes of claims occurrences

In this section, a detailed analysis is presented for the different causes of claims under the three families of procurement strategies and the two types of owners (public and private).

Overall, the availability and access to information category proved to be the category that recurs more often as a cause of claims (58.92% of all causes) followed by the coordination category (30.29% of all causes) then by the scope of the project category (10.79% of all causes) with the exception of the management-oriented procurement strategy under the public owner where the ranking is reversed between the coordination category and the scope of the project category. (see Figure 4.7, Figure 4.8 and Table 4.6).

As for the consequences of the three families of procurement strategies under the different types of owners, we note that for:

The separated and co-operative procurement strategy

Generally speaking, the separated and co-operative procurement strategy has no instances of: excessive interpretation of specifications (X15), late issuance of design documents (X26), late rectifications (X27), acceleration (X34) and payment delay (X38). The absence of the above causes of claims is not surprising since, with the exception of payment delay, the separated and co-operative procurement strategy is characterized by the completeness of design before construction. Also, the separated and co-operative procurement strategy is the strategy that has been around the longest and its intricacies are better understood by all parties to the building project, leaving little space for misunderstandings.

The separation of design and construction (which is the main characteristic of the separated and co-operative procurement strategy) leads to more problems arising from the availability and access to information as well as coordination problems (for both owners) as one would expect. The fact that the private owner has a higher instance of problems arising from the availability and access to information category came as a surprise since it is in contradiction to the general belief that it is the public owner who is more prone to this kind of problem.

A careful examination of the individual causes of claims under the availability and access to information category revealed that the untimely and uncoordinated change orders (X28) was the deciding factor in this interesting result, but not so surprising if we bear in mind the unpredictability of the private owners and their constant changing of mind (this may be due to their inexperience, their inability to define their requirements or due to their changing needs), while the public owners are more experienced and do not have the same luxury of changing their minds due to the constraints they are functioning under (i.e. bureaucratic nature of documentation; public service obligations, notably the risk aversion attitude due to public accountability).

Public owners appear to be having more problems in the coordination category than private owners. Again, as we have explained above, this is due to the constraints they are functioning under.

Both public and private owners stand on an equal footing in the scope of the project category for causes of claims (7.92% and 7.69% respectively).

The integrated procurement strategy

Generally speaking, the integrated procurement strategy has no instances of: changes in scope of work (X11), changes in specifications by A/E (X12), late issuance of design documents (X26), untimely design revisions (X29), lack of site supervision (X36),

disruption by A/E (X37) and payment delay (x38). The absence of the above causes of claims is not surprising since, there is one source of responsibility for the design and construction (whether a contractor in the design-build variant or the owner himself in the owner-builder variant), thus providing little room for the above causes of claims to appear.

The availability and access to information category has the highest occurrences of claims causes for both types of owners (52.50% for the public owner and 45.83% for the private owner - see Table 4.6). Most of the causes of claims under this category are more inherent in the separated and co-operative procurement strategy where the design and construction are apart.

The integration of the design and the construction phases (which is the main characteristic of the integrated procurement strategy) did not help eliminate the causes of claims pertaining to the coordination category. Actually, the integrated procurement strategy has the highest occurrences of causes of claims under the coordination category, regardless of the type of owner, compared to the other two procurement strategies (42.50% public owner and 35.42% private owner - see Table 4.6).

Since one would not expect any cause for conflict when the responsibility for the design and the construction is focused in the hands of one party, it was necessary to go back to the individual claims cases to get an explanation for this peculiarity. It was found that the coordination problems were either owner-related (i.e. delayed site access, acceleration - in the design-build strategy) or subcontractors-related (i.e. lack of coordination, restricted site access and interference between subcontractors - in both the owner-builder strategy and the design-build strategy).

The management-oriented procurement strategy

Generally speaking, the management-oriented procurement strategy has no instances of: changes in specifications by A/E (X12), misinterpretation of documents by A/E (X14), excessive interpretation of specifications (X15), ambiguous documents (X21), faulty specifications (X22), incomplete documents (X23), late approvals (X24), late documents (X25), late rectifications (X27), delayed site access (X33), acceleration (X34), winter work (X35), lack of site supervision (X36) and disruption by A/E (X37); it appears that the existence of a third party (a professional project or construction manager) was quite helpful in eliminating most of the root causes of claims found in the other two procurement strategies.

Again, the availability and access to information category proved to be the most crucial cause of claims for both owners (60% public owner and 56.25% private owner). A closer look at the individual causes under the availability and access to information category reveals that they are all pertaining to design changes or untimely change orders. This raises the question of the participants' understanding of the use of this strategy (especially owners and architects).

b) Experts' perceptions

As for the survey of experts' perceptions of the importance of the identified causes of claims, their responses covered a broad range of perceptions, as one would expect due to their varying perspectives and due to their tendency to minimize the importance of causes of claims stemming from matters intrinsic to each of their respective fields (e.g. architects gave low importance to the quality of documentation, while construction managers gave low importance to coordination problems). Nevertheless, the ranking of the Severity of causes of claims index (the result of multiplication of the Frequency of causes index by the experts' Importance index) coincides with the ranking of the Frequency of causes of claims index (Tables 4.8a and 4.8b).

It is interesting to speculate on the last statement because it appears to imply that in the experts' opinion, a cause of claims which they rank as "bad" nearly always coincides with a cause of claims which has a low frequency and *vice versa*. The reason for this rather surprising result might lie in the fact that a cause of claims that occurs frequently is considered by the experts as almost "routine".

Nevertheless, the ranking of the experts' Importance index for each category of causes of claims (calculated as the mathematical average of all the rankings of the individual causes of claims under that particular category) shows that the availability and access to information category is the most important category in causes of claims (Tables 4.8a and 4.8b), thus corroborating our findings.

The ranking of experts' perceptions for the three categories of causes of claims proved to be consistent regardless of the procurement strategy and the type of owner (i.e. availability and access to information category is the most important category causing claims followed by the scope of the project category then by the coordination category). This clearly shows that the construction industry participants are rigid in their perceptions and have yet a way to go to adapt to the use and practice of the alternate procurement strategies.

The next section investigates the relationship between the previous three classifications namely: (i) the project procurement characteristics (procurement strategy and type of owner), (ii) the claims outcomes and (iii) the causes of claims.

SECTION 4:

RELATIONSHIP BETWEEN CLASSIFICATIONS

4.4 RELATIONSHIP BETWEEN CLASSIFICATIONS

In order to investigate the relationship between the procurement strategies, the claims outcomes and the causes of claims, the multiple regression analysis technique was used. Coding of the causes of claims was necessary to perform this technique. Each of the causes of claims was ranked (on a scale from 1-7) according to its relative incidence in all cases.

In principle, the multiple regression equation is constructed to assess the simultaneous effect of several independent variables upon the dependent variable. Usually, in the general multiple regression equation, the dependent variable is seen as a linear function of more than one independent variable. Such a general form is expressed as:

$$Y = a_0 + b_1X_1 + b_2X_2 + b_3X_3 + - - - - - - - - b_kX_k + E$$

Where Y represents the dependent variable and the X's the independent variables and b_1 *to* b_k, are designated as the partial regression coefficients. They are the slopes of the regression line for each independent variable, controlling for the effects of the other variables. Thus, b_1 reflects the amount of change in Y associated with a given change in X_1, holding all other variables constant. a_0 designates the intercept point on the Y axis for all variables.

Using the claims data, the regression models shown in appendix C were obtained.

4.4.1 Interpretation of Results

The interpretation of the intercept, a_0, is fairly straightforward. It is the average value of Y when each independent variable equals zero. Thus, for the traditional building organization, the performance will average close to 3 (on a one to seven scale) when X_1 *to* X_k register zero. The interpretation of the slope, b_k= the average change in Y associated with a unit change in X_k, when the other independent variables are held constant, requires more attention. By means of this control, it is possible to separate out the effect of X_k itself, and free it of any distorting influences due to the other independent variables. Such a slope is called a partial slope, or partial regression coefficient. Thus, for example, according to the above regression equation, for the separated and co-operative procurement strategy and the % time overrun (P1):

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.785[a]	.615	.581	38.2096%

a. Predictors: (Constant), X35, X13, X12, X22, X23

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	130845.0	5	26169.002	17.924	.000[a]
	Residual	81758.314	56	1459.970		
	Total	212603.3	61			

a. Predictors: (Constant), X35, X13, X12, X22, X23

b. Dependent Variable: P1

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	38.502	5.752		6.693	.000
	X12	75.327	27.624	.227	2.727	.009
	X13	225.261	27.624	.680	8.155	.000
	X22	19.896	8.256	.201	2.410	.019
	X23	10.229	4.697	.185	2.178	.034
	X35	98.376	28.016	.297	3.511	.001

a. Dependent Variable: P1

$$P1 = a_0 + b_1 X_{12} + b_2 X_{13} + b_3 X_{22} + b_4 X_{23} + b_5 X_{35} + E$$

or

$$P1 = 38.502 + 75.327 X_{12} + 225.261 X_{13} + 19.896 X_{22} + 10.229 X_{23} + 98.376 X_{35} + E$$

Partial slope b_3 (19.896) estimates that, for example, with a unit increase in the incidence of "faulty specifications" (on a scale of one to seven), the average % of time overrun (P1) will increase by 19.896 %.

To assess the goodness of fit of the multiple regression equation, the R^2 or the coefficient of multiple determination, is employed. The R^2 for a multiple regression equation indicates the proportion of variation in Y " explained " by all the independent variables. For the above model, $R^2 = .615$, thus, indicating that the independent variables used in the equation (causes of claims), together account for 61.5% of the variance in the % time overrun (P1).

Obviously, it is desirable to have a high R^2, for it implies a more complete explanation of the phenomenon under study. Nevertheless, if a higher R^2 were the only goal, then one could do it by adding more variables to the equation. That is because an

additional variable cannot lower the R^2 and is virtually certain to increase it - at least somewhat. The inclusion of variables, however, should be guided by broader theoretical considerations as well as by a concern for the efficiency of the statistical analysis.

The statistical significance of R^2, and thus the regression, is determined by the F ratio, which is determined from the following equation (Norusis, 1996):

$$F = \frac{R^2 / K}{(1 - R^2) / (N - K - 1)}$$

Where

K = the number of independent variables

N = the number of cases

The F-ratio tells us that the regression of the dependent variable (in our example - P1) on the independent variables (in our example - X_{12}, X_{13}, X_{22}, X_{23} ,and X_{35}) is statistically significant because the probability of an F ratio as large as the one obtained in this equation occurring by chance is less than 0.000 (which means 100% confidence) . This means that the relation between the dependent variable (in our example - P1) and a linear least-squares combination of $X's$ could not at all have occurred by chance.

Similarly, regression models were built for the three procurement strategies correlating the different causes of claims to different claims outcomes (Appendix A). Only the models with high significance (F-ratio <0.05) were retained. The regression equations are shown below:

a) The separated and co-operative procurement strategy

$$P1 = 38.502 + 75.327X_{12} + 225.261X_{13} + 19.896X_{22} + 10.229X_{23} + 98.376X_{35} + E$$ where $R^2 = .615$

$$P2 = 25.547 + 21.469X_{11} + E$$ where $R^2 = .069$

$$P3 = 9.031 + 13.921X_{33} + E$$ where $R^2 = .112$

$$P4 = 39.880 + 16.019X_{22} + E$$ where $R^2 = .112$

$$P5 = 588.246 + 2129.630X_{13} + 1359.284X_{25} + 4683.976X_{35} + E$$ where $R^2 = .354$

b) The integrated procurement strategy

$$P1 = 45.359 + 188.073X_{13} + 62.460X_{33} + E$$ where $R^2 = .306$

$$P2 = 23.408 + 127.670X_{14} + 43.794X_{33} + E$$ where $R^2 = .289$

$$P5 = 631.823 + 1286.021X_{13} + E$$ where $R^2 = .311$

c) The management-oriented procurement strategy

$$P2 = 39.729 + 15.102X_{32} + 60.271X_{38} + E$$ where $R^2 = .477$

$$P3 = 5.241 + 24.974X_{29} + 13.981X_{32} + E$$ where $R^2 = .881$

$$P4 = 20.671 + 34.711X_{29} + 10.991X_{32} + E$$ where $R^2 = .706$

$$P5 = 333.094 + 1476.824X_{13} + 1447.394X_{38} + E$$ where $R^2 = .904$

4.4.2 The Relative Importance of the Independent Variables

Sometimes it is desirable to evaluate the relative importance of the independent variables in determining Y. Since the regression coefficients reflect the net effect of each

variable, an obvious procedure is to compare the magnitude of these partial slopes. However, since each variable may be measured on a different scale and in different units [in our example, variables X_{12} (changes of specifications by A/E) and X_{13} (differing site conditions)], the relative influence of different independent variables on the dependent variables is difficult to assess. One solution is to standardize the variable, re-estimate, and evaluate the new coefficients. Such a standardized partial slope is designated by "B" and is referred to as 'beta weight' or 'beta coefficient'. With the help of beta-weights calculated for the same data, it is now possible to write another regression equation as follows:

$$Y^* = B_1 X_1^* + B_2 X_2^* + B_3 X_3^* + B_4 X_4^* + \text{----------} + B_k X_k$$

where :

X_k^*, is the standardized variable.

B_K = beta-weight

(Note that standardization forces the intercept a_0 to zero)

The standardized partial slope estimate, or B, indicates the average standard deviation change in Y associated with a standard deviation change in X, when the other independent variables are held constant.

The multiple regression equation for the % time overrun (P1) under the separated and co-operative procurement strategy, expressed in beta-coefficients is:

$$P1^* = .227X_{12}^* + .680X_{13}^* + .201X_{22}^* + .185X_{23}^* + .297X_{35}^*$$

This would then indicate, for example, that for every increase of one standard deviation in, say, changes in specifications by A/E (X_{12}^*), the % time overrun will

increase by .227 standard deviations, but on the other hand, one standard deviation increase in the differing site conditions (X_{13}^{*}) will increase the % time overrun by .680 standard deviations.

The greater significance of beta-weight, however, lies in determining the relative value of the different variables, and hence when two variables X_{12} and X_{13}, are compared with each other (since they are both standardized, it is now allowable) it becomes evident that differing site conditions contributes about 3 times more to % time overrun than does the changes of specifications by A/E.

SECTION 4: DISCUSSION

The fact that both the multiple regression models and the independent variables have highly significant regression coefficients (< 0.05), means that the regression models as a whole are highly significant in terms of the insights they allow into the effect of claims causes on each of the claims outcomes for each of the procurement strategies.

In the example discussed above, five causes of claims - out of the twenty-two causes of claims that were identified - account for 61.5% of the variance of the dependent variable-performance. In other words, these five variables jointly account for 61.5% of the % time overrun under the separated and co-operative procurement strategy.

Furthermore, the multiple regression model used in the example gives specific information about the direction of the effects of the independent variables upon the % time overrun. In the same example, all independent variables (X_{12}, X_{13}, X_{22}, X_{23} and X_{35}) show a significant positive impact on the increase of % time overrun.

It should be noted that all the regression models obtained were the result of a stepwise regression. The stepwise regression only yields models with highly significant

correlation between the dependent and independent variables. The fact that only a few independent variables are present in the model is also due to a statistical phenomenon known as *multicollinearity*, meaning that many of the independent variables (causes of claims in our case) are interdependent (Bryman and Cramer, 1990).

A correlation matrix was calculated (using SPSS) for all the causes of claims under each procurement strategy and for each of the outcomes. Pearson's r (tolerances) between independent variables (causes of claims) were very high (>0.8) indicating a very strong multicollinearity.

This result is not surprising since when any cause of claims appears on a project, it will have a ripple effect on the other potential causes so that when things start to go wrong on the project everything goes wrong.

In cases of multicollinearity, statisticians advise one to combine these interrelated independent variables into groups. This was not deemed necessary here, since the focus of this research is on identifying the root causes of claims.

The following table (Table 4.9) gives a summary of the impact of each cause of claims - based on the beta coefficients - on each outcome of claims under the three families of procurement strategies.

Table 4.9: Claims outcomes and their causes (relative beta-weights)

CAUSES OF CLAIMS/OUTCOME OF CLAIMS	%TIME OVERRUN			%CLAIM TO BUDGET			%AWARD TO BUDGET			%AWARD TO CLAIM			%TRIAL OVERRUN		
	S&C	INT.	MGT	S&C	INT.	MGT	S&C	INT.	MGT	S&C	INT.	MGT	S&C	INT.	MGT
SCOPE OF THE PROJECT (X1)															
X11- CHANGES IN SCOPE OF WORK															
X12- CHANGES OF SPECS BY A/E															
X13- DIFFERING SITE CONDITIONS															
X14- MISINTERPRETATION OF DOCS. BY A/E															
X15- EXCESSIVE INTERPRETATION OF SPECIFICATIONS															
AVAILABILITY AND ACCESS TO INFO. (X2)															
X21- AMBIGUOUS DOCUMENTS															
X22- FAULTY SPECIFICATIONS															
X23- INCOMPLETE DOCUMENTS															
X24- LATE APPROVALS															
X25- LATE DOCUMENTS															
X26- LATE ISSUANCE OF DESIGN DOCUMENTS															
X27- LATE RECTIFICATIONS															
X28- UNTIMELY & UNCOORDINATED CHANGE ORDERS															
X29- UNTIMELY DESIGN REVISIONS															
COORDINATION (X3)															
X31- LACK OF COORDINATION															
X32- RESTRICTED SITE & INTERFERENCE															
X33- DELAYED SITE ACCESS															
X34- ACCELERATION															
X35- WINTER WORK															
X36- LACK OF SITE SUPERVISION															
X37- DISRUPTION BY A/E															
X38- PAYMENT DELAY															
SIGNIFICANCE LEVEL	0.000	0.000		0.009	0.001	0.054	0.008		0.000	0.008		0.004	0.000	0.000	0.000
TOTAL VARIANCE EXPLAINED (R2)	61.50%	38.60%		6.50%	28.90%	47.70%	11.20%		88.10%	11.20%		70.60%	35.40%	31.10%	90.40%

The blacked-out cells represent the causes of claims not found in that particular procurement strategy. Blank cells represent either insignificant causes of claims or highly interdependent causes of claims.

In the next chapter (chapter 5), a general discussion and conclusions of the data analysis results and recommendations for future research are presented.

CHAPTER 5:

CONCLUSIONS AND RECOMMENDATIONS

5.1 DISCUSSION OF RESULTS

In this final chapter the extent to which the objectives of this study have been achieved is discussed. We conclude with the contributions of this study, some suggestions to building owners, and some guidance as to what direction future work might take in this area (in the form of recommendations for future work).

One hundred and twenty one cases of litigated time-related claims were analyzed. One of the main findings of this study is that the procurement strategy adopted and the type of owner procuring the project have an effect on the frequency of occurrences and on the outcomes of claims. 22 causes of claims were identified and grouped into three main categories that coincide with the inter-organizational conflict inducing factors which had previously been found to be deterministic of the performance of the building process, thus linking claims to the inter-organizational conflict-inducing factors and thence to the building process performance.

Differences between the causes of claims and their outcomes under the three families of procurement strategies were noticed and recorded, helping us to gain an in-depth understanding of the performance of each type of procurement strategies.

Our findings point to the consequences (in terms of claims occurrences) of the constraints within which public sector owners operate. They also throw an unexpected light on the likelihood of all types of owners running into trouble when non-traditional procurement strategies are adopted, suggesting the need to fine-tune the practicalities of these strategies.

The management-oriented procurement strategy proved to be the worst strategy for both types of owners. The introduction of a new party (the construction manager) into the traditional project team poses a problem of integrating another party into the classic team of designers and constructors. Also, the fact that this new party is managing a project for

which he or she did not develop the design intelligence and logic, causes a new set of relationships to be involved, thus increasing the probability of misunderstandings and conflicts. This is in agreement with the general industry consensus that having a construction manager on the project is regarded negatively (Havilland, 1998).

The availability and access to information is the most frequent category of causes of claims under all procurement strategies.

For the private owners, the separated and co-operative (traditional) procurement strategy leads to less damaging claims outcomes and to fewer claims, but the availability and access to information category is a frequent cause of these problems. Regarding the public owners, they have more frequent claims but generally with better overall claims outcomes. Once again, the availability and access to information category is the most frequently occurring causes of these claims.

Although the models yielded by the regression analysis for the relationships between claims outcomes (dependent variable) and causes of claims (independent variables) contained very few independent variables, they confirmed our suspicion that the other unreported (i.e. rejected by the regression analysis) causes of claims are interdependent, especially after calculating the tolerances from the correlation matrices and finding very high collinearity between the independent variables. This clearly shows the damaging ripple effects that causes of claims have, once they start appearing on a project.

The first objective of this study was to investigate the premise *that different procurement strategies induce differing levels of inter-organizational conflict and that as procurement strategy moves from separated and coordinated system (traditional) to management oriented system (project management, construction management) and to integrated system (design-build, turnkey, owner-builder) on a continuum, the inter-organizational conflict decreases and so do claims.*

The conclusion of our study of claims occurrences, outcomes and causes proved different. The separated and co-operative procurement (or traditional) strategy still is the preferred strategy and has less occurrences of claims with less impact on time and cost of the project. Innovative procurement strategies proved to be in a bad position compared to the traditional procurement strategy. The possible explanation of this result is that the innovative procurement strategies (integrated procurement strategy and management-oriented procurement strategy) are relatively new, comparatively untried and obviously require further development in order to iron out contractual and other kinds of problems.

The second objective of this study was to investigate the premise *that different outcomes of claims have different root causes that differ according to the characteristics of each procurement strategy.*

Again, this is not true, the availability and access to information is the common root cause for claims for *all* procurement strategies. But interestingly the severity of their outcomes does not relate to any particular category of causes, which again means that the causes of claims (under the three categories: scope of the project, availability and access to information, and coordination) are either scattered or are collinear (dependent on one another). This again confirms that root causes of claims for the various procurement strategies do not differ.

The third objective of this study was to investigate the premise *that the frequency and importance of the root causes of claims are different from what is generally perceived by the construction industry participants.*

This premise is partially true regarding the scope of the project category and the coordination category. It is not true for the availability and access to information category, since there is there is a consensus between the experts' perceptions and the findings of our study, both pointing to this category being critical as far as causes of claims which lead to frequent incidences of litigation are concerned.

The ranking of the experts' perceptions for the three categories of causes of claims (i.e. availability and access to information category is the most important category causing claims followed by the scope of the project category then by the coordination category) proved to be consistent, regardless of the procurement strategy and the type of owner. This clearly shows that the construction industry participants are rigid in their perceptions and have yet a way to go to adapt to the use and practice of the alternate procurement strategies.

5.2 INTERPRETATION OF RESULTS

The discourse concerning delay-related claims is not very different from that on inter-organizational conflict and the performance of the building process from the point of view of the availability and access to information. A systematic effort to co-ordinate information management appears to be a prerequisite for the successful introduction of innovation, changes in the building process and the improvement of the performance of the process itself.

Meanwhile, our findings point to the consequences (in terms of claims) of the constraints within which public sector owners operate. They also throw an unexpected light on the likelihood of all types of owners running into trouble when non-traditional procurement strategies are adopted, suggesting the need to fine-tune the practicalities of these strategies.

The current research which looks into the relationship between different project procurement paths and delay-related claims is - to our informed knowledge - the first of its kind in North America. Linking disputes and claims to project procurement strategies as well as identifying and studying the effect of the causes of claims on building process' performance will provide owners with a suitable benchmark for assisting them in assessing the risks associated with a particular procurement strategy as well as creating an increased awareness among them of likely causes of disputes and their frequencies.

All facts were obtained from historical data since cases were drawn from case law, which represents facts-based judgement and is not biased by subjective opinions. No data were derived from perceptions or opinions obtained from participants of ongoing projects; instead, concrete and sad facts were extracted systematically from adjudicated cases.

A noticeable shift to more private-owner participation in the building industry indicates a shift in the needs of the clients. Building clients have more needs and aspirations that they want to satisfy by themselves, without depending on government bodies and agencies that are facing budgetary problems due to the current bad economical situation.

In this context, it is important to stress once again that private owners appear to have mastered the traditional procurement process and are less likely to fall into claims under this strategy. Private owners on the other hand, in their desire to exercise more control of their projects, are more ready to adopt non-traditional procurement strategies. Once again the incidence of claims for these strategies is higher, particularly for the integrated procurement strategy.

In the management-oriented procurement strategy the question of the participants' understanding of the use of this strategy (especially owners and architects) is very important if one is to hope for better implementation of this strategy.

5.3 CONTRIBUTIONS

This research has made the following contributions:

- A better understanding of temporary multi-organization behavior in the construction industry, achieved from evaluating the performance of the building process under different contractual arrangements, and isolating the problems observed and recorded from the case law.

- A more comprehensive understanding of claims, their causes and their impact on projects and how they can be minimized, and how the loss of money, time and quality can be avoided by the selection of a proper procurement strategy.

- Identifying, developing and using techniques for systematically collecting and analyzing highly qualitative data.

It is also hoped that this research has partially filled the substantial gap in the available knowledge of the sources, causes and effects of conflict in the North American construction industry. Such an investigation into, and identification of the "contributing causes" to conflict, can help shape strategies that may minimize conflict occurrences in the first instance.

5.4 SUGGESTIONS TO OWNERS

The selection of an appropriate form of procurement requires a careful exploration of each of the factors that influence an owner's decision to build (project characteristics, owner's risk profile, approach to design and coordination, etc.); then he or she can choose the contractual framework which is particularly suited to the needs and characteristics of the situation. Since each procurement path has both strengths and weaknesses, procurement

strategy selection involves balancing these against the specific demands of a particular project.

Though a selected procurement path has a direct bearing on the success of a particular project, each project delivery method, whether it be traditional, turnkey, design-build, owner-builder or construction management, has its own particular advantages and risks that must be considered and evaluated by a prospective project owner. Each project delivery method has its own benefits and risks and no method should be considered or accepted by a project owner as if it would rule out all construction changes, claims or disputes. Accordingly, the project owner must look for a project procurement method that is most advantageous to his or her goals and limitations rather than base the decision on a theoretical analysis of goals or limitations.

Management of risk starts with the allocation of risk through the project owner's selection of a particular project delivery method, continues in the prime contract, subcontracts and purchase orders, and culminates in the prevention and, if necessary, the successful resolution of changes and any claims that occur during a project. Ultimately, those who manage risk best are those who do the following four things: (1) recognize that no project delivery method or risk-shifting contract clauses will be a panacea for all the risks of construction; (2) know the extent and sharing of the risks associated with the available project delivery method or those contract clauses before choosing a particular project delivery method or risk-shifting clause; (3) plan ahead so as to minimize the allocated risks of the actual project delivery method or contract clauses; and (4) provide a cost-effective means for resolving changes and claims that will inevitably arise during a project, regardless of all risk-shifting whether by choice of project delivery method or contract clauses.

In the end, successful management of changes and claims contributes directly to bettering the timing and final cost of the building project.

Owners should think of the procurement strategy as a course of action and not as an organizational framework. The "discrete life cycle of the project" should be taken into consideration to benefit fully from the strategic decisions (procurement strategy) taken upstream of the project.

Feedback is perceived as a major problem in the building industry, each project participant (task organization) keeps its experience to itself and does not share with others. It is for this reason, recommended that the procurement practices, once adopted, should also include mechanisms to:

- Assure the involvement and commitment of all participants to the short-term objectives of the project by eliminating the traditional adversarial behavior between participants. Indeed, the findings of this research indicate that successful conflict management may rest on "paying attention" irrespective of procurement method. The introduction of the partnering concept in the last few years can be implemented as a business relationship framework for all parties to the project.
- Incorporate a discrete review process to facilitate learning from experience and sharing this experience during the life cycle of the building process, in order to obtain continuous performance improvement.
- Encourage and promote performance specifications wherever possible to ensure that all parties grasp the logic and spirit of the project and open the door for innovation. Innovative ideas and products may change the actual procurement practices to the better.
- There is an urgent need to build a database to keep track of projects and their causes of success and failure in order to avoid the latter in the future; this is particularly important since experts' perceptions tend to be biased and influenced by projects they have been recently involved with.

The conclusions about the connections between procurement processes and claims warn strongly against a "rush to judgement" on the presumed deficiencies of more traditional ways of building.

At the end of the day, one must wonder if one procurement process is "better" than another in any truly generalizable way - or if success is more a matter of *fit* between project circumstances and project procurement processes, and then *execution* once the procurement strategy is selected.

5.5 RECOMMENDATIONS FOR FUTURE RESEARCH

The current situation of the construction industry appears to be like a transitional period, in which the innovative procurement strategies need to be "re-engineered" and fine-tuned to suit the evolving needs of building owners.

Continuous monitoring of the situation to find out whether the acquisition and availability of experience with the novel procurement methods change the positions we have discussed. This work needs to be done at an equivalently detailed level, in order to detect possible shifts in the impacts of the various sources of claims.

Since availability and access to information is the most critical factor in claims causation, information management systems should be investigated more closely and refined to make a better use of the new tools that are now available (e.g. Internet and intranet) and which are redefining many current paradigms. At the same time, the use of such tools offers an excellent opportunity to transfer research into practice (both regarding procurement and other related subjects) and thus benefit the construction industry.

The study was carried out on building projects in North America (Canada and USA). The causes of claims classified in this study are specific to the North American building

industry and are not necessarily similar to those found in other countries or in other socio-economic environments. Nevertheless, the same study could be repeated elsewhere using the same categorization of the root causes of claims, since this categorization stems from the theory of inter-organizational conflict which is applicable to all environments and all organization structures.

Incidentally, a "standardized" comparison of the root causes of claims in different countries would help in understanding the impact of the cultural differences and would lead, most beneficially, to improved performance for multi-national owners and for international construction companies.

While the choice of a procurement system cannot be based merely on the potential to minimize unhealthy disputes and litigation, this criterion can be incorporated as one of the criteria to be considered when selecting an appropriate procurement system. One such application is the integration of such a criterion as a module in a more comprehensive procurement selection mechanism (decision support system or expert system) such as PASCON (Mohsini, 1993).

BIBLIOGRAPHY

A-

Abdel Meguid, T.A., and Davidson, C.H. (1996). "Managed Claims Procurement Strategy: A Preventive Approach." in Taylor, R., (ed.), *North meets South - Procurement Systems Symposium, CIB W92 Proceedings*, South Africa, Natal, Durban. pp. 11-20.

Adrian, James J. 1988. *Construction Claims: A Quantitative Approach*. Reston Publishing Company, Inc. A Prentice Hall Company.

Alkass, S., Mazerolle, M., and Harris, F. (1993). "An Integrated System to Minimize the Cost of Analyzing Construction Claims". *Computing Systems in Engineering*, ASCE, Vol. 4, No. (2-3), pp.271-280.

Alkass, S., and Harris, F.C. (1991). "Expert System, Construction Contractor's Claims Analysis: An Integrated Approach". *Building Research and Information*, Vol. 19, No. (1), pp.56-64.

Alkass, S., and Mazerolle, M. (1990). "Computerized Delay Claims Analysis for Construction Projects". *Preview 2000, 6th Canadian Construction Congress*, Toronto, 1990.

Arditi, D. and Patel, B.K. (1989). "Impact Analysis of Owner-Directed Acceleration". *Journal of Construction Engineering and Management*, ASCE, Vol. 115, No. 1, pp. 144-157.

B-

Barrie, Donald S., and Paulson, Boyd C. (jr.). (1992). *Professional Construction Management*. McGraw-Hill Series in Construction Engineering and Project Management, McGraw-Hill Book Company, N.Y.

Bennett, J. (1985). *Construction Project Management*. Butterworths, London, UK.

Bramble, B.B., and Callahan, M.T. (1987). *Construction Delay Claims*. John Wiley and Sons Inc., New York, N.Y.

Brunies, R.A. (1988). "Impact Costs - What Are They? And How to Quantify them". Project Management Institute, San Francisco, California, pp. 386-392.

Bryman, A., and Cramer, D. (1990). *Quantitative Data Analysis For Social Scientists*. USA and Canada, Routledge, Chapman and Hall Inc.

Bubbers, G., and Christian, J. (1992). "Hypertext and Claim Analysis". Journal of Construction Engineering and Management, ASCE, Vol. 118, No. 4, pp. 716-730.

C-

Canadian Thesaurus of Construction Science and Technology: T-C/C-S (1978 - 1st Edition), Developed for the Department of Industry, Trade and Commerce of the Government of Canada by the IF Research Group, Université de Montréal.

Chappell, D. (1991), *Which form of building contract?*, E&FN Spon Ltd.

Clark, W.G. (1990). "Claims Avoidance and Resolution". *AACE Transactions*, Paper No. R-1.

Clegg, S.R. (1992). "Contracts Cause Conflicts" *Proceedings of the 1st International Construction Management Conference* on "*Construction Conflict Management and Resolution*", UMIST, UK. E. & F. N. Spon Ltd.

Cobb, J.E. and Diekmann, J.E. (1986). "A Claim Analysis Expert System". *Project Management Journal*, pp. 39-48.

Conlin, J.T., Langford, D.A., and Kennedy, P. (1996). "The Relationship Between Construction Procurement Strategies and Construction Contracts Disputes." in Taylor, R., (ed.), *North meets South - Procurement Systems Symposium, CIB W92 Proceedings*, South Africa, Natal, Durban. pp. 66-79.

Crichton, C., (ed.) (1967). *Interdependence and Uncertainty: A Study of the Building Industry*, London, Tavistock Publications, 84 pp.

D-

Davidson, C.H., and Abdel Meguid, T.A., (eds.) (1997). *Procurement - A Key To Innovation / La Maîtrise d'ouvrage - Clé de l'Innovation.* CIB W92 Procurement Symposium, CIB publication 203, Montreal. 850 pp.

Davidson, C.H. (1997). "Methodologie de Recherche I: Orientations et Principes", *AME 6502 methodology course notes*, Faculté de l'aménagement, Université de Montréal, p 7.

Davidson, Colin H., and Mohsini, R. (1990). "Effects of Organizational Variables Upon Task-organizations' Performance in the Building Industry," in Ireland, J., and Uher, T.,

(eds.), *CIB-90, Building Economics and Construction Management, Vol. 4, Managing Projects*, University of Technology, Sydney.

Davidson, C.H. (1989). "Overview and assessment of building procurement options in North America for high-technology companies," in Goumain, P. (ed.), *High-Technology Workplaces*, pp. 211-26. Van Norstrand Reinhold, New York.

Davidson, Colin H. (1988). "The Building Team," in Wilkes, J.A., and Packard, R.A., (eds.), *Encyclopedia of Architecture: Design, Engineering and Construction*, New York, John Wiley and Sons, pp. 509-515.

Davidson, Colin H., and Mohsini, R. (1987). "Building Procurement: A Strategic Organization and Management Decision." in Lansley, P.R., and Harlow P.A., (eds.), *Managing Construction Worldwide*, vol. 1: *Systems for Managing Construction*, London and New York, E. & F. N. Spon, pp. 28-39.

De Vaus, D.A. (1991). *Surveys in Social Science*, (3rd Edition), Allen and Unwin, London, UK.

De Wit, A. (1986), Measuring project success: an illusion. *Project Management Institute Seminar I Symposium*, Canada, p.20-25.

Diekman, J.E., and Girard, M.J. (1995). "Are Contract Disputes Predictable?" *Journal of Construction Engineering and Management*, ASCE, Vol. 121, No. 4, pp. 355-363.

Diekman, J.E., and Nelson, M.C. (1985). "Constuction Claims: Frequency and Severity" *Journal of Construction Engineering and Management*, ASCE, Vol. 111, No. 1, pp. 74-81.

Diesing, P. (1972). *Patterns of Discovery in the Social Sciences*. London, Routledg & Kegan Paul .

F-

Fazio, P., Moselhi, O., Theberge, P., and Revay, S. (1988). "Design Impact of Construction Fast-track" *Construction Management and Economics*, Vol. 6, pp. 195-208.

Fellows, R.F., Hancock, M.R., and Seymour, D. (1994). "Conflict Resulting From Cultural Differentiation, *TG 15 "Construction Conflict: Management and Resolution" Conference Proceedings, CIB Publication 171*, Lexington, Kentucky, USA.

Franks, J. and Harlow, P. (1990). *Building Procurement Systems*, CIB, London, UK.

Franks, J. (1984). Building Procurement Systems - A Guide to Building Project Management, CIOB, Ascott, UK.

G-

Gardiner, P.D., and Simmons, J.E.L. (1992). "Analysis of Conflict and Change in Construction Projects". *Construction Management and Economics*, Vol. 10, pp. 459-478.

Gazette, The, (1992). "Sue me but there are better ways to settle disputes than going to court". March 28, 1992, p. D1, Montreal, Quebec, Canada.

Glaser, B. and Strauss, A. (1967), "The discovery of grounded theory" in *The forest ranger: A Study in Administrative Behaviour*, John Hopkins University Press.

Glover, M. (ed.) (1976). *Alternative Processes: Building Procurement, Design and Construction*, IF Occasional Paper No.2, The IF Team and the University of Illinois, 168pp.

Glover, M. (ed.) (1974). *Building Procurement: Proceedings of a Workshop*, IF Occasional Paper No.1, The IF Team and the University of Illinois, 64pp.

Goldsmith, I. (1983). Canadian Building Contracts. (2nd ed.) Carswell: Toronto.

Griffith, A., and Headley, J.D. (1997). "Using a Weighted Score Model as an Aid to Selecting Procurement Methods for Small Building Works." *Construction Management and Economics*, Vol. 15, pp. 341-348.

H-

Handy. C.B. (1983). *Understanding Organizations*. Penguin Books, Harmondsworth.

Hartman, F.T. (1993). *Construction dispute reduction through an improved contracting process in the Canadian context*. PhD thesis, University of Technology at Loughborough, Leicestershire, England.

Havilland, D.S. (1998). "Procurement Strategy - Key To Quality For Building Owners", in Davidson, C.H., (ed.), *Procurement, The Way Forward / La Maîtrise d'ouvrage de*

Demain, Montréal & Rotterdam, IF Research Group / Société de Recherche IF & CIB (in press).

Havilland, D.S. (1996). "Managing Your Project: Claims Factors - Listening to Experience." in *Guidelines for Improving Practice*. Victor O. Schinnerer & Co., Inc., Vol. 26, No. 2.

Havilland, D.S. (1995a). "Managing Your Project: Providing Professional Services." in *Guidelines for Improving Practice*. Victor O. Schinnerer & Co., Inc., Vol. 25, No. 3.

Havilland, D.S. (1995b). "Managing Your Project: Structuring the Project Team." in *Guidelines for Improving Practice*. Victor O. Schinnerer & Co., Inc., Vol. 25, No. 2.

Havilland, D.S. (1981). *Managing Architectural Projects: The Process*. The American Institute of Architects (AIA), Washington D.C.

Haviland, D.S. (1981). *Systems Building Technology*. Unpublished Report, New York, Troy, Rensselaer Polytechnic Institute.

Havilland, D.S. (1976). *Project Delivery Approaches: An AIA Guide*. The American Institute of Architects (AIA), Washington D.C.

Heather, P.R. (1989). "Mathews Curve - A Model for Evaluating Impact". AACE Transactions, Paper No. I-4.

Hendrickson, C., and Au, T. (1989). Project Management for Construction: Fundamental Concepts for Owners, Engineers, Architects, and Builders. Prentice Hall, New Jersey.

Hewitt, R. (1991). *Winning Construction Disputes*, Ernst & Young.

Hibberd, P., Merrifield, D., and Taylor, A. (1990). *Key Factors in Contractual Relationships*, Working Report, Royal Institution of Chartered Surveyors (RICS), London, UK.

Hohns, M.H. (1979). Preventing and solving construction contract disputes. Van Norstrand Reinhold Co., New York, NY.

I-

Ibbs, C.W., and Ashley, D.B. (1987). "Impact of Various Construction Contract Clauses". *Journal of Construction Engineering and Management*. ASCE, Vol. 113, No. 3, pp. 501-521.

K-

Katsanis, C. J., and Davidson, C.H. (1996). "Horizon 2020: Building Procurement and Industry Fragmentation, A North American Scenario." in Taylor, R., (ed.), *North meets South - Procurement Systems Symposium, CIB W92 Proceedings*, South Africa, Natal, Durban. pp. 251-260.

Kraiem, Z.M., and Diekmann, J.E. (1987). "Concurrent Delays in Construction Projects". Journal of Construction Engineering and Management, ASCE, 113(4), pp. 591-602

Kumaraswamy, M.M. (1996). "Is Construction Conflict Congenital?" in Thorpe A., (ed.), *ARCOM 96 - Conference Proceedings*, Sheffield Hallam University, pp. 190-199.

L-

Langford, D.A., Kennedy, P., and Sommerville, J. (1992). "Contingency Management of Conflict: An Analysis of Contract Interfaces" in Fenn, P., and Gameson, R., (eds.), *Construction Conflict: Management and Resolution*, E & F.N. Spon Ltd. pp. 64-71.

Lansley, P.R. (1986). "Modelling Construction Organizations." *Construction Management and Economics*, Vol. 4, No. 1, pp. 19-36.

Lawrence, P.R., and Lorsch, J.W. (1986). *Organization and Environment: Managing Differentiation and Integration.* Harvard Business School Press, Boston, Massachusetts.

Lawrence, P.R., and Lorsch, J.W. (1969). *Organization and Environment.* Homewood, Illinois, Richard D. Irwin, 1969, 280 pp.

Leonard, C. A. (1988). *The effects of change orders on productivity.* M.Eng. Thesis presented to CBS, Concordia University, Montreal, Quebec, CA.

M-

Masterman, J.W.E. (1992), *An introduction to building procurement systems*, E & F.N. Spon Ltd.

Mazerolle, M. and Alkass, S. (1993). "An Integrated System to Facilitate the Analysis of Construction Claims". Proceeding of fifth International Conference on Computing in Civil Engineering, ASCE, Anaheim, California, Vol.2, pp. 1509-15

Mazerolle, M. (1992). "Cost effective approach for delay analysis and claims preparation", M.Eng. report, CBS, Concordia university, Montreal, Quebec, CA.

McDermott, P., and Quinn, B. (1996). "A Culture of Contentiousness? - A Pilot Study of the Procurement of Contractual and Legal Services in U.K. Construction Industry", addendum (pages not numbered), in Taylor, R., (ed.), *North meets South - Procurement Systems Symposium. CIB W92 Proceedings*, South Africa, Natal, Durban.

Miller, E.J., and Rice, A.K. (1967). *Systems of Organizations*. Tavistock Publication. London, UK.

Mohsini, R.A., Sirpal, R., and Davidson, C.H. (1995). "Procurement: A Comparative Analysis of Construction Management and Traditional Building Processes", *Building Research and Information*, Vol. 23, No. 5, pp. 285-290.

Mohsini, R.A. (1993). "Knowledge-Based Design of Project-Procurement Process", *Journal of Computing in Civil Engineering*, Vol. 7, No. 1, pp. 107-122.

Mohsini, R.A. (1992). "On Measuring Project Performance: Some Problems of Aggregation" in Kalay, Y.E. (ed.), *Evaluating and Predicting Design Performance*. John Wiley and Sons, Inc. New York, Buffalo, pp. 239-250.

Mohsini, R.A., and Davidson, C.H. (1992). "Determinants of Performance in the Traditional Building Process", *Construction Management and Economics*, Vol. 10, pp. 343-359.

Mohsini, R.A., and Davidson, C.H. (1991). "Building Procurement: Key to Improved Performance", *Building Research and Information*, Vol. 19, pp. 106-113.

Mohsini, R.A. (1989). "Performance and Building: Problems of Evaluation", *Journal of Performance of Constructed Facilities*, ASCE, Vol. 3, No. 4, pp. 235-242.

Mohsini, R.A., and Davidson, C.H. (1986). "Procurement, Organizational Design and Building Team Performance: A Study of Inter-firm Conflict" in *CIB W86 Proceedings*, Vol. 8, Washington, D.C., pp. 3548-3555.

Mohsini, R.A. (1985). *Building Procurement Process: A Study of Temporary Multi-Organizations*. Unpublished PhD Thesis, Faculté de l'aménagement, Université de Montréal, Montréal, Qc., Canada.

Moser, C.A. and Kalton, G. (1971). *Survey Methods in Social Investigation*, 2nd edn. Gower Publishing Company, Aldershot.

N-

Nahapiet, H., and Nahapiet, J. (1985). "A Comparison of Contractual Arrangements for Building Projects." *Construction Management and Economics*, Vol. 13, No. 3, pp. 217-231.

Naoum, S.G., and Langford, D. (1987). "Management Contracting - The Client's View." *Journal of Construction Engineering and Management*, ASCE, Vol. 113, No. 3, pp. 369-384.

NEDO, (1985). *Thinking about Building*. National Economic Development Office, London, UK.

Norusis, M.J. (1996). *SPSS Guide to Data Analysis: Release 7.0*. SPSS Inc.Chicago.

0-

Oppenheim, A.N. (1992). *Questionnaire Design, Interviewing and Attitude Measurement*. London, Printer Publishers Ltd.

P-

Paris, J. (1970). Structuration d'un projet de recherche, Industialization Forum, vol. 1, no. 2, 5-12.

Phillips, E.M, and Pugh, D.S. (1994) *How to get a Ph.D. - A handbook for students and their supervisors*, (2nd Edition), Open Press, Buckingham, PA.

Pretorius, F.I.H., and Taylor, R.G. (1986). "Conflict and individual coping behaviour in Informal Matrix Organizations Within the Construction Industry". *Construction Management and Economics*, Vol. 4, pp. 87-104.

R-

Revay, S.G. (1992). "Can Construction Claims be Avoided?" *Proceedings of the 1st International Construction Management Conference* on "*Construction Conflict Management and Resolution*", UMIST, UK. E. & F. N. Spon Ltd.

Rhys Jones, S. (1994). "How Constructive is Construction Law?" *Construction Law Journal*, Vol. 10, pp. 28-38.

Roberts, C.J.B. (1974). *Project Analysis and Organizational Design in Building: An Investigation into the Performance of Building Projects*. Unpublished Report, St. Louis, Washington University, 220pp.

Robson, C. (1993). *Real World Research: A Resource for Social Scientists and Practitioner-researchers*. Oxford, Blackwell Publishing.

Rose, G. (1991). *Alternative dispute mechanisms and contract settlement: Secretarial report*, Construction Industry Development Council, Ottawa, Ontario, Canada.

Rubin, R., Guy, S., Maevis, A., and Fairweather, V., (1983). Construction Claims Analysis. Presentation, Defence, Van Nostrand Reinhold Co., New York.

S-

Sekaran. U. (1992). *Research Methods for Business - A Skill Building Approach*. 2nd Edition, John Wiley and Sons, New York.

Semple, C., Hartmann, F.T., and Jergeas, G. (1994). "Construction Claims And Disputes: Causes And Cost/Time Overruns". Journal of Construction Engineering and Management, ASCE, Vol. 120, No. 4, pp. 785-795.

Sharif, A., and Morledge, R. (1994). "A Functional Approach to Modelling Procurement Systems Internationally and the Identification of Necessary Support Frameworks" in Rowlinson, S. (ed.), *East Meets West*, Hong Kong, CIB W92 Procurement Systems Symposium. pp. 295-305.

Shirazi, B., Langford, D.A., and Rowlinson, S.M. (1996). "Organizational Structures in the Construction Industry." *Construction Management and Economics*, Vol. 14, pp. 199-212.

Sidwell, A.C. (1983). "An Evaluation of Management Contracting." *Construction Management and Economics*, Vol. 1, No. 1, pp. 47-55.

Simister, S. (1995), Case study methodology for construction management research. ARCOM, p.18-20.

Skitmore, R.M. and Marsden, D.E. (1988). Which procurement system? Towards a universal procurement selection technique, *Construction Management and Economics*, Vol. 16, pp. 71-89.

Snyder, James C., (ed.). (1984), *Architectural Research*, New York, Van Nostrand Reinhold, 296 pp.

Statistics Canada, (1991-1994). Construction in Canada, Catalog no. 64-201.

Sykes, J.K. (1996). "Claims and Disputes in Construction: Suggestions for their Timely Resolution" *Construction Law Journal*, Vol. 12, No. 1, pp. 3-13.

T-

Tatum, C.B. (1989). "Management Challenges of Integrating Construction Methods and Design Approaches." *Journal of Construction Engineering and Management*, ASCE, Vol. 5, No.2, pp.139-154.

Tatum, C.B., and Fawcett, R.P. (1986). "Organizational Alternatives for Large Projects". *Journal of Construction Engineering and Management*, ASCE, Vol. 112, No.1, pp.49-61.

Tribaldos, E. (1994). *An Expert System for Classifying and Quantifying Construction Delays*. M.Eng. report, CBS, Concordia university, Montreal, Quebec, CA.

W-

Walker, D.H.T. (1997). "Choosing An Appropriate Research Methodology." *Construction Management and Economics*, Vol. 15, pp. 149-159.

Winch, G., and Campagnac, E. (1995). "The Organization of Building Projects: An Anglo/French Comparison." *Construction Management and Economics*, Vol. 13, pp. 3-14.

Winch, G. (1989). "The Construction Firm and the Construction Project: A Transaction Cost Approach." *Construction Management and Economics*, Vol. 7, pp. 331-345.

Y-

Yin, P.K. (1990), Case study research: Design and methods, Sage Publication Ltd, London.

Z-

Zikmund, W.G. (1994). *Business Research Methods*, (4th Edition), Dryden Press, Fort Worth, TX.

APPENDIX A

CONTROL GROUP: 1st MONTREAL SURVEY (1992)

Enquête sur les stratégies des donneurs d'ouvrage*
un projet de la Chambre de commerce du Montréal métropolitain
et de la Faculté de l'aménagement, Université de Montréal.

Nom du répondant** : .....; Compagnie:.....

Veuillez choisir un projet récent auquel vous avez participé, et répondre aux questions suivantes à son sujet, en cochant les cases appropriées:

Le projet que j'ai choisi s'appelle:.....

Le type de projet est: résidentiel ☐ institutionnel ☐ commercial ☐ industriel ☐
autre: .....

Son financement est: public ☐ privé ☐ les deux ☐
Son coût (en $) est: < 5,000,000 ☐ de 5 à 50 m. ☐ >50,000,000 ☐
Le projet est: ± simple ☐ ± complexe ☐ exceptionnel ☐

Le projet était effectué en mode:

- conception-appel d'offres-construction ☐
- conception-construction ☐
- clé-en-main ☐
- produit-en-main ☐
- gérance de projet ☐
- gérance de la construction ☐
- autre: .....

Qui était responsable pour:

1. le design:
   - le propriétaire/donneur d'ouvrage ☐
   - l'architecte ☐
   - l'ingénieur ☐
   - le gérant de projet ☐
   - le fabricant d'un produit principal ☐
   - le concepteur-constructeur/promoteur ☐
   - autre .....

---

* Par «stratégies des donneurs d'ouvrage» ou «maîtrise d'ouvrage» nous entendons l'ensemble des décisions de nature contractuelle prises par chaque donneur d'ouvrage; tout porte à croire que ces décisions déterminent (i) l'ensemble des contrats qui régissent l'équipe de concepteurs, de fournisseurs et d'entrepreneurs chargée du design et de la réalisation d'un bâtiment, (ii) les liens formels et informels qui peuvent s'établir à l'intérieur de l'équipe et (iii) le rapport qualité/prix final du projet.

** La confidentialité des réponses sera respectée; seules des compilations anonymes seront utilisées pour la suite de l'étude et pour les activités visant à promouvoir le concept de la maîtrise d'ouvrage par la Chambre.

2. la construction:
- le propriétaire/donneur d'ouvrage ☐
- l'entrepreneur général ☐
- plusieurs entrepreneurs spécialisés ☐
- le concepteur-contructeur/promoteur ☐
- autre .....

3. l'administration du contrat de design:
- le propriétaire/donneur d'ouvrage, ☐
- l'architecte-administrateur ☐
- l'ingénieur-administrateur ☐
- le gérant de projet ☐
- autre .....

4. l'admin. du contrat de construction:
- le propriétaire/donneur d'ouvrage ☐
- l'architecte-administrateur ☐
- l'ingénieur-administrateur ☐
- le gérant de construction ☐
- le gérant de projet ☐
- autre .....

Quelle était la base pour:

5. le choix du concepteur:
- négociation ☐
- concours ☐
- faisant partie d'un contrat de construction ☐
- autre .....

6. le choix du/des constructeur(s):
- de gré à gré ☐
- appel d'offres ouvert ☐
- appel d'offres sur invitation ☐
- appel d'offres après préqualification ☐

(dans le cas d'un appel d'offres, le contrat était accordé au moins offrant: oui ☐ non ☐

si non, expliquer:.....)

- autre.....

7. la rémunération de la construction:
- à forfait ☐
- coût plus honoraires ☐
- prix maximum garanti ☐
- autre.....

Quel était:

8. le type de documentation contractuelle: plans et devis complets ☐
listes des facilités (devis fonctionnel) ☐
avant-projet sommaire ☐
devis de performance ☐
autre .....

À refaire ce projet, recommanderiez-vous d'adopter la même stratégie: oui ☐ non ☐
Si non, les difficultés découlaient des choix suivants (se référer aux numéros ci-dessus):
(encerclez le(s) numéro(s) pertinents s.v.p): 1 2 3 4 5 6 7 8

Commentaires?.....

.....(continuez sur une autre feuille au besoin)

Accepteriez-vous éventuellement de répondre à d'autres questions au téléphone?
oui ☐ non, c'est malheureusement impossible ☐

Merci beaucoup de votre aide. Veuillez retourner ces informations par fax au 343-2183 à l'attention du Pr Colin Davidson.

APPENDIX B

CONTROL GROUP: 2nd MONTREAL SURVEY (1997)

Survey of Procurement Strategies (1997)

Firm's Name .....
Speciality: ..... (Architect / Engineer / Project Mgt. / Contractor /Other - indicate)

Question (1): Please indicate the % of projects undertaken by your company and type of owner

	Traditional	Turnkey	Design-Build	Owner-Builde	Constr. Mg
Public Owner	.....%	.....%	.....%	.....%	.....%
Private Owner	.....%	.....%	.....%	.....%	.....%

Question (2): Please indicate your perception of the relative importance of causes of delay and claim under each type of project organization and ownership (on a scale from 1 - 5, 1 being **least** important and 5 being the **most** important)

	Traditional		Turnkey		Design-Build		Owner-Builder		Constr. Mgt.	
	Pub.	Priv.	Pub.	Priv.	Pub.	Priv.	Pub.	Priv.	Pub.	Priv.
PROJECT CHARACTERISTICS										
Complexity of the project	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Budget constraint	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Time constraint	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Flexibility to change during constr.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Lowest-bid constraint	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
SCOPE OF THE PROJECT										
Ambiguous documents	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Changes in scope of work	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Changes of specs by A/E	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Differing site conditions	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Misinterpretation of Docs by A/E	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Excessive Interpretation of specs	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
AVAILABILITY AND ACCESS TO INFORMATION										
Faulty specifications	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Incomplete documents	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Late approvals	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Late documents	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Late issuance of design Docs.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Late rectifications	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Untimely design revisions	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
COORDINATION										
Untimely and uncoordinated C/O'	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Lack of coordination	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Restricted site & interference	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Delayed site access	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Acceleration	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Winter work	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Lack of site supervision	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Disruption by A/E	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Payment delay	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

APPENDIX C

REGRESSION ANALYSIS - SPSS OUTPUT

Regression Analysis (Separated and Cooperative Strategy)

In this procurement strategy, X15, X26, X27, X34, and X38 have no occurrences

P1 (% Time Overrun)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.785[a]	.615	.581	38.2096%

a. Predictors: (Constant), X35, X13, X12, X22, X23

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	130845.0	5	26169.002	17.924	.000[a]
	Residual	81758.314	56	1459.970		
	Total	212603.3	61			

a. Predictors: (Constant), X35, X13, X12, X22, X23

b. Dependent Variable: P1

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	38.502	5.752		6.693	.000
	X12	75.327	27.624	.227	2.727	.009
	X13	225.261	27.624	.680	8.155	.000
	X22	19.896	8.256	.201	2.410	.019
	X23	10.229	4.697	.185	2.178	.034
	X35	98.376	28.016	.297	3.511	.001

a. Dependent Variable: P1

P2 (% Claimed to Budget)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.263[a]	.069	.054	39.3044%

a. Predictors: (Constant), X11

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6899.189	1	6899.189	4.466	.039[a]
	Residual	92690.298	60	1544.838		
	Total	99589.487	61			

a. Predictors: (Constant), X11

b. Dependent Variable: P2

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	25.547	5.161		4.950	.000
	X11	21.469	10.159	.263	2.113	.039

a. Dependent Variable: P2

P3 (% Awarded to Budget)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.334[a]	.112	.097	21.7148%

a. Predictors: (Constant), X33

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3563.469	1	3563.469	7.557	.008[a]
	Residual	28292.034	60	471.534		
	Total	31855.503	61			

a. Predictors: (Constant), X33

b. Dependent Variable: P3

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	9.031	2.876		3.140	.003
	X33	13.921	5.064	.334	2.749	.008

a. Dependent Variable: P3

P4 (% Awarded to Claimed)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.335[a]	.112	.097	27.0859%

a. Predictors: (Constant), X22

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5562.273	1	5562.273	7.582	.008[a]
	Residual	44018.812	60	733.647		
	Total	49581.086	61			

a. Predictors: (Constant), X22

b. Dependent Variable: P4

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	39.880	3.620		11.018	.000
	X22	16.019	5.818	.335	2.753	.008

a. Dependent Variable: P4

P5 (% Trial Overrun)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.595[a]	.354	.320	1514.319%

a. Predictors: (Constant), X35, X13, X25

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7.3E+07	3	2.4E+07	10.587	.000[a]
	Residual	1.3E+08	58	2293163		
	Total	2.1E+08	61			

a. Predictors: (Constant), X35, X13, X25

b. Dependent Variable: P5

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	588.246	206.073		2.855	.006
	X13	2129.630	1090.435	.207	1.953	.056
	X25	1359.284	392.351	.367	3.464	.001
	X35	4683.976	1090.435	.454	4.296	.000

a. Dependent Variable: P5

Regression Analysis (Integrated Strategy)

In this strategy, X11, X12, X26, X29, X36, X37, and X38 have no occurrences.

P1 (% Time Overrun)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.553[a]	.306	.274	116.9843%

a. Predictors: (Constant), X33, X13

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	265237.7	2	132618.8	9.691	.000[a]
	Residual	602154.1	44	13685.320		
	Total	867391.8	46			

a. Predictors: (Constant), X33, X13

b. Dependent Variable: P1

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	45.359	18.817		2.411	.020
	X13	188.073	51.457	.462	3.655	.001
	X33	62.460	30.769	.257	2.030	.048

a. Dependent Variable: P1

P2 (% Claimed to Budget)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.538[a]	.289	.257	48.5100%

a. Predictors: (Constant), X33, X14

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	42124.849	2	21062.425	8.950	.001[a]
	Residual	103541.7	44	2353.220		
	Total	145666.5	46			

a. Predictors: (Constant), X33, X14

b. Dependent Variable: P2

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	23.408	7.485		3.127	.003
	X14	127.670	49.084	.331	2.601	.013
	X33	43.794	12.692	.439	3.451	.001

a. Dependent Variable: P2

P5 (% Trial Overrun)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.558[a]	.311	.296	652.3805%

a. Predictors: (Constant), X13

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8656327	1	8656327	20.339	.000[a]
	Residual	1.9E+07	45	425600.3		
	Total	2.8E+07	46			

a. Predictors: (Constant), X13

b. Dependent Variable: P5

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	631.823	101.885		6.201	.000
	X13	1286.021	285.156	.558	4.510	.000

a. Dependent Variable: P5

Regression Analysis (Management-oriented Strategy)

In this strategy, X12, X14, X15, X21, X22, X23, X24, X25, X27, X33, X34, X35, X36, and X37 have no occurrences.

P2 (% Claimed to Budget)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.690[a]	.477	.360	28.3467%

a. Predictors: (Constant), X38, X32

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6582.893	2	3291.447	4.096	.054[a]
	Residual	7231.796	9	803.533		
	Total	13814.690	11			

a. Predictors: (Constant), X38, X32

b. Dependent Variable: P2

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	39.729	10.022		3.964	.003
	X32	15.102	6.397	.578	2.361	.043
	X38	60.271	30.066	.491	2.005	.076

a. Dependent Variable: P2

P3 (% Awarded to Budget)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.939[a]	.881	.855	9.3856%

a. Predictors: (Constant), X32, X29

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5885.127	2	2942.563	33.404	.000[a]
	Residual	792.806	9	88.090		
	Total	6677.932	11			

a. Predictors: (Constant), X32, X29

b. Dependent Variable: P3

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.241	3.427		1.529	.161
	X29	24.974	6.296	.458	3.967	.003
	X32	13.981	2.099	.770	6.662	.000

a. Dependent Variable: P3

P4 (% Awarded to Claimed)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.840[a]	.706	.641	16.2712%

a. Predictors: (Constant), X32, X29

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5729.536	2	2864.768	10.821	.004[a]
	Residual	2382.764	9	264.752		
	Total	8112.300	11			

a. Predictors: (Constant), X32, X29

b. Dependent Variable: P4

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	20.671	5.941		3.479	.007
	X29	34.711	10.915	.578	3.180	.011
	X32	10.991	3.638	.549	3.021	.014

a. Dependent Variable: P4

P5 (% Trial Overrun)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.951[a]	.904	.882	205.4102%

a. Predictors: (Constant), X38, X13

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3563370	2	1781685	42.227	.000[a]
	Residual	379740.0	9	42193.338		
	Total	3943110	11			

a. Predictors: (Constant), X38, X13

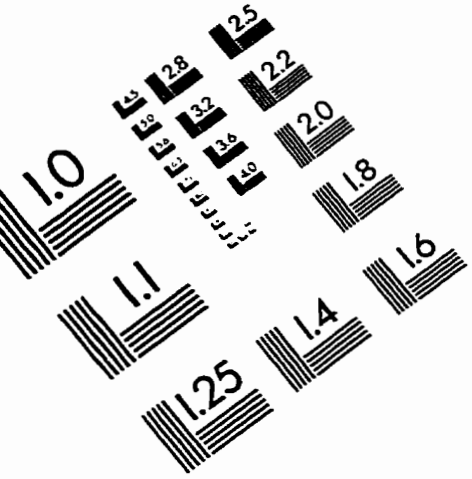
b. Dependent Variable: P5

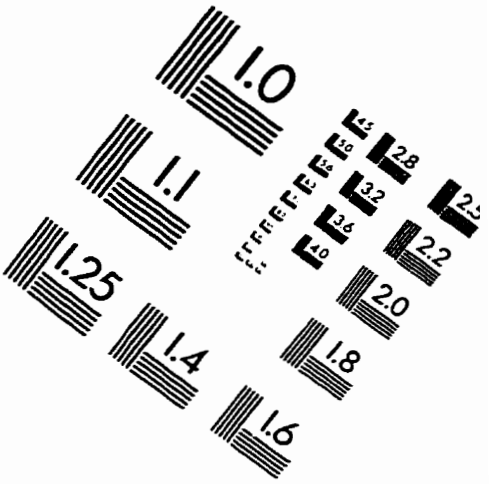
Coefficients[a]

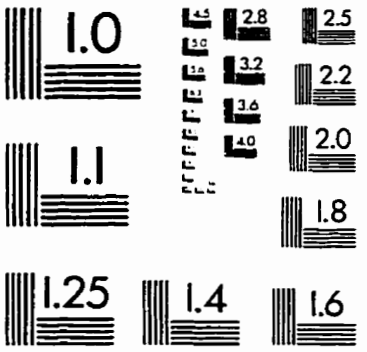
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	333.094	64.956		5.128	.001
	X13	1476.824	215.436	.712	6.855	.000
	X38	1447.394	215.436	.698	6.718	.000

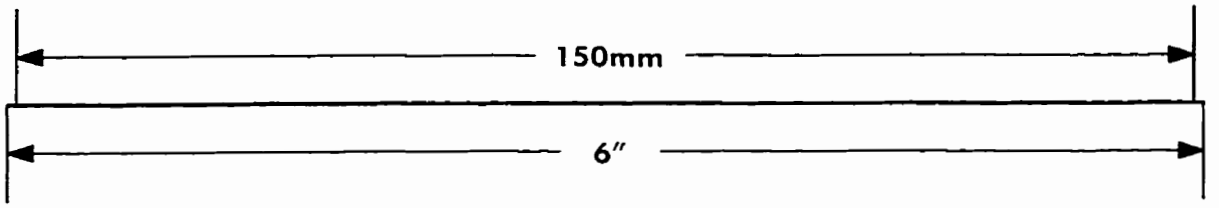
a. Dependent Variable: P5

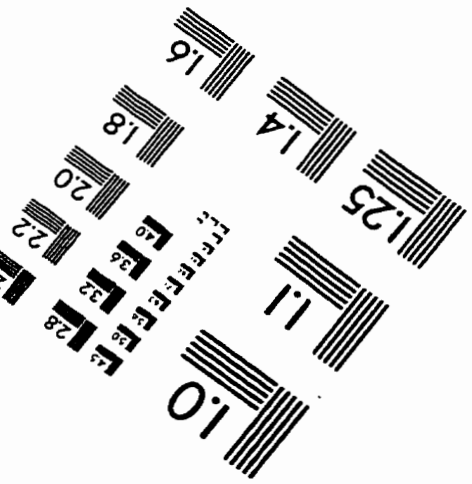
IMAGE EVALUATION
TEST TARGET (QA-3)

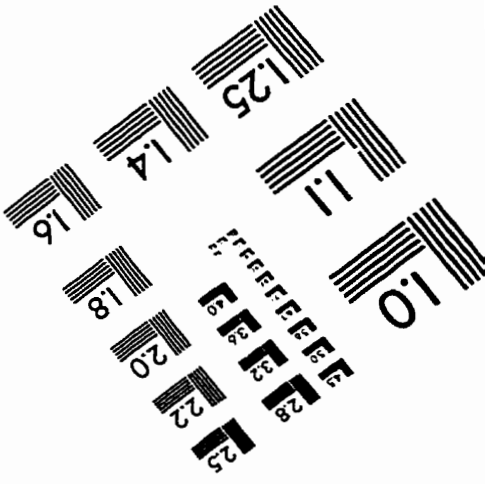












APPLIED IMAGE, Inc
1653 East Main Street
Rochester, NY 14609 USA
Phone: 716/482-0300
Fax: 716/288-5989