A COMPUTER-BASED MANAGEMENT SYSTEM FOR COOPERATIVE DECISION MAKING IN DEVELOPMENT CONTROL USING THE CONTRACT MODEL - A Case For Johor Bahru

By

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Chapter 1

Managing Urban Development and Decision Making

1.0 Introduction

As an introduction, this chapter is intended to give an overview of the subject matter, problem identification, and research objectives that constitute this thesis on the requirement for developing generic computing systems that can be supportive of, and enhance the process of cooperative problem solving activities among distributed agents, in a coherent manner. In particular, we will analyse the problem solving activities related to the field of Design and Planning, and especially those dealing with the issues of development control.

Here we define development control as "a system whereby the City Council exercise the right to approve or refuse applications for permission to carry out development on a site" (Jay, 1962, p. 18). The problem solving environment in development control can be described as being distributive and cooperative. It is distributive because expertise and relevant knowledge are assumed to be held amongst a wide range of participants. Each participant is considered as an individual expert. However, these experts need to interact and cooperate to solve the problem.

One of the main tasks of the computer system therefore is to manage the cooperation among the experts, each with differing opinions and viewpoints, so that decisions can be synthesised and integrated as a whole. The problem is exemplified by the eratic hyper-development which has caused a strain in the resources of the City Council responsible for managing development control. We will analyse the problem faced by Malaysia's second largest city, Johor Bahru, as a case study for the thesis.

To help us better understand the issues, we will look at two main fields, namely project management and Distributed Artificial Intelligence (DAI). The attraction of project management is the way in which the output of different experts are divided, distributed, and coordinated within a constraint such as time and budget. DAI on the other hand, deals with the issues of distribution and cooperation of experts in computer systems, two characteristics of problem solving in development control.

We believe that an enquiry into the muti-displinary nature of problem solving and decision making in development control, can give us leads into the fundamental questions of cooperative decision making and guide us in developing generic computing systems in the near future.

1.1 Problem Identification

1.1.1 Problems in Development Control

The first task of the thesis is to identify the problems related to development control in Johor Bahru. Situated in one of the fastest growing economic regions, it is experiencing all the symptoms of uncontrolled growth, similar to those experienced by the post-industrial cities of Europe and North America during the industrial revolution. Behind the facade Johor Bahru's booming urban conglomeration, lies tell-tale evidence of urban decadence, cronic congestion spurred by haphazard and often chaotic development. As a result, the city for example, has become a less and less attractive as a place to live; its citizens have become increasingly estranged from the city, and a large number of its inhabitants have already resorted to the suburbs to live.

While the current issues in European and North American cities are regeneration and redevelopment to overcome urban blight, those of Johor Bahru are often related to hyper-development. However, it is fair to conclude that the common denominator in both cases is one and the same, i.e. related to the issue of *management* and *control.* In Europe, the problem is how to make best use of existing resources to manage and revive the past glories of these cities. Johor Bahru's problem on the other hand, relates to the issues of managing and controlling the fast pace of intervention in the form of new development.

There are two critical issues related to development control in Johor Bahru, namely *delay* and *uncertainty*. Approval for development proposals, can only be formulated when all the different *technical departments* have been consulted and cooperated in the decision making process. Decision making here can been defined as "an act of choice which generates commitment to a specific action" (Levin, 1972). However, the process of *consultation* and *cooperation* is often fraught with unreasonable *delays* due to the complexity and the lack of proper dissemination procedures and requirements. The consequences of this situation can be explicitly illustrated in the practice of client having to appoint '*file-chasers*' to follow up on the progress of a submission. Eventhough there is a 'charter' to ensure that applications will be processed within a three months period, the lack of enforcement and adequate consultation procedure has resulted in the 'file-chasers' physically fowarding the client's casefiles from one technical department to the next.

The *discretionary* and *overlapping* nature of the control systems, have made decision making one of the most prominent issues. The unavailability of a clear blueprint as a guiding principle for development has created the discretionary situation. Decisions are being made by different people and committees, and at different levels and stages; a reflection of the ineffeciency of existing hierarchical organisation structure practiced in the City Council. Development control decisions, are seen almost entirely from the viewpoint of control-officers, and councillors, and little effort is being made to understand the client's (applicants) requirements. References used as a basis for interpretation in control, provides avenues for conflicting judgements. Consequently, *the process can be as uncertain as the outcome.*

There is also no attempt to make this decision making process more *transparent.* It is clear that much of the frustration for all parties, stems from the lack of communication, especially the failure to engage the client in the process at the 'right level and at the right time'. Similarly, trust and cooperation are also lacking and needs to be built up on both sides. Since the process can be costly to both the client and City Council, the need to reduce these uncertainties, and therefore 'cost' due to the length of time taken to make decisions have become paramount.

If the development of JB is to be more disciplined, the process by which civic society and those directly involved in the development can participate and are informed, will have to be institutionalised. Therefore given the organisational ecology, the complexity of the development processes, and the issues involved, it would appear that the development of Johor Bahru, have to be addressed through *dialogue* and *cooperation* among the diverse actors in the city.

1.1.2 Urban Problems and Computers in Group Cooperation and Decision Making

Having outlined the issues and problems, the second task of the thesis is to study how computers can be used as a tool to manage development control. In particular how computers can be utilised to help manage dialogue, participation and cooperation in decision making. Participation and cooperation is important to build trust, and ownership.

There are two main issues related to the problem solving and decision making process in development control. Firstly, the problems can be classified under the wider and more general class of design (Cross, 1984), and is characterised by being ill-defined (Archer, 1979), ill-structured (Simon, 1973) and wicked (Rittel and Webber, 1973). Secondly, solving the problems requires a multi-disciplinary approach (Page, 1972; Rittel and Webber, 1973). The diversity of problems clearly requires the problem solver to seek multi-solutions and goals, as opposed to a single objective. Consequently, solving the problem in this environment, demands a dual approach. Solving structured and routine problems, such as the calculation of the plot-ratio requirement for a development, requires quantifiable solutions such as the use of formulae. Ill-structured and wicked problems such as those related to the aesthetics on the other hand, requires judgement and innovative solutions.

The need for a social and multi-disciplinary approach to problem solving both from within the Johor Bahru City Council (JBCC) and from outside participants, has added a new dimension to the problem. The formulation of a final decision can only be achieved through the act of cooperation, negotiation, and mutual-adjustment among the participants. Moreover each participant have their own, often conflicting objectives (Couch, 1990). However these participants, classified here as expert problem solvers such as the architects, and planners, always consider the problem solving as an individual *creative* process, and usually do not want their *private design space* to be 'invaded' (Page, 1972). This has led to three critical problems, namely,

i. how to ensure that the individual experts can operate independently, but coherently with other participants within a group or team.
ii. how to ensure that the result of the output i.e the decisions, can be integrated into a complete whole.

iii. how to ensure that the decision can be made within a certain constraints, such as time (to solve the problems of delays).

In computer studies, a new sub-field of Artificial Intelligence called Distributed Artificial Intelligence (DAI) has been researched, with the objective of distributing problems and integrating solutions in a network. Of interest to us is that DAI treats each problem solvers called *agents*, as individuals, but also views them collectively as a society (Gasser, 1991; Hayes-Roth, 1981; Huhns, 1987). Agents cooperate and communicate to achieve their own goals, as well as the goal of the society as a whole (Gasser, 1991; Hayes-Roth, 1981; Huhns, 1987, Werner, 1989).

1.1.3 History of DAI Problems

Until recently, computer systems have been developed conventionally to support peoples individual and isolated work (Greenberg, 1991). Computer systems have been built for, and used by people to pursue their own isolated tasks. This approach has been proven insufficient due to the inevitable presence of a number of agents in the real world (Decker, 1987, Gasser and Huhns, 1989, Smith and Davis, 1981). Moreover there is an increasing realisation that agents need to share goals and understanding when solving problems, (Malone and Crowston, 1994), and that many classes of problems cannot be solved in isolation (Chaib-Draa and Moulin, 1992).

Cooperation among the specialised expert agents to solve the problem as a whole, is therefore, essential. Here, each of the agents, such as an architect or engineer, is characterised as having a *distinct* and *related* expert knowledge to make *assessments* and solve a part of development control problem. Agents cooperate for three reasons; firstly no one individual or group has all the knowledge and resources to solve the whole problem *independently*; secondly, the necessity of meeting *constraints,* and thirdly, the existence of many *interdependencies* involved in the execution of the decision making.

The problems cannot be solved by individual groups working independently because they do not possess the necessary expertise, resources or information. Moreover, because of the complex nature of the problem, the different expertise and resources each group has, needs to be harnessed, and combined to solve the problem. For instance, in development control, the planning department will need to consult and cooperate with the engineering department to solve the city's traffic problem. Consultation is vital to find out if a proposal by a client to increase the plot-ratio of a development, will burden the traffic load coming to the city.

Constraints exist when the solution being developed by an agent or group must satisfy certain conditions to be deemed successful. In Johor Bahru for instance, one constraint put on the Council is that the formulation of decisions must be completed within a three month period. If individual groups acted in isolation and merely tried to optimise their local group performances, then such constraints are unlikely to be satisfied. Only through coordinated actions will acceptable solutions and decisions be developed.

Interdependence occurs when activities undertaken by individual groups are inter-related, i.e. the local decisions made by an expert agent or group, have an impact on the decisions of other team agents. Refering to the example above once more, the planning department's consideration for an application to increase the plot ratio for a development, is usually conditional (and dependent) on the traffic department's expert opinions. This is because the increase in plot ratio will contribute to an increase number of car parking space and therefore traffic on the site.

One of the most fundamental issues when developing a *multi-agent* DAI systems, is *how do we ensure that the team of agents act in a coherent manner.* More importantly, *how should the agents behave*, during the act of cooperation. Previous theoretical models have not satisfactorily address this issue, and these models assume that all agents 'willingly' cooperate to solve a problem, and that all cooperation will be successful. How do we for example, ensure that all technical department experts are commited to execute the cooperative act? What happen for example, if something goes wrong such as, if a cooperation is not successful? How should the experts react when one of its team members decides to pull-out of the cooperative action, half-way into the process? Or, how should an agent react, when after making a commitment to cooperate, finds that it needs more time to solve the problem because of unforseen circumstances beyond its control?

The comparative ease with which such an incoherency occurs can be attributed partly to the fact that agents may not posses sufficient knowledge of the cooperative problem solving process to operate in a dynamic and complex problem solving environment which is characteristic of development control.

1.2 Research Objectives

There are at least four disciplines contributing to the thesis, namely planning and architectural design, computer science, and project management. This inter-disciplinary nature of the problems demands a fairly full understanding of the various discipline involved, on which the theoretical framework for the design of a management system for development control system will be fowarded. In this context the research aims to achieve the following :

i. To device a system whereby all matters related to development control can be made available and can be accessed by the participants of the city, solving the problem of uncertainty.

ii. To develop a system that will allow and encourage participatory and cooperative decision making by providing a medium (channel) through which the process of negotiation, trade-off, and mutual adjustment are facilitated, creating transparency.

iii. To design a model that provides a framework which allows the creativity of self-interested expert problem solvers to operate independently, but co-operate coherently with the others as a team.

iv. To develop an explicit model of cooperative problem solving on which the behaviour, roles, and responsibilities of agents could be based. This model should not only prescribe how agents should behave when everything is progressing as planned, but also deals with cases in which something goes wrong.

v. Provide a prototype system to distibute, monitor, and integrate the various consultation processes ensuring that the cooperative act will be executed within the time constraints, hence solving the problem of delay.

1.3 Organisation of the Thesis

The remainder of the thesis will consist of eight chapters organised in the following sequence. In Chapter 2, we look at the theory behind urban planning, design, and management. To help us understand the multi-dimensional and complex nature of the urban environment, we will analyse the views of a city, as being promoted by the Systems Theory. The attraction of the theory as a medium for identifying a conceptual framework, lies in the basic premise that a system is an organised or complex whole - *an assemblage or combination of things or parts forming a unitary whole, which is greater than the sums of its parts.*

Using this theory, we consider the application for development made by the client as an attempt to 'disturb' the systems' balance. The function of City Councils as *managers* of the systems then, is to ensure that these 'disturbances' are in accordance with the plans and objectives of the systems by using *controls* and *feedback* studies.

To aid the the managers in decision making, we analyse how *model* can be used to provide a holistic view about the systems to be managed. Most importantly, we study how the model can act as a *focal point* for all activities, discussion, debate, experiment, analysis, and innovation which can go into the exploration, and management of the city. We then discuss the merits of current development of computer-based urban models, to see if the promises and potentials of such models has been harnessed.

To continue our enquiry, Chapter 3 looks at how the different parts of the systems, namely the participants, can be integrated. Here, we classify the participants into three major components, namely the *managing* system, the *operating* system, and the *client* system. Since managing this environment requires the contribution and cooperation from these independent components, it is vital to ensure that firstly, the cooperation can proceed in a coherent manner, and secondly, the objectives of the cooperation process can be achieved within the time constraints.

For ideas and guidance, we look at the way the construction industry handles its problems. The attraction of looking at this industry is the similarities of the problems to be solved. Firstly, it is multi-disciplinary, and secondly, it is concerned with the problems of control and coordination of the various disciplines. In particular we analyse

1. the way in which the different experts within the industry interact to solve the overall problem,

2. the manner in which the workload is distributed among the experts, and

3. how the execution of tasks of individual experts are monitored and integrated, while ensuring that they are completed on time.

This lead us to the two main contributions of the industry, firstly project management and secondly, the use of contracts to enforce commitments. In *project management*, we look at the project *culture* in organisation and how the *project concept* can be used to response to change, a characteristics of the urban environment. In particular we will study the role of the project manager in a *team*, and the tools that it uses such as *planning* and *schedules* to control projects. We also study the way *conflicts* are being resolved among the members of the project team.

The second contribution is to study how the project team's commitments and objectives are being achieved within a certain constraints such as time, using a *contract*. Since a contract also sets out the *roles*, and *responsiblities* of those signing to it, it can be used to ensure the coherent group behaviour of team members. Moreover, since time is of the essence, the *penalty* that a contract imposes for those beaking it, can be used to ensure (enforce) that the commitments of those signing it, are being honoured.

Chapter 4 and 5 are inter-connected, and look at how the process of development control is practiced in Johor Bahru. We start with Chapter 4 which examines the history of development control in Malaysia. The country's policy to redistribute wealth, the political and hierarchy in decision making, and criticism of current system will also be analysed. We briefly outline the pros and cons of public participation and how (and if) it can be implemented in 'young' democracy like Malaysia.

Before a closer look at the outcome of empirical study in the next chapter, we report on the practise of development control in Johor Bahru. This includes identifying the organisational structure and decision making process in the City Council. Our enquiries also identify specific issues such as the path of casefiles, and the personnel involved in the decision making process. In particular, we want to find out how decisions are being executed and delegated, and the references used by caseworkers in formulating decisions.

Chapter 5 sets out the outcome of the empirical study consisting of surveys and interviews done by the author. The objective of the empirical study is to identify the issues, problems, knowledge, tasks, and people's relationships, among others, that will give the author a better understanding of the 'elements' that need to be considered in designing a management system for development control at Johor Bahru.

Before outlining a framework for a management system, Chapter 6 turns to the field of computer science for the final reference. In particular, we analyse the ways computer science deals with the issues related to *distributive* and *cooperative* decision making, the two characteristics of development control problems as outlined in the preceeding chapters. Defined as Distributed Artificial Intelligence (DAI), it attempts to construct systems of intelligent entities, that interact with one another. These entities, called *agents*, are viewed collectively as a *society*. If the main aim of project management in Chapter 3 is to achieve project *integration*, DAI is concerned with studying a broad range of issues related to the *distribution* and *coordination* of knowledge, and the actions of these agents. Agents collaborate and communicate for their own self-interest, and the interest of the team. The spectrum of the communication methodlogies used by agents, in particular blackboard systems, are also described.

Another important enquiry in this chapter is the study of the impact of *culture* on the design of *groupware*. Here we have defined groupware as a technology that helps people to work in teams across functional and geographical boundaries, and to make decisions, communicate, collaborate and co-operate more efficiently and effectively. For far too long, research in this area, makes the assumptions that groupware will *democratise* the process of decision making in groups, regardless of the groups' cultural background. The advantage of this 'individualistic' view of cooperation, is that every member is being treated as equal, allowing ideas to flow freely. Goupware also encourages open criticism and open conflict resolution.

In a 'collectivist' society like Malaysia however, these actions are seen as a 'threat' to a group's or organisation's 'well-being', where respect for one's position is paramount. Moreover group coherence and achieving *collective goals* is more important than any individuals. Decision making by *consensus*, usually 'behind closed doors', is a high priority. We end with some suggestions on including cultural aspects in the design of our prototype.

As a companion to Chapter 8, Chapter 7, identify and specify among others, the requirements, mechanisms and specifications for the design of a computer-based management system for development control in Johor Bahru. An important enquiry in this chapter is the concept of designing *multi-agent plans* using *assumption*. To speed up the process of plan design, agents make assumptions about the *beliefs* of other team agents. As a result, it reduces the need for constant communication among agents. Assumptions however, need to be confirmed or negated. Based on the negotiations among the agents, the plans are made more concrete. Hence, we find the traditional model to be unsuitable for environments which require agents to constantly cooperate and communicate iteratively, such as in development control.

Chapter 8 develops a prototype system based on the framework suggested in the previous chapters. It focuses on the technical aspect of the implementation and intends to demonstrate that the theoretical propositions made in earlier chapters are practically attainable.

Finally, in the concluding chapter, we present a review of what we have been through in the thesis. It ends with a discussion on the limitations of the prototype systems and a proposal of directions for future research. The technical terminology, surveys and interviews, the roles and responsibilities of agents using the contract model, and the source program, among others, follows in the appendices.

Chapter 2

Systems Theory and Urban Models

2.1 Introduction

Computer application for urban planning, urban design, and urban management involves a distinctly rich hybrid of geometric, geographic, and annotative information. The multi-dimensional and multi-disciplinary nature of the urban problems, contributed to this blending, often based on the integration of planning GIS, architectural CAD, and general Management respectively. More recently, the use of Interactive Multimedia and Collaborative Support Systems has been introduced of these model-based computer systems. One of the reason for the attraction to these rich dataset systems, has been the ease with which different hypotheses can be tested experimentally using simulation.

In the past, applications of this technology have been almost entirely limited to individual and small scale development. However with new hardware and software technology becoming available, the scale of these endeavours has grown as is seen in the Abacus 'walk-thru' model of Glasgow (Maver 1987) and many other urban scale models of cities such as Osaka and Yokohama (Sasada, 1986), medieval Genoa (Dicconetti, 1991), Kuala Lumpur (Ismail, 1992) and Los Angeles (Liggett and Jepson, 1995).

The aim of all these models was to develop comprehensive datasets for the urban environment, incorporated in a single system, all the myriad pieces of information about land and its uses and about people and their activities, that are generated by the operations of urban planning, design and management. Objectively, by providing all the relevant information in one integrated system, the process of problem solving and decision making related to this endevour will be enhanced. However, this ambition for '*comprehensiveness*' has now been moderated and we find that most of the uses for these *model-based systems*, are in the area of visual simulation, which concentrated on the creation of 3-Dimensional animation and photorealistic images of the built form.

This chapter will look at the theory behind urban planning, design and management and analyse how model-based computer systems for the urban environment, can be used as a common denominator to augment the *decision making process* between those involved in the management of the city and those who want to *'disturb'* the balance of the city through development proposals. In particular, we will argue for an adoption of a more concrete approach towards the development of model-based computer systems as being promoted by Systems Theory. Only then can we harness the true potential of these systems as envisioned.

2.1 The Systems Perspective, Urban Theories and Urban Management

> " A city is a live structure, not a dead one.....it is a loose assemblage or aggregate of components, which is all the time being added to, and changed" (Alexander, 1963, pp.85)

One of the most interesting concepts to echoe Alexander's definition of a city was promoted by the biologist Von Bertalanffy (1967). He noticed similarities in the way that living organisms interacted with and controlled their environments. At the same time, similar patterns were observed by Gestalt psychologists[1] in the way the human mind organised sensory data (Atkinson, 1983).

There are now many general applications of this concept which encompass organisation, (Kast and Rosenzweig 1981, Argyris, 1959), construction management (Morris, 1987), psychology (Singleton, 1981), engineering (Gosling, 1963) and architecture (Handler, 1970). The attraction of systems theory as a medium for identifying a conceptual framework, lies in the basic premise that a system is

> *an organised or complex whole - an assemblage or combination of things or parts forming a unitary whole, which is greater than the sum of the parts.*

The systems approach achieves its potency by going back to fundamentals. It looks at a system as an assemblege of goals, people, things, information, or other components grouped together according to a particular systems 'objective'. Thus

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[1] A movement in psychology founded in Germany in 1912. Formed in response to previous theories of perception which tended to analyse perception and experience by breaking them down into their constituent parts, gestalt psychology was an attempt to explain human perceptions in terms of gestaldts; it aimed to show how the mind can perceive organised wholes by understanding relations between otherwise unconnected physical stimuli, a commonly given example being that of the illusions of the moving picture created from a series of 'stills' (Oxford Dictionary, 1995).

for example, one has a road system, an air-conditioning system, or a weather system. A system may be logically broken down into a number of sub-systems, that is assemblages of goals, people, things, information, or organisations required to achieve a systems *sub*-objectives, like the switching, building, drainage, or subscriber subsystem in a telephone system. Thus a hierarchy of, for example goals and sub-goals is formed, each goal being the defining objective of a system or subsystem. Subsets of these subsets may then be identified- cables, poles, and so on. Properly organised and managed, the overall system acts in a way that is greater than the sum of its parts.

In architecure, this concept of hierarchical sub-division, is explicitly illustrated by Simon (1973) when he observes that the process of architectural design is essentially one of hierarchical decomposition.

> "The whole design, then, begins to acquire structure by being decomposed into various problems of components design" (p.154)

This attention to *primary* objectives and dealing with the system as a *whole*, are the first two principal features of the systems approach. The third is that the subsystems and their *interrelationships* should be so designed that that the sub-systems work towards the main system goal as effectively as possible (Jenkins, 1972). Ackoff (1969), stressing the contribution of these inter-relationships of the parts of the system has defined it as:

> "....any entity, conceptual or physical, which consists of interdependent parts. Each of a system's elements is connected to every other element, directly or indirectly, and no sub-set of elements is unrelated to any other sub-set" (p.12)

Another example of this concept of sub-division and the relationships and interactions of each with the whole was clearly demonstrated in psychology, when Singleton (1981) concluded that:

> " ...an investigator will understand things better if he takes them apart either physically of conceptually. He analyses what happens, reduces a great variety of objects or phenomena to the smallest possible number of universal components or elements, and constructs explanations in terms of the combinations and interactions of theses elements" (pp.11)

Particular attention is given to the *boundaries* of the system and the sub-systems. Infact, concern with boundary definition and boundary management is the fourth strand of the systems approach. Management of the boundary is important for the system to *adapt* to changes in this environment. Systems of this type are known as *open* systems. Morris (1988) made an observation that :

> " open system are 'open' to the effect of their environments ....there is a constant energy and information exchange between the system and its environment; ....Closed systems operate in almost exactly the opposite manner" (p. 17)

A fifth feature is that attention is given to optimising the system's *coordination* and *control*. This follows from the emphasis on boundary definitions, for the amount and type of co-ordination and control in a system is a function of its subsystem definitions (Morris, 1974). In organisation management, for example, the significance of control, has been identified by Machin (1983) when he defines it as:

> "..the process by which managers assure that resources are obtained and used effectively and efficiently in the accomplishment of the organisation's objectives" (p.23)

2.1.1 Attraction of Systems Theory in Urban Development

Critics like Chris Alexander (1977), have always argued for a greater systemisation of the planning and design process; their premise is that things have simply become too complex for traditional methods. In the past for example, construction techniques were largely determined by the materials employed, and given the relatively narrow choice of available materials within a particular culture, techniques remained traditional. Intuition, in the context of this tradition, seemed a sufficient guide for innovative elaboration upon established methods (Ferguson, 1975).

In contrast, contemporary problems related to urban development are of a wholly different order of complexity. As observed by Moore (1970), there is now for example, a significant change both in terms of scale and scope of projects. Todays large-scale urban development encompasses more of an economic, social and political nature that was not encountered in the building of earlier physical structures.

While interest in systems is stimulated by the obvious need and desire to improve planning and design decisions, systems thinking is attractive now that there has been an increase in requirement to justify decisions once they have been made. Unlike previous periods, clients today are likely to be corporate bodies, a community, or groups having diverse objectives and interests in a particular urban development. Explanation and justification to the various participants in the development process in terms of the '*rationality*' involved are very much in order. The demand for *transparency* in judgement and *accountability* in decision making is paramount.

Moreover, a city is a *dynamic* system and therefore changes over time. Conditions, constraints, and objectives are always in flux. In contrast, its been proposed that cities requires some form of 'stability' in order for it to continue living (Chadwick, 1972). One way of achieving stability, is by being able to *adapt* and be *responsive* to these environemnt. As observed earlier, a system adapts by being *open* to the events and occurances outside its environment, and it uses *control* to regulate and manage the disturbances that these events might pose.

Arguably, the attraction of systems theory, is the 'consciously articulated approach' (Jones, 1963) it offers to those involved with urban development; participants as well as managers. Ferguson (1975) sums up the appropriateness of systems theory by making the following conclusion.

> " The systems approach is an attitude of mind in facing complexity; it reflects a search for the inter-relatedness of things in any problematic situation. As a planning and design tool, it means approaching the city as a very complex whole within which many elements act inter-dependently. The premise is that the city has a certain synergistic quality, that it is, in fact, more than the sum of its parts" (pp.14)

2.1.2 Urban Design and Urban Management

2.1.2.1 Urban Design

It is often said that the urban design disciplines lies between architecture and urban planning. The RIBA's has defined urban design as:

> ".... an integral part of the process of city and development planning. It is primarily and essentially three-dimensional design but must also deal with the non-visual aspects of environment...Its major characteristic are the arrangement of the physical objects and human activities which make up the environment" (quoted in Gosling & Maitland, 1984, p.7)

Urban design therefore comes under the wider and more general class of design (Cross, 1984). Here we can define design as a process of intervention on the (built) environment, and an urban designer in short is 'solving a problem' that exist within the environment. These design problems are characterised by being ill-defined

(Archer, 1979), ill-structured (Simon, 1973), and 'wicked[2] ' (Rittel and Webber, 1973). The problems to be solved are either quantifiable variables, for example, calculating the car parking requirement for a building, or it may be qualitative, especially when dealing with aesthetic aspects.

Consequently, the existance of the various sub-systems requires a multi-disciplinary approach to problem solving (Rittel and Webber, 1973; Page, 1972). The diversity of problems that the environment poses, clearly requires the problem solver in this domain to seek multiple solutions and goals, as opposed to a single objective.

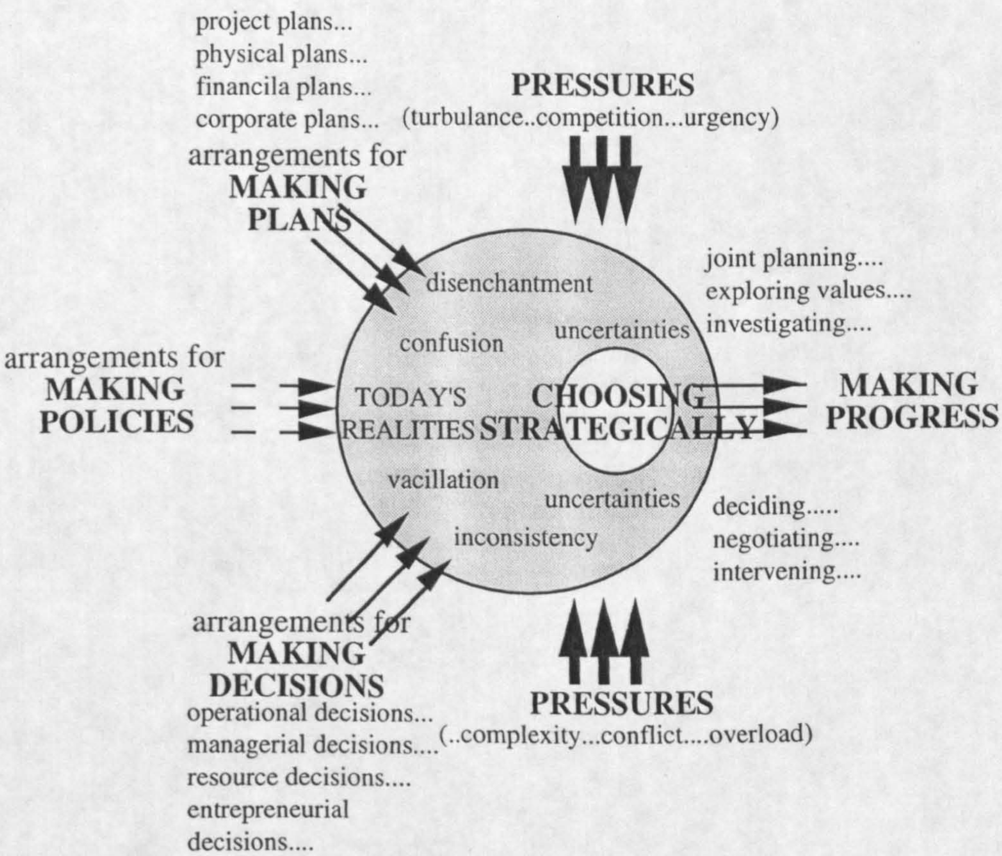

Figure 2-1 - Planning: A View of Realities
(after Friend and Hickling, 1987)

A problem is generated by the desire to transform one state of affairs into another, for example, trying to transform a slum area into one of safe and sound physical

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2 The best way to explain 'wicked' problems is to look at its opposite, which is 'tame' problems. Unlike planning problems, Rittel and Webber (1973), argues that problems in science and engineering have to be 'tamed' before they are amenable to the conventional problem solving process. In particular, they have clear goals, and clear criteria for testing their solution. Wicked problems, in contrast, have neither of these clarifying traits.

structure. To accomplish this a designer might use a number of means, such as rehabilitation and reconstruction, etc. singly or in combination. These of course are the *alternatives* or *options* available.

To find out which alternative is prefered, an urban designer refers to a *criterion* or some 'mix of criteria' which can be used as a yardstick for evaluating the various alternatives, for example, the use of past objectives, or projects. However in trying to solve a problem, designers have to try to deal with elements which they do not have control over, called *constraints* which might include for example, the minimum requirement, maximum plot-ratio allowed, or even budgetary constraints.

2.1.2.2 Urban Management

The concept and definition of urban management however, is more elusive (Werna, 1995). To the World Bank (1991), urban management relates more to a business like-approach to government, one which might make more efficient use of its loans. An alternative view was taken by Mattingly (1994), when he relates urban management to the management of the activities which takes place in urban spaces, for the purpose of increasing the quality of the area. He asserted that:

> " ...a direct impact is badly needed upon the quality of urban life everywhere, which, if it is not poor, is declining. The value of an idea called urban management lies in its ability to arrest this decline" (p. 201)

Arguably, the closest definition has been provided by the planning profession and in the field of organisation management. Here planning has been defined as 'a technique of foreseeing or guiding change' (Friend and Hickling, 1988). Kast and Rosenzweig (1984) see organisation management as 'an act to gain influence with or maintain control'. Since guiding change is in essence a management operation, we can define the act of urban management to have direct correlation with the *controlling operation* of the system.

The task of this operation is the responsibility of the City Council and in our context, this tasks refer to its responsibility in the *management of urban development* . From the systems point of view, these developments '*disturb*' the stability of the systems and demand a focussed, coordinated, and comprehensive approach by the City Council as *urban managers* to make sure that the goals and objective of the systems are achieved.

Since most of the *disturbances* and *demands* to the system come from external sources, for example, market and technological forces, (Knight, 1995) we can conclude that the function of the City Council is one that is *reactive* in nature. However, in order to gain greater *control* over their destinies, the City Council must begin taking initiatives which shape the city's futures instead of just adapting to these demands. City Council must be more 'intentional' in their actions by giving guidance as how the city should be designed and shaped. To some extent, the function of the City Council, responsible for the management of the system as a whole, must be changed from being reactive to that of *proactive*, providing vision and leadership to enable the city to survive, adapt and grow foward in the face of these influences.

2.1.3 Cybernetics, Control, and Feedback

In systems thinking, the most exciting concepts relating to this 'controlling operation' are offered by *cybernetics*, defined here as 'the study of the processes of information transfer, communication and control in very large and highly complex systems, especially those found in living matter' (Ashby, 1956). Cybernetics tells us that one of the goals of complex systems is to achieve *homeostasis* or internal stability and this can be done in two ways. Firstly by organising the internal relations between parts interacting with their connections; and secondly, by the capacity to anticipate and absorb the disturbances which arise from the system's environment in such a way as to keep the systems viable, enabling it to grow and develop in desirable ways (Ashby, 1965; p.5). In order to perform this latter function, the system must possess some *control device* through which it can sense threatening disturbances, estimate and anticipate their effects and deal appropriately with them (Beer, 1959).

Ashby (1956), explains to us that:

> "...cybernetics offers the hope of providing effective methods for the study and control, of systems that are intrinsically extremely complex. It will do this by first marking out what is achievable....and provide generalised strategies of demonstrable value, that can be used uniformly in a variety of special cases. In this way it offers the hope of providing the essential methods by which to attack the ills - psychological, social, economic - which at present are defeating us by their intrinsic complexity." (pp 5-6)

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A central idea promoted by cybernetics is that of '*feedback*'. The simplest example of control and feedback is that of a thermostat, whereby the heat source is controlled by deviations from the prescribed temperature. The characteristics of urban management however, is the large *time-lag* in the feedback systems before changes happen (Handler, 1970). Urban development takes a long time to be realised. The role of anticipating change through the process of continuous updating and adpating to the changing environment, becomes crucial for a systems survival.

The general principle involved is what Ashby (1956) called 'error-controlled regulations': the system is actuated by a control device which is supplied with information about the *actual state* compared with the *intended state* (Figure 2-2) .

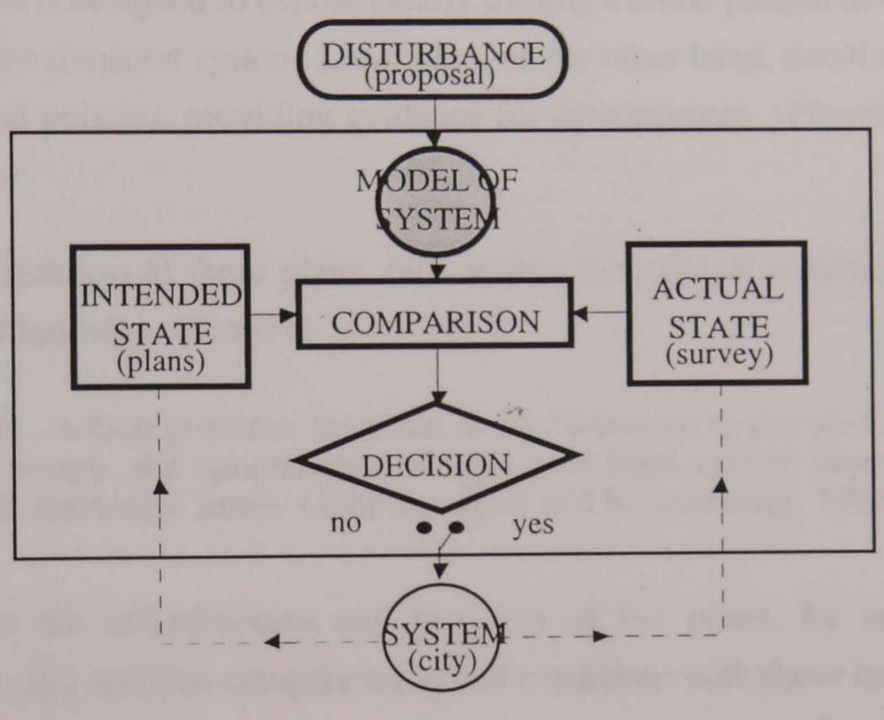

Figure 2-2 - Error-Controlled Regulation
(After McLoughlin 1971)

Extracting from Ashby's definition, McLoughlin (1971), has identified four common features of all control, namely;

1. the systems to be controlled
2. the intended state or states of the system
3. a device for measuring the actual state of the system and thus its deviation from intended state
4. a means of supplying correcting influences to keep the system within the limits set.

2.1.4 Development Contol and Urban Govenance

Refering to Figure 2-2, the city is the system we wish to control, and the intended states are expressed in the plans. Accordingly, we can define plans as 'statements which describe how the city should evolve over a period of time' (McLoughlin, 1973). These statements are a series of diagrams, statistics, and written explanation, that will set out a city's intended principal activities over the specific period, ie. it shows where a city should go and how it can get there.

Two type of plans are conventinally used, namely structure plan and local plan. *Structure plan* is designed to expose clearly the city's broad pattern of development and include the transport system. *Local plan*, on the other hand, detail the execution of these broad policies, providing guidance for development (Planning Advisory Group, 1956).

The implementation of these plans, falls within the general province of control. Here, control has been defined as:

> "..that ...which provides direction in conformance to the plan, or in other words, the maintenance of variations from system objectives within allowable limits' (Johnson, Kast and Rosenzweig, 1963).

We measure the effectiveness and progress of the plans, by surveying the environment, and can thus compare the actual conditions with those intended by the plan.

Disturbance to the balance of the systems can come in the form of development proposals submitted by the systems participants[3]. These disturbances need to be regulated, and this can be done by regulating and controlling the flow of changes made by these proposals, through the processes of ***development control***. Development control can be seen as 'a system whereby the City Council in anticipation of, or, in furtherance of a plan, exercise the right to approve or to refuse applications for permission to carry out on land those actions that by statute are defined as development' (Jay, 1971; p. 171). Development control in our system, can be defined as the power to say 'yes' or 'no' to these proposals.

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[3] Participants here are identified as those who are directly or indirectly affected by the changes that may happen to the system, due to the decisions made by the managers of the environemnt. Directly, these include the applicants who interact and 'disturbs' the system through their development proposals. Indirectly, these include those who live, work, invest, or just visit the city.

Accordingly, a model of the city is used by the urban managers to to help decide whether to allow or prevent such a 'disturbance' to the system. Conventionally, models help the manager to simulate the proposals and can act as an early-warning device. The philosophy implies the need of a continuous feedback to the actual state of the system to allow for a comparison based on up-to-date information.
In the work of development control, the integration of feedback has two functions; firstly, to show the trends in the amount, type and location of new development as well as the amount of development 'in the pipeline' by way of outstanding consents; and secondly, to help keep track and monitor planning consents, i.e. if and when, conditions attached to a planning consent have been complied with.

2.2 Abstraction and Modelling

> "No substantial part of the universe is so simple that it can be grasped and controlled without abstraction. Abstraction consists in replacing the part of the universe under consideration by a model of similar but simpler structure. Models, formal or intellectual....are thus a central necessity of scientific procedure" (Rosenbleuth and Weiner (1945); p.316)

In its simplest sense, a model is a 'representation of reality' (Ferguson, 1975). One builds models to understand or to control some aspect of reality. The model is arrived at through the process of abstracting from reality those aspects which one perceives as significant and useful to the tasks at hand.

Models are also utilised to augment or amplify one's experience - an aid to imagination in a wider process of design, problem solving and decision making. Recalling previous observation, this can be done through the process of *simulation*. Simulation gives new insights into the behaviour of the system under study through the process of ***experiment***. In behavioural science for example, Simon (1969) rightly highlighted this important feature, when he argues that simulation is essential for 'generating new knowledge about how the system works and how it is likely to work under foreseeable conditions'.

Another utilisation of the model is to act as an 'early warning device', indicating needs for corrective actions that may lie ahead. It will enable the urban manager to experiment with the various forms of intervention or policies which would keep the systems in control and thus put it back on course again. Since *time* is simulated in these models, we can see the different effects of short, medium, and long-term actions.

We can conclude that the simulation approach in our context, can be seen as a fundamental method for setting and testing hypotheses about the workings of urban systems. Evidently, it is only appropriate to suggest that models be made to be the *technical heart* for the operations of urban management.

2.2.1 Origin of Urban Modelling

> " A most ambitious attempt at holism and rationality is the modelling of large-scale systems. It is holistic because it attempts to encompass enormous diverse phenomena, and rational because it tries to deal in a calculating manner with almost incomprehensible complexity" (Ferguson, 1975; p.55)

The use of urban models has its origin in the planning discipline. Harris (1966) has defined an urban model as 'an experimental design based on a theory', thus recognising the role of modelling in the search for a relavant understanding of urban structure. In fact, the art of urban modelling which has evolved during the last few decades, is part of a wider revolution in thought within the social sciences (Batty, 1976), a revolution which began in North America over 30 years ago, and which is continuing apace today.

Increasing car ownership in the 40's and 50's in North America triggered the development of the 'first-generation' model. This led to the growing realisation that cities with their traditional form could not cope with the new 'mobility', and a more systematic planning and forecasting method was needed. Thus urban modelling was developed as a direct response to this complexity.

Out of these problems came the first transportation studies in which planners and engineers sought to understand and solve congestion in the late 1950's. However, the initial transportation studies neglected many important questions concerning, for example, land use, and it was inevitable that transport engineers should attempt to take such questions into account by extending their scope to encompass land-use forecasting. It was Mitchell and Rapkin (1954) that first introduced the idea for an *integrated approach* to model building. Their pioneering work had convinced engineer and planners to combine land-use matters with that of transportation planning in their problem solving.

The development of the 'first-generation' urban model, also coincided with the period when design methodologists developed a 'systematic' approach to design. Influenced by Systems Theory, *systematic design* is an attempt to restructure the design process on the basis of the new methods and techniques of problem solving, management and operational research, which had been developed in the 1950's (Cross, 1984). Proponents of systematic design procedures like Jones (1963) argued that to respond to the increased complexity requires a more articulated approach to planning and forecasting. Only then can we reduce the amount of design error, and thus increase efficiency and reliability of the design decision making process.

However, the systematic approach was only possible with the availability of large-scale computer processing. Infact it is no exaggeration to state that computers have made urban modelling possible. The observation by Lee (1973) sums up the thinking when he wrote :

> "...everything seemed interrelated. Some way of integrating it all was needed without giving anything up...and computers and models held out this promise" (p.25)

The introduction of computers, also changes the direction of urban theory and modelling from 'inductive' style toward 'deductive'[4] analyses (Batty, 1976).

2.2.2 Problems of (First-generation) Modelling

Although a great deal was learnt from the first generation urban models, the experience was somewhat unprecedented in that several fundamental factors affecting the whole process of modelling were only discovered *after* the model construction begun. The first major problem confronted by most of these early models involved question of *size*. Many of these models were so ambitious in terms of their scale, the data required and the computer processing power needed, that money ran out and the models were then abandon or drastically pruned. Classic examples of such failures were the San Francisco Housing Market Model. (Robinson, et. al, 1965). Optimism among model-builders turn to pessimism and bitterness and after the mid-1960's, 'sharp criticism forced the movement to go underground' (Lee, 1973).

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4 Stronger grounding in *a priori* theory building has been largely responsible for this change but the development of large-scale computation has also helped this trend.

Another problem was the failure of modellers to recognised the limitations of their models in helping to sort out 'ill-defined planning problems'. This was not helped by the lack of concrete theories upon which these urban models rely, which were sparse and often appearing arbitary and somewhat mechanistic and scientific in structure. In fact, Batty (1976) went even further to argue that most modern theories on urban planning grew from the fact that planners, like social scientist, were looking for a more concrete method to put foward to society, and so looked at science to give them direction.

According to Rittel and Webber, (1973), any search for these scientific basis for solving urban problems is bound to fail because urban problems, as described earlier, are 'wicked' problems. In contrast, scientific problems which they characterise as 'tame', have clear goals, and clear criteria for testing their solutions.

Their view received sympathetic ears by those who criticised early 'systems approach', which relied on exhaustive information collection followed by data analysis and then solution synthesis of the 'creative leap'. Rittel and Webber went on to argue that 'one cannot first understand then solve'. Like design, planning is multi-participatory, and methods should be based 'on a model of planning as an argumentative process in the course of which an image of the problem and the solution emerges gradually among participants, as a product of incessant judgement, subjected to critical argument'. They went on to propose a 'second-generation' model based on this premise (Rittel and Webber, 1973).

However, the most fundamental flaws of these urban models, is in the attempt for *comprehensiveness*. The dilemma of current modelling systems is the huge data processing and data storage tasks that has proved to be much larger and more complex than imagined. More crucially, the reason for failure is because it now becomes less clear just *how* the data were to 'enter' into the decision making process, or indeed to just *what* decisions were relevant. After a few attempts to construct a 'comprehensive model' the enthusiansm for such a task has been moderated and new ways of looking at urban models were searched.

2.3 Computers, Modelling, and Decision Making

The development of urban modelling using computers has been influenced by two major disciplines, both with different but somewhat related emphasis. The first is in the development of Computer-Aided Design (CAD) and Visualtisation techniques in architectural design, and the secondly, in the advancement of Urban Information Systems (UIS) as a tool for doing spatial analysis in planning.

Tried and tested Computer-Aided Architecture Design (CAAD) tools are already being utilised by the architecure profession to create three-dimensional building models to generate visualisation. Their purpose is either to acquire design feedbacks, assist design communication, convince third parties of the value of the proposed building, or present difficult to achieve views of existing building. Less often, such models are also used to generate construction drawings, and to provide schedules for Bill of Quantities.

Planners on the other hand, have for many years utilised Geographic Information Systems (GIS) as a two-dimensional visualisation tool for understanding complexity and spatial relationships required for decision making, (McCollough, 1995).

2.3.1 Architectural CAD and 3-Dimensional Modelling

The work of Negroponte and his team at MIT to build URBAN 5 in the late 1960's, was one of the earliest attempts to apply CAD techniques to urban models. Infact his Architecture Machine Group was formed when the concept of cybernatics in urban design, particularly the idea of feedback, was being rigorously promoted. With the specific purpose of harnessing the computer power to create and investigate a new man-machine dialogue, the groups research was concentrated on three parallel developments: technical improvements to the man-machine interface especially graphics, which enhanced a designers's skills; user-friendly techniques and aids which helped non-designer to become their own 'architects'; and personalised, 'intelligent' environments or 'soft architecture machines', which would respond to occupants' individual whims and environmental needs (Negroponte, 1970).

Parallel development to use computer based systems to 'democratise' urban design by encouraging 'dialogue' among participants, was also attempted by Kamnitzer and his colleagues at UCLA, with the building of CITY-SCAPE. Dubbed 'an urban flight simulator' it was initially built for the purpose of pilot training and for the simulation of space-craft manoeuvres. Similar to Negroponte, Kamnitzer envisages that this new interactivity, will encourage active participation in the planning process. He wrote:

> "Within this decade we should see the wide-scale implementation of various graphics systems for urban researchers and decision makers.... There is a pronounced trend in the direction of interactive computer graphics systems which permit on-line planning and design activities in a participatory decision environment. Such systems permit the juxtaposition of many different data displays to aid the decision-making process. Other computer graphics systems would permit the experiencing of alternative future environment in three dimensions and their immediate modification by user feedback" Kamnitzer (1972, p.298)

A more sophisticated 'visual-based' system of this kind was developed by Greenberg (1974), Sasada (1986) and Maver (1988). In these systems, 3-Dimensional models of the city was built on the foundation of 2-D maps recording land parcels, roads, and other features of the ground surface (Maver, 1988). Apart from the 'surrogate walks' that a user can simulate, the system allows for *experimentation* on the proposed disturbances to be done on the environment (model) where hypothetical solutions to urban problems are tested before implementation. Users for the first time can simulate WHAT-IF scenarios of these intervention.

However, the 'obsession' with animation and visualisation, has somewhat 'distracted' the role and development of CAD in urban modelling. Development was focussed on the three-dimensional form of the city, at the scale of the urban block, street or locality. Aspects like land-use, plot-ratio, and traffic impact studies are just as important and will only enhance the systems' capability to provide the information required, for example, for urban management strategies (Grant, 1991).

Recognising these limitations, researchers then attempted to combine 'analytical' capabilities by integrating 'alphanumeric data' together in different ways to create a rich multi-dimensional systems. The idea of an Integrated Urban Computer Models (Grant, 1991), which was able to combine the visual and dynamic view of the city, with the capabilites that enable valid quantitative evaluation of the models, was a natural progression. Computer systems used by the planning profession, generally known as Urban Information Systems, seems to provide this promise.

2.3.2 Planning and Urban Information System

An Urban Information System (UIS) has been defined as 'a formalised computer-based system capable of integrating data from various sources to provide the information necessary for effective decision making in urban planning' (Kim, et. al. 1990). Basically, the role of information in these systems has been based on the purpose of gathering, processing, and organising the data to help understand the environment where the complex planning activities take place. The argument is that, better understanding of the environment through the use of information, facilitates better planning.

2.3.2.1 Nature of Urban Information System

Han and Kim (1990) have classified Urban Information System into three basic categories, according to the functions and technologies involved. As illustrated in Figure: 2, these include Data-Based Management System (DBMS), Geographic Information Systems (GIS), and Decision Support Systems (DSS).

UIS Type	Inputs	Processes	Outputs
DBMS	Raw data	Organising, and modifying data and simple statistics	Process data and customised report
GIS	Point, line, and area data	Organising and modifying data, geo-metric manipulation of data (cartographic modelling)	Composite overlay, graphic display of spatial data, customised reports
DSS	Raw and pro-cessed data and models	Data analysis, operations research, and modelling other modelling	Information such as optimal values and other inputs to difficult decisions.

Figure 2-3 - Characteristics of the Three Types of UIS
(after, Han and Kim, 1990)

Database Management Systems (DBMS) have been primarily concerned with data storage, processing, and retrieval. In planning, the major purpose of DBMS is to make data readily available to the planners in an orderly, efficient, and effective way. One major function of DBMS, is to computerise routine tasks of planners to enable fast and correct processing of data. Examples of these tasks include organising, updating, and reporting of traffic studies and property transaction data.

DBMS also function to serve as a basis for the other types of computer-based systems, including GIS and DSS.

Geographic Information Systems (GIS) on the other hand, may also be thought of as a DBMS in that the basic function of both systems is data processing. The type of data GIS deals with, however, is unique, since its provides data manipulation functions for the various types of 'spatial analysis'. Therefore, a more precise description of the relationship between GIS and DBMS may be that DBMS is a part of GIS. Infact, Raster (1978) argues that the core of GIS is a DBMS system.

Spatial analysis is a very important function of GIS. Teng (1986) explains spatial analysis as cartographic modelling and defines it as "the process of manipulating single or multiple sets of digital map themes". Cartographic modelling has been explained as a computerised version of manual overlay techniques (Newell and Theriault, 1990)

The third type is *Decisison Support System (DSS)*, regarded as a distinctive type of urban information system (UIS) because of its unique structures and the unique type of problems it deals with. It may be asserted that DSS is an enhanced version of DBMS upgraded by the addition of a model base. Infact Han and Kim (1990) observed that the output of DBMS serves as an input of DSS .

However, the problems dealt with by DSS are generally different from those dealt with by DBMS. DBMS is suited for structured problems which have standard operational procedure, decision rules, and clear output format such as identifying low income district, etc. DSS on the other hand, is intended for unstructured or semi-structured problems, such as evaluating land development proposals, for which DSS can be used to estimate fiscal and other impacts of a proposal, providing quantitative support to the decision maker.

Kroeber and Watson (1987) define DSS as "an interactive system that provides the user with easy access to decision models and data in order to support semi-structured and unstructured decision making tasks". As with GIS, the role of DBMS is important to building DSS, because DSS needs the input from DBMS to run its models.

Recently, attempts have been made to include Expert Systems capabilities in the design of UIS to tackle the multi-dimensional aspects of urban planning. The attractiveness of Expert Systems technology is in its ability to 'represent human expertise in a speciality domain in order to perform functions similar to those normally performed by a human expert in that domain' (Goodall, 1985). These include the incorporation of judgement, experience, rules of thumbs, and intuition of human experts into problem solving.

2.3.3 Integrating CAD, GIS, and Simulation - A Model-Based Urban System.

One successful attempt to integrate CAD and GIS capabilities, was the Glasgow Model developed by Grant (1993). His proposal was to extend the usefulness of an earlier developed model of the city (Maver, 1987), to include 'spatial analysis' capabilities of Geographical Information Systems. Grant's 'urbanGIS' system allows 'a virtual abstraction of the city, containing not only the spatial information contained in the geometry, but also the ability to harness the diversity of other existing urban databases' such as 'spatial attributable data'. According to Grant, these capabilities are important to support the activities of planning, management, and decision making

The work by Liggett and Jepson (1995) was a further attempt to integrate modelling, database management and, this time, dynamic simulation. Using state-of-the art computer graphics systems, their team at UCLA managed to combine fast rendering within a GIS structure, permitting 'direct query of attributes of objects displayed in interactive perspective views' (p. 292). Bragdon, et.al (1995) went even further and argued for the addition of 'sensory' information to the simulation environment. Apart from the CAD and GIS integration, their system will be able to add to this environment, sound, odour, vibration and even taste.

Like Bragdon, et.al, the work by Schiffer (1995) aimed to provide additional sensory simulation to his model, but hoped to achieve a different objective. The distinction of his effort was that it was primarily concerned with the integration of his earlier work on Collaborative Planning Systems (1992) and multimedia. Using multimedia techniques, a planning participant for example, while viewing a chart showing traffic flow and noise impact, may also see a video representing the traffic flow and hear a digital recording of the sound. Eventually, what interest Schiffer is not only the type of information provided, but in 'how the information is communicated and understood' and in 'whether the technology meaningfully changes group process'. Recently, the work by McCullough (1995) to incorporate Computer Support Collaborative Works (CSCW) techniques into these model-based urban systems, confirms the trend to encourage more participation amongs users of the system (city) at large. Perhaps Negroponte's (1970, 1975) and Kamitzer's (1972) vision of an interactive participatory system will soon be realised.

However, as previously described, the pursuit and obsession with visualisation is still apparent in many of the current systems being developed. Moreover, while many researchers concentrate on integrating the technology of 'virtual reality' by supplementing visual with other sensory stimuli in the simulation environment (Bragdon et. al, 1995) the worry is that, development of urban models in the future will be 'technology led' and the main objective of models will be secondary. What is needed is to look back at the theory and practice of urban models and find a common ground upon which it can be developed as a tool to enhance the process of planning, design, decision making, and urban management. Perhaps, only then can we truly harness the potential of such systems.

2.3.4 Observation and Conclusion

Generally, all of the model-based urban systems descibed so far, share a common commitment to utilising computer visualisation, spatial analysis, and more recently CSCW and multimedia, to improve access to information, increase understanding, and facilitate decision making. Ultimately, as noted by Grant (1993), the aim of such development is towards the integration of the various datasets and techniques to 'merge into one comprehensive system' where 'the sums of the parts would be worth considerably more than the individual parts would suggest' (p.557).

However, the lesson in urban modelling is clear, for there is no magic in *comprehensiveness*. Past development of similar systems has taught us that the mere existence of a mass of data is not a sufficient reason for collecting it into a single comprehensive information system (Simon, 1976).

In our enthusiasm to make use of the enormous power of the computer, there is a tendency to design systems that take existing data sources as a 'starting point' and to give the decision makers access to all the information. The question that was not asked is whether firstly, decision makers, especially managers, either wanted or needed such information, and secondly, whether the information that they needed or wanted, could infact be derived from these particular sources (Miner, 1978). Perhaps, lessons can be learnt from Simon's (1976) obsevation on the design of similar systems when he noted that:

> " (These) systems were not designed to conserve the crticially scarce resoures, which is the *attention* of managers. Therefore efforts to design an information system for the urban environment fell into the fallacy of thinking that 'more is better'. They took over implicitly the assumption of past society where information rather than attention was the scarce resource" (p. 295)

2.4 Summary

This chapter looks at the urban environment and concluded that it is one of a multi-dimensional and complex nature. To help us analyse the relationship of complexity, we have to utilise systems thinking, that permits us to develop a better understanding of the city as an assemblage or combination of parts forming a unitary whole, which is greater than the sums of the parts.

A city is a live structure and as such is being influenced by the actions and changes that its users might bring. Direct changes to 'disturb' the complex balance of the system, usually come in the form of development proposals, and are initiated by the various participants of the environment. The role of City Councils as managers of the systems, is to make sure that these 'disturbances' are in accordance with the plans and objectives of the systems by using controls and feedbacks. However, another problem face by the managers, is the enormous time-lag in the feedback systems before changes happen.

The role of anticipating change together with the continuous process of updating and adapting to these changes becomes crucial for a city's survival. Increasingly, this role will include the demands that the City Council which is entrusted to govern the systems, be more responsive to the changes, and proactive in its actions. City Councils actions should be more 'relevant' to the problems and 'accountable' to the participants.

City Councils must therefore, have a holistic view about the systems to be managed and this is best achieved and advanced through the use of a *model* which can simulate the systems behaviour. The model will act as a *focal point* for all activities, discussion, debate, experiment, analysis, and innovation which can go into the exploration, and management of the city's future. Evidently, we suggest that the model be made to be the *technical heart* for the operation of design and management in the City Council.

Chapter 3
Organisation, Project Management and the Contract

Chapter 3

Organisation, Project Management and the Contract

3.0 Introduction

In Chapter 2, we found that decision making relating to the development control process, requires a multi-disciplinary approach where each discipline contributes to a part of the solution. We used systems theory to help us develop a larger frame of reference to *coordinate* and *synthesise* these individual contributions to form a finished and complete *whole*. For the process of synthesis to succeed, individual disciplines need to interact and *cooperate* during the decision making process itself. As noted by Page (1972) , the success of decision making in this environment 'depends upon the individual parts perceiving the same objectives and recognising that what each of them achieves, depends upon what the others do' (p. 19).

Cooperation among the specialised disciplines is essential for three reasons; firstly no one group (disciplines) has all the knowledge and resources to solve the whole problem *independently*; secondly, the necessity of meeting *constraints,* and thirdly, the existence of many *interdependencies* involved in the execution of the decision making.

The problems cannot be solved by individual groups working independently because they do not possess the necessary expertise, resources or information. This is compounded by the problem solvers' limited capacity for rationality, a problem termed by Simon (1964), as *bounded rationality*. Moreover, because of the complex nature of the problem, the different expertise and resources each group has, needs to be harnessed, and combined to solve the problem. For instance, in a City Council organisation, the planning department will need to consult with the engineering department to find out if a proposal to increase the plot-ratio of a development, will burden the traffic load coming to the city.

Constraints exist when the solution being developed by a group must satisfy certain conditions if it is deemed successful. For instance, decisions must be made within certain time constraints, eg. within a three months period. If individual groups acted in isolation and merely tried to optimise their local group performances, then such constraints are unlikely to be satisfied. Only through coordinated actions will acceptable solutions and decisions be developed.

Interdependence occurs when activities undertaken by individual groups are related because local decisions made by one group have an impact on the decisions of other disciplines. For example, the decision by the City Council's planning department to allow a developer to pay 'development charges' at the expense of providing an open space at the ground floor level of the development, will affect the architecture department's attempt to provide more public spaces in the city.

This chapter will look at how the organisation responsible for managing the urban environment, i.e. the City Council, can be responsive to the flux in the environment. We will study the design and role of the organisation, and the way in which the different elements that exist in the organisation, are integrated into a complete whole. Since managing this environment requires the contribution and cooperation from the various disciplines, it is vital to ensure that firstly, the cooperation can proceed in a coherent manner, and secondly, the objectives of the cooperation process can be achieved within the time constraints.

For this, we will analyse the methods of synthesising the decision making process of individual technical departments involved in devopment control - a process, as we found in the last chapter, that is concerned with *coordination* and *control*. However, the interest is larger than that, for the main aim is to do with the issues of *integration* of the decision making process. Central to this, is the idea of the *contract*, for we see the contract as an element that can bind together the act of cooperation. We will argue and foward a proposal for integration based on the concept of Management in general and utilising the principles of *Project Management* in particular.

3.1 Project Management - Concepts and Definition

> ".....project management is a blend of art and science: the art of getting things done through and with people in formally organised groups; and the science of handling large amounts of data to plan and control " (Moder, 1988; p.324)

In Chapter 2, the fast and everchanging pace of the urban environment, has revised our views on the function of the urban system, and led us to give new definitions on the functions and roles of the managers of the system, and eventually, the organisation upon which the managers operate. We concluded that a greater understanding and more intelligent response to these changes is needed. In the world of management, change is reshaping the nature and meaning of work. Nowhere is this more pronounced than through the *projectisation* of work.

Unlike the traditional management methods which are *operations* based and utilise the concept of *using* existing systems, properties, processes, and capabilities in a continuous, fairly repetitive ways, (Galbraith, 1973), it is fair to conclude, that *project* is based on the concept of *change*. If operations are aimed at making the best use of what exists, over and over again, projects in contrast, presuppose no fixed tools, techniques or capabilities. Moreover, they seek to create a limited impact through temporary and expedient means. Uniqueness of effort and results, are the hallmarks of projects (Reiss, 1992). This point is explicitly explained by Gilbreath (1988), when he differentiated between operations and projects. According to him,

> "Projects are the perfect response to change. They are no less than change-responsive bundles of effort. Projects can expand, shrink, accelerate, and slow down, change shape and direction. While operations try to withstand the impacts of change, projects ride along with it" (p. 322)

The argument uses the concept of states (as in physics). To manage a project is to manage the movement from one state to another. The change can be perceived by comparing the two states. The end state will be different from the start state and this *difference* is what project managers are trying to achieve and bring about.

Originated by the need to coordinate the various activities and disciplines involved in the weapons industry, from the idea stage through to completion in America in the mid-50's, we can further conclude that project management is basically the act of *planning*, *coordinating*, and *controlling* the process of change. In fact Palmer (1987), defined project management as :

> " ....a combination of the task of planning, co-ordinating and controlling resources,.....in order to meet the objectives of the project" (pp.563)

A similar definition has been provided by the Chartered Institue of Building (1992), and the Royal Institute of British Architects (RIBA) (1990). Relating to the construction industry in particular, project management has been defined as an act which involves:

> "overall planning, control, and co-ordination of a project from inception to completion aimed at meeting a Client's requirements in order that the project will be completed on time within authorised cost and to the required quality standards" (The Chartered Institute of Building, 1992; p.3)

Reflecting the need to coordinate the contribution of a multi-disciplinary profession, the RIBA Handbook (1992) has aptly defined project management as an act of:

> "(welding) together (a number of professional teams), to produce a finished whole. The work of each will affect the work of others, (and) none can suceed in isolation" (p. 330)

A reflection of this definition is best described again by Gilbreath (1988), when he sumarises the thinking behind project management as:

> "a *mutual effort*, using a collection of resources in an orchestrated way to achieve a joint goal. As such projects are like 'waves' - forces and bundles of energy moving through time" (p.326)

3.1.1 Systems Theory's Influence on Project Management

Its been said that the most 'pervasive intellectual tradition' to project management, whether in organisation, planning, control, or other aspects, is without doubt the systems approach (Morris, 1988, p. 16). The systems perspective has contributed substantially to the development of project management. Firstly, the systems emphasis on viewing a system as a *whole* has frequently been behind the recognition of the need for an 'across-the-board' *integrating* role, that is for project management itself (Lawrence and Lorch, 1970). Secondly, it has shown how projects should work as successfully regulated organisations, for example, the need for clearly defined objectives, the recognition that projects are organisations in constant change, and the need to define and manage major components (subsystems) and their *interfaces*.[1]

Thirdly, the dynamic control needs of projects are now better understood - the importance of feedback, the progressive development of information and multi-level project control, and fourthly, the widespread use of systems techniques, such as systems analysis, systems engineering, work breakdown structure, and simulation

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[1] Interface in this instant, can be defined as a point where interaction occurs between two systems (Morris, 1988)

models (Cleland and King, 1972). We will explore further some of these techniques in section 3.3.

3.2 Interdependency and Integration

Objectively, we have concluded that one of the main aims of utilising project management techniques is to achieve *integration.* Project integration consists of ensuring that the pieces of the project come together as a 'whole' at the right time and that the project functions as an integrated unit according to plan (Struckenbruck, 1974, and 1988).

In development control process, two types of integrating tasks are demanded to form a whole (Walker, 1984). Firstly, the integration of the different people (disciplines) involved with execution of specific tasks (eg. the decision making and processing application), and secondly, the need for integration between the output of the tasks. Integration in both cases is paramount, because of the existence of *interdependency*

The activities of these different departments (groups), creates what Kerzner (1984) identified as certain 'technical, organisational, and environmental' interdependencies. These interdependencies may be almost accidental or may be deliberately organised. Moreover, integration becomes important when the degree of organisational interdepence becomes significant.

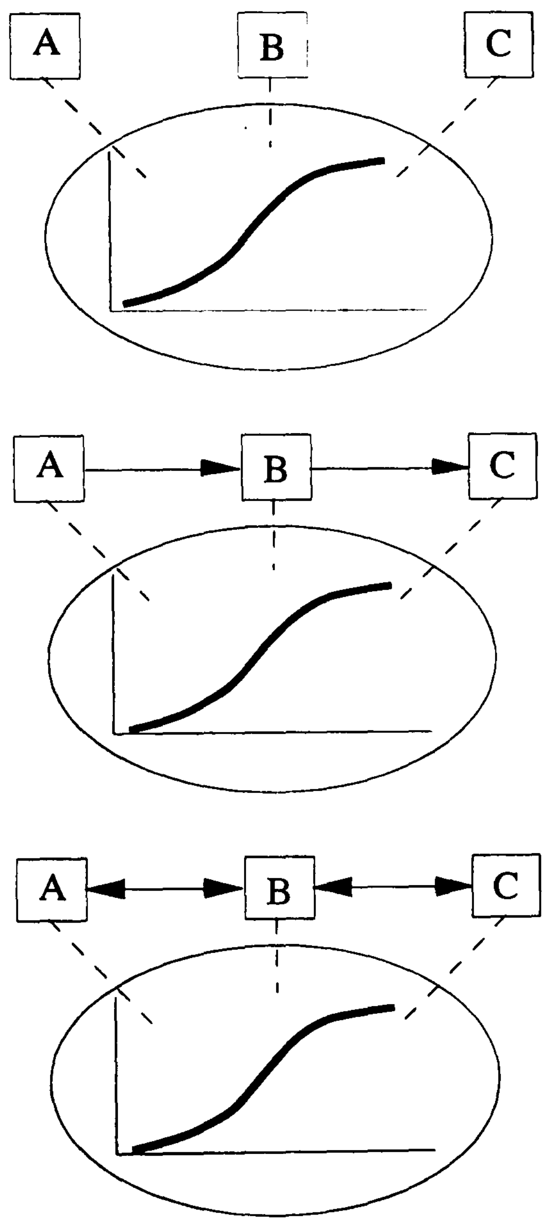
Research by Morris (1975), which is applicable to the process of development control, has shown that tighter organisational integration is necessary when:

a) the goals and objectives of an enterprise bring a need for different groups to work together.
b) the environment is complex and rapidly changing
c) the technology is uncertain or complex
d) the enterprise is changing quickly
e) the enterprise is organisationally complex

3.2.1 Methods of Integration

Choosing the degree of integration, what Morris (1988) termd as the 'amount of *pulling together*', calls for considerable judgement. Thomson (1967) in his classic book "Organisation in Action", observed that there are three kinds of interdependencies, each requiring its own type of integration.

1. the simplest, *pooled* only requires that people obey certain *rules* and *standards.*
2. the second form, *sequential,* requires that interdependencies be *scheduled.*
3. *Reciprocal* interdependence, the most complex kind, requires *mutual adjustment* between parties (Figure: 3-1).



1. Pooled Interdependence
* Participants pool resources, etc.
eg. membership of a club
* Coordination by standards, rules

2. Sequential Interdependence
* Participants follow each other sequentially
* Coordination by schedule

3. Reciprocal Interdependence
* Participants Interact
* Coordination by committee or others such as liaison devise, ie. by mutual adjustment

Figure: 3-1 Three Types of Interdependence
(after Morris, 1988, Thomson, 1967, and Walker, 1984)

In project terms, the basic and easiest to integrate form of group interdependency is the *pooled,* where each part renders a discrete contribution to the whole. The parts do not have to be operationally dependent or even interact with other parts, but the failure of any one can threaten the whole, and therefore other parts. It is found that the integration of pooled interdependency is best achieved through *standardisation* and formal *rules.*

Groups that follow on from one another, ie. interdependency which takes a *serial* or *sequential* form, is best integrated using *planning* and *schedules*. That is the tasks to be undertaken can be anticipated and their sequence planned so that sequential interdependency is identified and recognised at an early stage. Consequently, the management process should ensure that integration takes place as planned.

On the other hand, groups which are in continuous interaction, require *cooperation* and *communication* in order to achieve the necessary integration. Here, interdependency is when the outputs of each part becomes the input for the others and the process moves foward through a series of steps. Each step requires interaction between the parts and each part is 'penetrated' by the others. *Reciprocal* interdependecy is integrated by *mutual adjustment* and *feedback* between the parties involved

From the above, we can conclude that the multi-disciplinary nature of development control process, requires the combination of *firstly* mutual adjustment and feedback, and *secondly*, planning and schedule. Since each discipline do not have the knowledge to solve the whole problem independently, they need to iteratively intract and cooperate with each other. In the process, each will need to make compromises and adjustments before mutually agreeing with a solution, i.e the condition for approval. On the other hand, planning and schedule is vital to ensure that the contributions from the individuals, are made within the time constraints. Failure to process the application for development control on time, for example, can result in a penalty being imposed on the City Council.

Galbratih (1973) proposes a range of devices which can be used to achieve cooperation:

a) liaison position
b) tasks force
c) special teams
d) co-ordinators (or permanent integrators)
e) full project management
f) matrix organisation

Each of these options provide stronger integration than the last.

The primary function of the *liaison* position is to facilitate communication between groups. Other than this, the liaison position carries no real authority and responsibility. The *tasks force* is much stronger. It provides mission-oriented integration: a group is formed specifically for a special task and upon completion of the task, the group disbands. *Special teams* are like tasks force but attend to regularly recurring types of problem rather than specific issues. The *co-ordinator*, or permanent integrator, provides a similar service as the liaison position but has some formal authority. He exercises his authority over the decision making processes though not over the actual decision makers themselves. This is a subtle point, but an important one, and it often causes difficulties in projects (Allinson, 1993; Walker, 1984). The coordinator cannot command the persons he is coordinating to take specific actions. That authority rests with their functional manager[2] . He can however, influence their behaviour and decisions, either through formal means such as managing the projects schedule, approving scope changes, etc., or through informal means such as his persuasive and negotiating skills (Young, 1994).

The full *project manager* role upgrades the authority and responsibility of the integration function to allow cross-functional coordination. The integrator, ie. the project manager, now has authority to order groups directly to take certain actions or decisions. *Matrix organisation* is by general consent, considered to be the most complex form of organisation structure. Matrix structure provides for maximum information exchange, management coordination, and resource sharing (David and Lawrence, 1977), and as such generates the most considerable conflict (Cleland and King, 1972, Galbraith, 1977, Morris, 1988)

3.2.2 Integration versus Conflict

As observed, because of the nature of project integration, it is almost impossible to have a project without differences between people, differences of opinions, values, objectives, etc. These differences can lead to discussion, argument, competition, and in turn, conflict. Indeed, one of the biggest obstacles to project integration and group cooperation is the occurance of conflict (Allinson, 1993).

As such, project managers have constantly been described as *conflict managers* (Kerzner, 1988). The ability of project managers to handle conflict is a determinant of successful project performance (Wilemon and Baker, 1971). An examination of

2 Functional manager relates to the most common form of organiations, which is functional organisation. The organisation is formed according to main functions or similar group activities. So for example, all civil engineering activities, are grouped together, headed by a functional manager.

the definition of conflicts, its determinants, and the approaches used to resolve it. would clearly be of benefit to this thesis.

3.2.3 Conflict Definition

In the past, some authors have used the term 'conflict' in specific ways, for example as opposite to 'cooperation', and as opposite to 'competition' and 'integration' (Mack, 1965). A broader definition is given by Putnam and Poole (1987) which defines conflict as :

> " the interaction of interdependent people who perceive opposition of goals, aims, and values and who see the other party as potentially interfering with the realisation of these goals .....(This) definition highlights three general characteristics of conflict: interaction, interdependence, and incompatible goals" (p.552)

In *sociology*, conflict is concerned, in part, with how social order is challenged and maintained. (Dahrendorf, 1959). The applied field of organisational psychology is partly concerned with team-work within organisations, and how communication and co-ordination leading to integration of teams can be achieved. In terms of conflict resolution, Strauss (1978) points out that, in fact most social conflicts are resolved by co-operative means, often unconciously, and that despite this, little attention is paid to these co-operative mechanisms. We will look at some of the methods used in conflict resolution in section 3.2.4.

Early work tended to assume that all conflict was undesirable, and so should be eliminated. In the planning discipline for example, the issue of conflict exists at its core. This is explicitly expressed by Page (1972), when he observed that:

> "......there are a lot of conflicts to be resolved in planning decision making - the conflict is often a 'nuisance' to the designers. (p.15)

3.2.3.1 Conflict and Groups Cooperation

In an extensive survey of empirical studies of the phenomena of conflict in groups, Steve Easterbrook (1993) has identified the occurances of conflicts. Amongst them, he observed that the more cohesive the group, the less conflict there is. Here, cohesiveness can be defined as a sense of 'we-ness' - a dynamic process that is reflected in the tendency for a group to stick together and remain united in the pursuit of its goals and objectives.

Occurances of conflict also vary with the development of the group. The classic model of group development is presented by Tuckman (1965), where he identifies four phases in the development of a group , ie. *forming, storming, norming, and performing*. Allinson (1993), added *uniting* as the fifth process. Tuckman found that storming (ie. group interaction) was marked by concerns, conflicts, confrontation and criticism, and that these characteristics were absent from the other phases.

3.2.3.2 Causes of Conflict.

In cases related to project management, Allinson (1993) noticed that conflict situations result primarily from the concerned groups or managers losing sight of the overall project golas, or having differing interpretation of how to get the job accomplished. One of the tasks of project managers therefore, is to continually be on the lookout for real and potential conflict situations and resolve them immediately if they expect to have project integration.

The classic study of sources of project conflict, carried out by Thamin and Wilemon in 1975, indicated that the disagreement over *schedules* resulted in the most intense conflict situations over the entire life of a project. This includde the disagreement over timing and the sequence of how the project task should be executed. We will analyse these issues further in section 3.3. Other issues that may cause conflict, include administrative procedures such as responsibilities, and personal conflict which is almost certainly centred on ego disputes.

3.2.4 Resolution and Mangement of Conflict

Conflict covers a multitude of project events and interaction. In one sense, conflict is no more than the opposite of all those kind of project features which the manager wants to positively promote (integration, communication, coordination, problem solving, etc) ie. lack of integration, poor communication and co-ordination, disputes and interpersonal disharmonies. Conflict resolution is, at a minimum, the neutralisation of this negativity; at its most positive, it is the translation of aggrevation, disagreement and confrontation into something beneficial to the project. As Allinson (1993) rightly stressed:

> "Managing conflict is, at its most basic, getting people to agree". (p.125)

The role of the project manager as the 'third person' to resolve conflict is also echoed by DeBono (1985). He claims that the introduction of a third party is necessary because according to him:

> " (participants become) bogged down by tradition, training and complacency, in the argument mode of thinking.....(and) simply cannot carry out certain thinking operations because these would not be consistent with their position in the conflict" (p.79)

Works by Robins (1974) amongst others has advocated that conflict management should include not just resolution of conflict, but *simulation* of conflict too. This is a result of observations that conflict has a useful role in organisations, in providing a stimulus to innovation, as it involves questioning and evaluating 'received wisdom'. In particular, simulation has been promoted as a major weapon against stagnation and a resistance to change. Infact conflict simulation is widely encouraged in organisations that promote 'creativity'. (Allinson, 1993).

Research by Blake and Mouton (1964), suggested that project managers adopt five principal means of coping with conflict (p.291)

1. *confrontation* or *problem solving* - in which the parties focus on the issues, consider the alternatives, and look at the best overall solution.

2. *compromising* or *negotiation* - in which each party must give up something but each walks away partly satisfied.

3. *smoothing* - ie. emphasising the points of agreement and de-emphasising areas of conflict

4. *forcing* - ie. putting foward one's viewpoint at the potential expense of the other party

5. *withdrawal* - or retreat from actual or potential conflict.

Building on the methodologies of Lawrence and Lorsch (1967), Blake and Mouton (1964), and Burke (1969), Thamin and Wilemon (1974) examined the effects of five conflict-handling modes (forcing, confrontation, compromise, smoothing, and withdrawal) on the intensity of conflict experienced. They found that, firstly, project managers experienced more conflict when they utilised the forcing and confrontation modes and secondly, the utilisation of the compromise, and smoothing approaches by project managers were often associated with reduced degrees of conflict in dealing with assigned personnel.

Several suggestions for minimising or preventing detrimental conflict were also provided by the study. These include the need for :

1. *Planning* - minimising conflict requires careful planning. Effective planning early in the life cycle of the project can assist in forecasting and perhaps minimising the number of potential problem areas likely to produce conflict in subsequent project phases.

2. *Communication* - since there are a number different participants (groups) in the decision making process (project), it is important that major decisions affecting the project be communicated to all the groups.

3. *Problem-solving* - project managers need to be aware of their conflict resolution styles, and their important effect on key interfaces. As described earlier, forcing and withdrawal modes appear to increase conflict, while problem-solving and compromise can reduce conflict. Creating an open dialogue can also produce positive results for the decision-making process.

4. *Leadership* - the appropriate choice of a leader, and the subsequent performance of the leader will affect the occurance of conflict. It is also suggested that strong leadership is a prerequisite for conflict resolution.

As a conclusion, the cooperation of the different parties is best achieved if everyone is *willing* parties, rather than enforcing cooperation as a form of compromise between conflicting compromise. Moreover, the project mangers must not only be aware of the approaches they use in eliciting support, but also of the effect of the conflict resolution approaches they employ. Particularly for the project leader (manager), each set of skills is critical for effective performance; for if a project manager cannot manage the inevitable conflict situation which develops in the course of a project, then his or her effectiveness as a manager will erode.

3.3 Contract and the JCT 80[3]

We described briefly in section 3.0, and 3.2.1, the importance of arriving at a decison within a time limit. In fact, achieving the project's objective within a constraint, eg. budget or time, is the hallmark of project management. To enforce

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[3] The concept of an official range of forms grew from the standard form of contract first published by the Royal Institute of British Architect (RIBA) at the end of the 19 century. The "JCT Form" was not adopted until 1963. The 1963 Form, was a subject of a great deal of criticism, particularly in the courts, for what were perceived as a number of ambiguities and unclarities. The 1963 Form underwent a revision and the JCT 80 was the outcome of these, and is currently is the standard form.

and ensure that the commitment of the various parties are achieved within the time constraints, we will now look at the concept of the contract.

3.3.1 Concept of the Contract

As oulined in section 3.3, activities are dependable on 'linkages', human or artificial, for the project to suceed. As defined, the project management term for this is *dependency*. Gilbreath (1988), on the other hand termed this as 'soft links' which function to tie an otherwise disparate but inter-connected elements together. In the construction industry, soft-links can be identified as a binding agreement that parties enter into once the project objectives have been accepted (Keating, 1978).

An *agreement* in this case, is to ensure that things happen according to schedule and are on time. If the second party agrees and consent to the same thing, both parties will enter into an agreement and a *contract* is *formed.* By entering into a contract, a *contractor* has accepted his commitment and agreed to the project objectives. Appropriately, Emmons (1988) has described the contract as the 'keystone' to project management as it acts to 'provide integrity to the structure'. According to him:

> " (contract).......provides the support to and brings together those activities which have been accomplished and those activities which are to be accomplished" (p.411).

In our context therefore, a contract can be utilied to formalise, concretise, and make explicit the act of cooperation among the different disciplines.

3.3.1 Definition

A broad definition of a contract has been provided by Fletcher (1981) when he defines it as:

> "the drawing together of two minds to form a common intention" (p.23)

Powell-Smith, (1981) and (Chappel and Cecil, 1989), both give a similar definition when they see a contract as a 'binding agreement between two or more parties which creates mutual rights and duties'. This means that a contract not just spells out the behaviour and responsibilities of the parties to the contract but also outlining their rights. The essential features of a valid contract formation includes the following (Atiyah, 1989, Powell-Smith, 1981):

a) there must be an *offer* by one party
b) there must be an *acceptance* [4] by the other party
c) the contract must be supported by*consideration* [5]
d) there must be an *intention* to create legal relations
e) there must be genuine *consent* ie. there must be no duress
f) the parties must have the *capacity*[6] to contract
g) the object of the contract must be *possible*

3.5.2 Contract Administration and the JCT 80

In the construction industry, there is a *standard form* of contract that is used by the various parties invloved. This agreed standard form of contract is issued under the sanction of the Joint Contract Tribunal (JCT). The JCT committee (tribunal) is made up of twelve constituent members related with the building industry such as the Royal Institute of British Architect, The Association of Consulting Engineers, Association of Metropolitans Authorities, etc. The use of *standard form contract* is encourage because it has been written and published with the involvement and approval of representatives of all the main parties (consensus), and as such is generally understood by all sides of the industry. Most importantly it is comprehensive and deals fairly with the respective rights and duties, and reduces the likelihood of conflict and misunderstanding, both at tender stage and during the works themselves. As observed by Malone (1987), the best methods for ensuring coordination in groups is by using *standardisation.*

An intention of the contract is normally communicated to the various parties in the form of a contract document. *Contract documents* are used as an evidence of a contract, agreed by the parties and signed as such. Contract documents normally spells out the detail desciption and schedule of the task to be executed (printed

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[4] Acceptance of a contractor's offer creates a binding contract. The acceptance must be unconditional and if it suggests new terms, it probably constitute a counter offer.

[5] Consideration can be defined as anything given or promised by one party in exchange for the promise or undertaking of another (Atiyah, 1989, p. 126). In our context, consideration may consist of anything having legal value, such as payment of money, or the performance of work or services (Fletcher, 1981, p. 28)

[6] Thus certain categories of person or organisation have only limited capacity to contract. These include minors and the insane.

form, drawings, specifications, bill of quantities, etc). It also spells out the condition of the contract.

Contract *conditions* is a term which is of fundamental importance to the contract as a whole. It detailed provisions incorporated in the contract, laying down the rights and duties of the parties, the functions of all the parties connected with the contract, and the procedures of administering the contract. So if for example, a *term* is broken by one party, the other party may repudiate the contract. He may even elect for example, to treat the contract as at an end and sue for damages.

All aspects regarding a contract is administered and managed by a *contract manager*, usually an architect or a project manager. The manager usually has responsibility for seeing that work is carried out in conformity with the contract documents, making sure that the project is on programme. He or she also deals with and supervise other aspects of the contract such as liaison, valuation, delays, and extension of time.

3.4 Project Planning - Timing, Schedule, and Control[7]

It has been argued that the main measure of the skill of a project manager, is in his or her ability and success in ensuring that the project objectives are executed and achieved on time (Allinson, 1993, Gaddis, 1959, Struckenbruck, 1988). Here, a *project* can been defined, as 'a set of interrelated activities which utilise various resources' and posesses the following characteristics: (after Reiss, 1992)

a) a project is finite (limited) and has a definite goal.
b) it is homogeneous, ie., the individual activities of the project can be definately identified as belonging to it.
c) it is complex, involving a number of parallel activities with a significant interplay of skills, materials, and facilities.
d) it is usually non-repetative. Each activity has a particular duration, and uses a specific amount of resources.

Authors like Lock (1994, Walker (1984), and Young (1994a) observed that the main component (ingredient) to a successful project, is planning. In fact Simms (1987) went even further to suggest that the special thing that seperates project management from plain management is the need and emphasis on *planning*. Stressing on the importance of this task, Reiss (1992) has outlined three objectives of project planning, firstly, to motivate the project team to *think ahead*, secondly, to *communicate* by*distributing* and getting agreement on the *plan* timing, methods, and

[7] A full glossary of the project management terms used in the thesis, will be enclosed in Appendix 2-A.

strategy to every team members, and thirdly, using the plan as a *yardstick* against which to monitor and measure the progress of the project. As elaborated by Reiss (1992).

> "Planning is the driving force....behind every successful project, there is a successful plan" (p.23)

The task of the project manager then is to design a *schedule plan* ie. *an assignment of a start time and the resource to each activity, so that scheduling objective such as minimising the project duration is acheived.*

Project planning is itself a part of a larger problem of project management, which is usually divided into three phases, ie. *planning, scheduling,* and *control* (Kerzner,1988 and Young, 1994)

Planning refers to the initial stage of a project during which a *network* is drawn to show all the activities necessary for project completion. This includes identifying the projects *key stages* by making a *logical sequence* showing the *inter-relationships* between the key stages. A methods usually used to show this relationship is the *Work Breakdown Structure (WBS)* (Lavold, 1988). WBS is used for the decomposition of each of the key stages into their smaller elements.

Scheduling is the second stage during which estimates of the *time*, and *resource allocation* are made for all activities. Timing will determine the likely project duration and identify those activities which are likely to prove *critical* to the project. Resources used in a project can include labour and materials, and its the responsibility of the project manager to allocate appropriate resources to meet the projects objectives. The project manager usually extracts the information from the planning phase to produce a practical schedule of resources (Micro Planner, 1990).

During the *control* stages, project progress and performance is measured against the plan and deviations from schedules are noted and used for corrective action. This is achieved through the process of *continuous* co-ordination, replanning and rescheduling. While initial planning and scheduling may take place over a long period of time, it is obvious that coordination, replanning and rescheduling must be done in *real-time* to meet deadlines (Young, 1994c). Moreover, the need to disrupt the earlier schedule as little as possible becomes an important objective during rescheduling.

3.4.1 Methods and Concepts

All the development of the planning, scheduling, and control methods used in project management are based upon the concept of a *network* representation of the project plan. Here a *plan* can be defined as 'a formulated and detailed *programme*, outlining the *strategy* ' by which the project is to be executed (Pollock, 1992). To stress again, a *plan* in turn is used by the project manager as a *yardstick* against which to monitor the project and as a basis against which to measure progress.

Two types of representation of the plan that is widely used today are the Bar or Gantt Chart, and the Network or Arrow Diagram.

3.4.2 Bar Chart, Network Diagram and Project Timing

3.4.2.1 The Bar Chart

Developed by the Henry Gantt around 1990, the bar chart in project management, is primarily designed to control the *time* element of a program, as depicted in Figure: 3-2. Here, the bar chart lists the major activities comprising a hypothetical project, their schedule start and finish times, and their current status. The primary advantage of the bar chart is that plan, schedule, and progress of the project can all be portrayed graphically together.

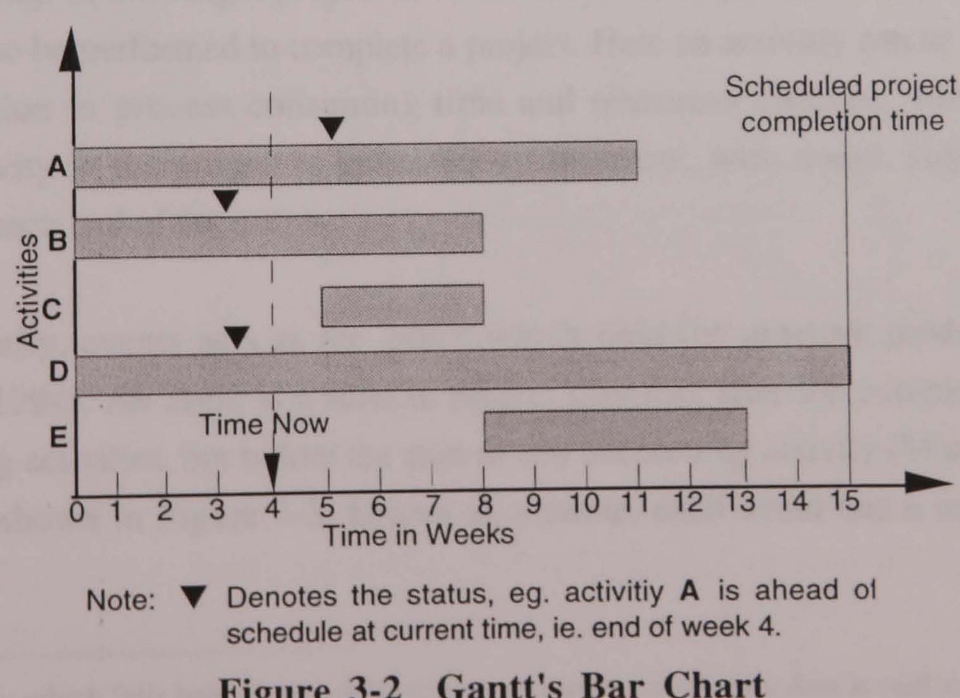

Figure 3-2 Gantt's Bar Chart

Inspite of this important advantage, bar charts have not been too successful on large-scale projects (Moder, 1988). The reasons for this include the fact that the simplicity of the bar chart precludes showing sufficient detail to enable timely detection of schedule *slippages* [8] on activities with relatively long duration times. Also, the bar chart does not show explicitly the *dependency relationships* among the activities. Hence, it is very difficult to impute the effects on project completion of progress delays in individual activities. Finally, the bar chart is awkward to set up and maintain for large projects, and it has a tendency to quickly become outdated and lose its usefulness. With this disadvantages in mind, along with certain events of the mid-fifties such as the emergence of large technical programs, large digital computers, and general systems theory, the stage was set for the development of a network-based project management methodology. Something like the critical path method literally had to emerge.

3.4.2.2 Network Plan and the Critical Path Methods[9]

The *network* representation of the the project plan is essentially an outgrowth of Gantt's bar chart. The objective of developing the network plan was to improve the methods of planning, scheduling and controlling large and complicated projects characterised by having complex interrelationships among project activities.

3.4.2.3 Building Networks Models

The first step in drawing a project network is to list all jobs, known as *activities,* that have to be performed to complete a project. Here an activitiy can be defined as 'an operation or process consuming time and resources' (Simms, 1987, p.359). Each activity in the project is indicated by an arrow, with nodes, called events, placed at each end of the arrow.

Symbolically, events acts as the 'bolts' which hold the network model together (Simms, 1994). An *event* is a state in project progress after the completion of all preceeding activities, but before the start of any succeeding activity (Micro Planner, 1990) as shown in Figure 3-3. Drawn as a circle, each event has a unique label

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8 An activity which falls behind or is delayed past an earlier completion date is said to have slipped behind schedule. The amount by which it has slipped can be termed slippage.

9 The concepts used in this section are based on the works by Battersby (1978), Lock (1994b), Simms (1994 a and b), Young (1994 a,b, and c) and the Micro Planner (1990) Manuals. Micro Planner is a project management software marketed by Micro Planning International, and available on the Mac, Windows, and a range of UNIX hardware.

such as Begin Event, End Event and Key Event, and is usually represented by numbers.

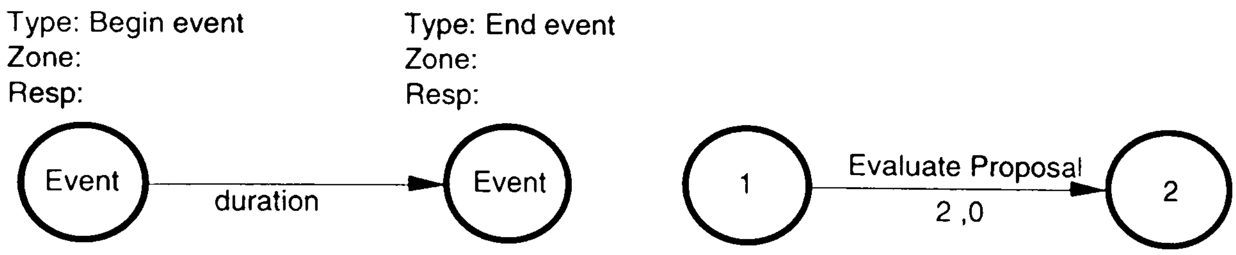


Figure: 3-3 An Activity with its Start and End Event
Note: The estimated duration of this activity, which is to evaluate proposals, is two weeks. The *start event* has been numbered 1 for reference, and the *end event* numbered 2. Event numbering becomes significant when a computer is used for network analysis, and this activity would be known as activity 1,2

3.4.2.4 Relationships Between Activities

To summarise, there are only three kind of relationships that can be identified, namely *independence*, *sequence*, and *dependence,* and these suffice to encompass completely the most complex of projects.

1. *Independence.* Two activities are not related to one another. For example, in Figure 3-4, the activity 'make site visit ' is not directly related to the activity 'coordinate consultation '. Neither the start nor the end time of each job is affected by what happens to the other.

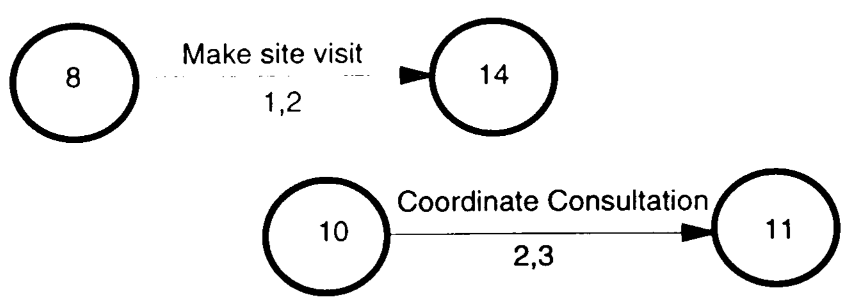


Figure 3-4 Two Independent Activities

2. *Sequence.* One job cannot start before another is finished. For example, as shown in Figure 3-5, a wall cannot be built until its foundation is finished. The end event of the earlier activity is the start event of the later one.

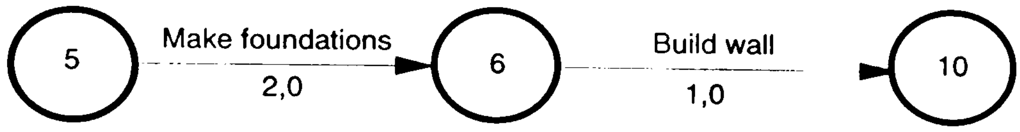


Figure 3-5 Simple Sequence of Two Activities
Activity 6, 10 (build wall) cannot begin until activity 5, 6 (make foundation) has finished or, in other words, until event 6 has been achieved

3. *Dependence* . It can be further divided into three categories namely, burst, merge, and combined burst and merge.

a) *Burst* . As soon as one activity is finished, two or more others can start. In Figure 3-6, for example, as soon as the project manager has evaluated the proposal, the project team can check it against other commitments and identify the need for cooperation.

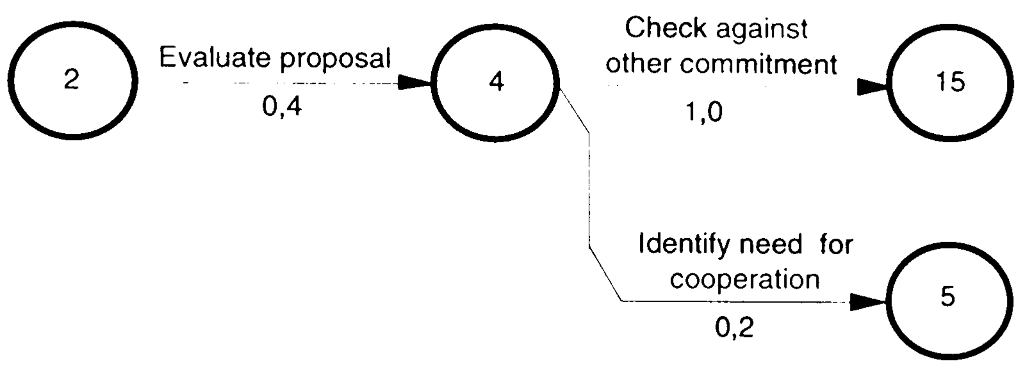


Figure 3-6 Dependent activities - 1 (burst)
Neither activity 4,15 nor activity 4,5 can begin until activity 2,4 has finished.

b) *Merge.* An activity cannot start until two or more immediately preceding activities have been completed. This is illustrated in Figure 3-7. Here the activity 'crit session' cannot start until the feedback from the internal input and from the consultant's are coordinated.

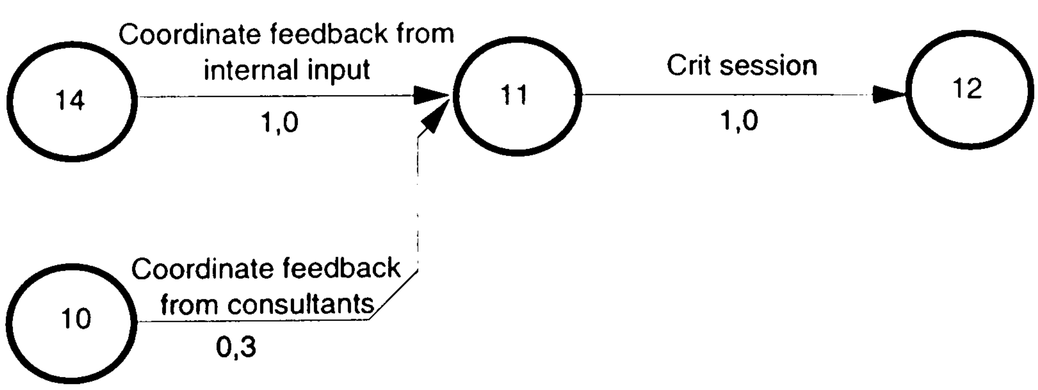


Figure 3-7 Dependent Activities - 2 (merge)
Activity 11, 12 cannot logically start until both preceding activities (14, 11 and 10, 11) have been finished.

c) *Combined burst and merge.* Several activities cannot start until two or more immediately preceding activities have been finished. For example, in Figure 3-8, the rules of the logic says that neither activity C nor D may start until both activities A and B have been finished. If, however, activity D depends on the completion of activity B only (and not A), but activity C must wait for the completion of of both activities A and B, then the logic may be modified using dummy activities.

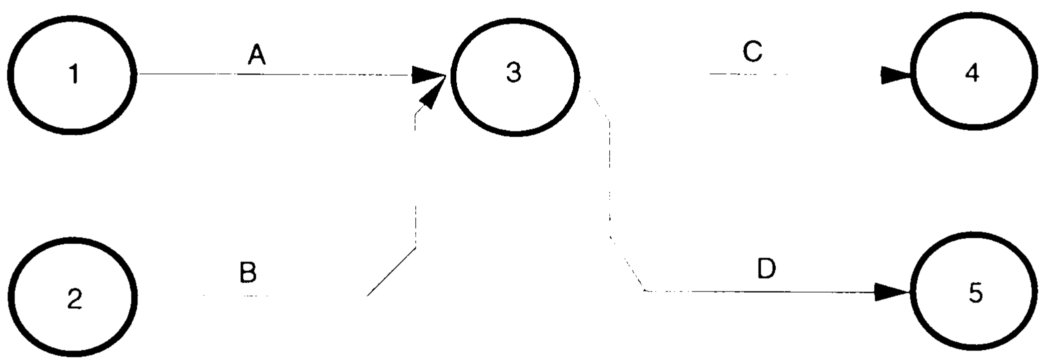


Figure 3-8 Dependent Activities - 3 (combined)
In this example, both activities 1,3 and 2,3 must be finished before either activity 2,4 or activity 3,5 can start

Dummy activities are activities which do not in themselves represent time or work. They are put in the network to show logical links between other activities. Dummies are shown as dotted lines, and do not have a timescale (ie. zero). Figure 3-9 illustrates the use of a dummy activity to show a logical link.

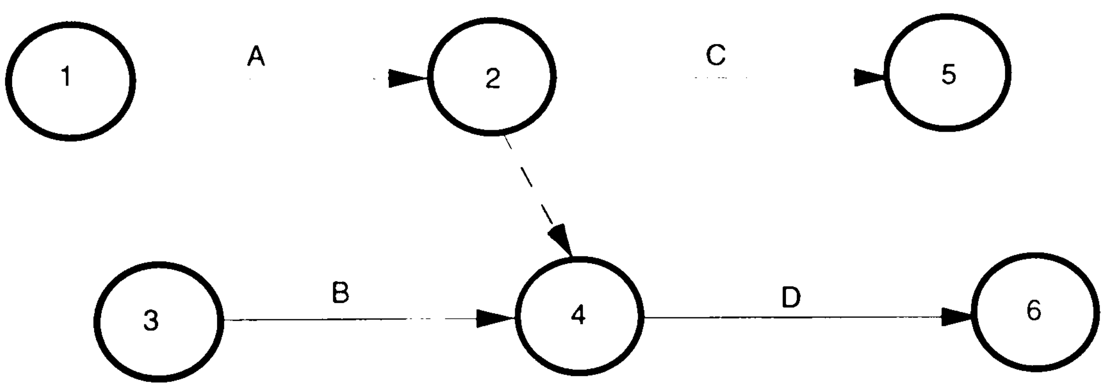


Figure 3-9 Use of a Dummy Activity as a Logical Link
The dummy activity does not represent any work and has no duration, but is used to show a logical link. In this case the dummy denotes that activity 4,6 is dependent not only on activity 3,4, but also on the completion of activity 1,2

3.4.2.5 Time Analysis

The timing phase of project planning produces the project programme, namely, *start times* and *end times* for all activities. Its basis is the project plan, as pictured by the network diagram, together with estimates of the duration of every activity. Two sets of calculation are needed in order to determine the timing of all the network events (and consequently their associated events), namely the *earliest possible date* (time) and the *latest possible date* (time) for each event.

3.4.2.5.1 Earliest Dates (or Foward Pass)

By working from left to right through a network, adding the durations of activities leading to an event, will give the earliest possible date at which the event can be achieved. When more than one path is possible through the event, then the longest path, in duration terms, will provide the answer. In other words, an event does not takes place until the last of the incoming arrows completes it. The earliest event date therefore, is the last of the end dates of all activities going into the event.

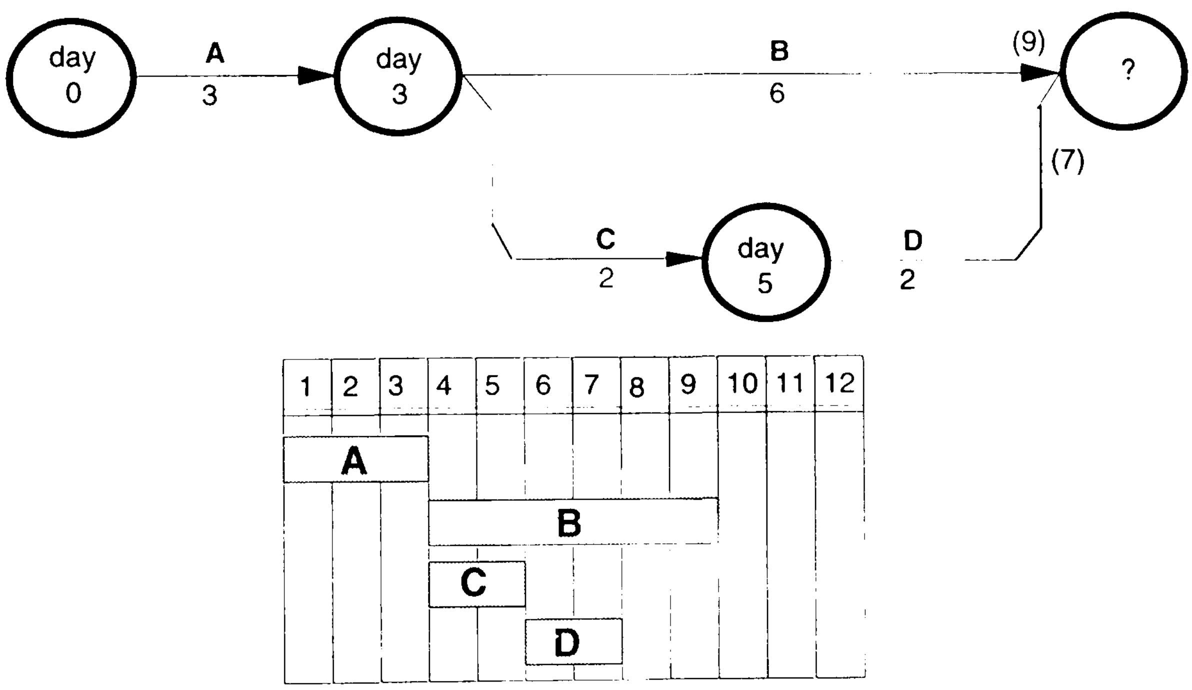


Figure 3-10 Concept for Earliest Event Times

In Figure 3-10 for example, if the timing starts at zero and activity A takes 3 days, then activities B and C can only start after day 3. Consequently, if activity C takes 2 days, then activity D can start after day 5. Therefore, if activity D takes 2 days and activity B takes 6 days to complete, the earliest date to complete activity B (therefore the whole project) is on day 9.

3.4.2.5.2 Latest Dates (or Backward Pass)

The latest permissible date for each event is found using a process which is exactly opposite to that use to find the earliest date. It is necessary to work back along each path through the network, subtracting activity duration from the earliest time of the final event - called the project *deadline*. The result for each event is the latest permissible date for that event to be completed if the final event (project deadline) is to be achieved at the earliest date possible.

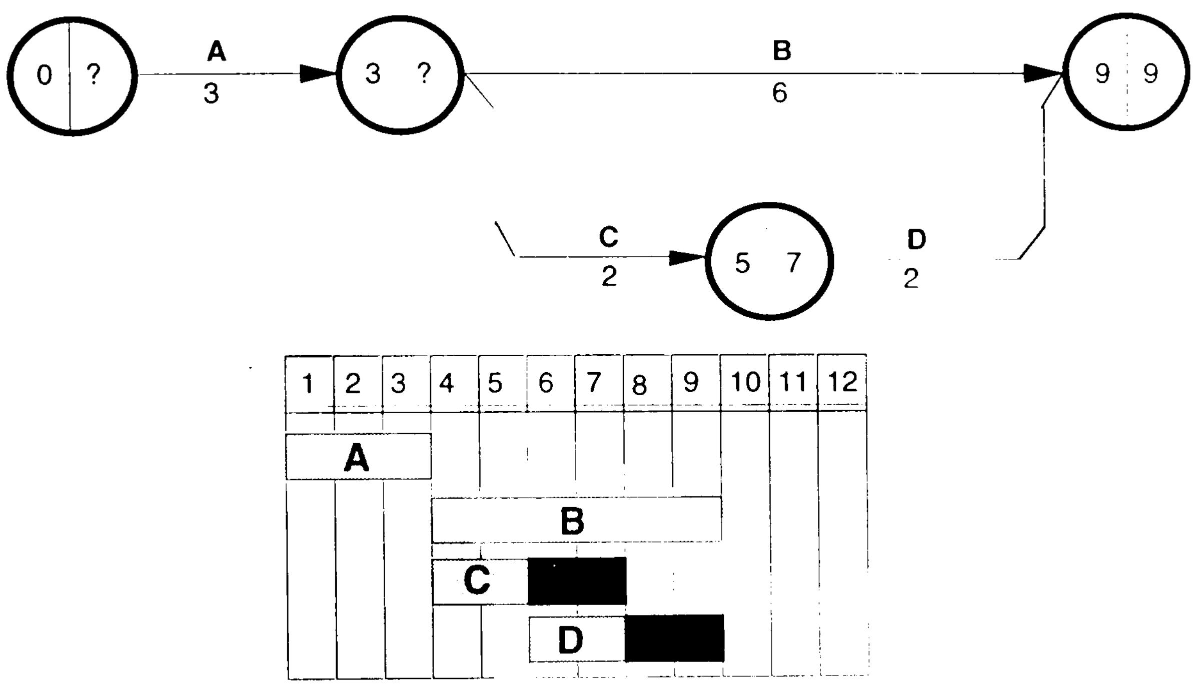


Figure 3-11 Concept of Latest Dates

This again, can be examined by looking at Figure 3-11. In this example, if activity D's duration is subtracted from 9, we get 7. That means activity D could start as late as day 7 without delaying the project and activity C could finish as late as day 7.

3.4.2.5.3 Float and Critical Path.

When the foward and backward passes have been carried out through the network diagram, and the earliest and latest dates are known for all events and activites, then the initial part of programming the project is complete. This process is called, for obvious reason, *time analysis*. The most important result is that the total project duration becomes known, namely, the difference between the times for the project start and finish events.

Refering again to Figure 3-11, we can see that the earliest and latest start dates for activities C and D differ by 2 days, while those for activities A and B are the same. This means that activities C and D may be delayed by 2 days before delaying the project. This margin of spare time is referred to as *float*.

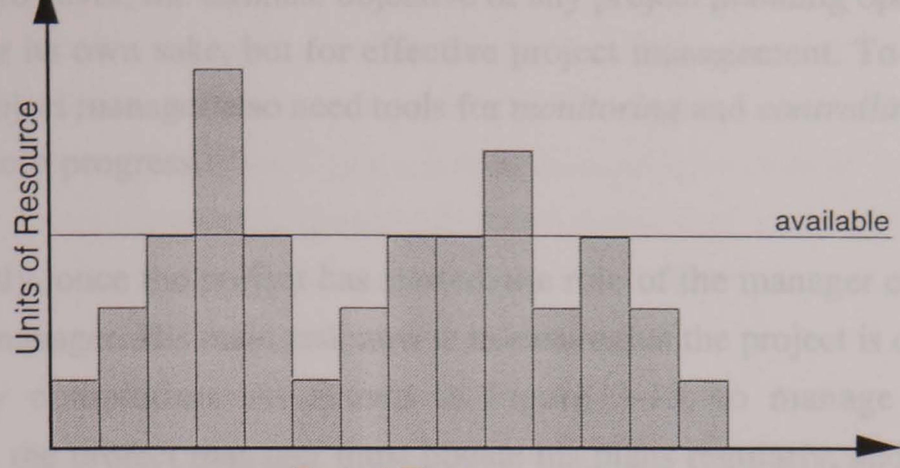
If however, activities A or B are delayed, then the project is delayed. These activities have *zero float* and are refered to as *critical* activities. The sequence of such activities, ie. the longest chain of activities through the network, is what is termed as *Critical Path*.

3.4.3 Resource Scheduling

As discovered, when we analyse a project on timing alone, the results only show when the project can be completed and what the deadlines are for each operation. What analysis of time does not tell us however, is whether there are enough *resources* ie. defined as people, accomodation, materials, machines, or cash (Lock, 1994), to meet this schedule. If Time Analysis is used by the project manager to calculate when each operation *could* happen, Resource Analysis is important in order to determine when each operation *should* happen. For the purpose of the thesis, only resources related to people will be considered.

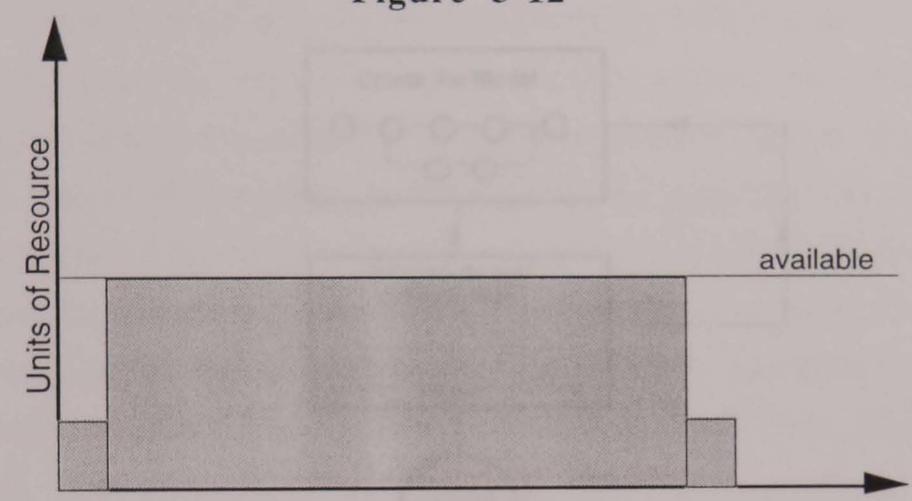
3.4.3.1 Objective of Resource Scheduling

Figure 3-12 (a) shows the type of resource usage pattern that might be expected if no resource scheduling were to be attempted. Imagine, for example, that the histogram represents the number of caseworkers needed each day to process the applications for development control. The horizontal line indicates the number of caseworkers actually available. Here we can see that the project manager has unresonably expected every task to be performed at its earliest possible time, as calculated from his project network diagram (Time-Analysis). Adding up the number of caseworkers needed to do all the tasks in each day reveals the unsatisfactory pattern of Figure 3-12(a), where there are overloads on some days and people are idle on others.



(a)

Figure 3-12



(b)

Figure 3-12 Planned Resource Usage Patterns - before and after resource allocation

The histogram in (a) is the sort of unacceptable resource usage that would be needed if every activity were to be scheduled to start at its earliest possible time. This purpose of resource allocation is to achieve a more practicable planned use of resources, aiming for a usage pattern which approaches the ideal sort of picture shown at (b).

Figure 3-12(b) shows the type of resource usage pattern that scheduling should attempt to achieve. The principle of this schedulling, is to delay the start of non-critical activities to help reduce the height of 'work peaks'. Sensible resource scheduling will help remove the worst and most uneconomical fluctuation (Lock, 1994).

3.4.4 Project Control

Project control is the final sequence in project management. We have noted in section 3.3, that the main task of the project manager using planning, is to ensure that the project objectives are executed and achieved on time and using available resources. However, the ultimate objective of any project planning operation is not planning for its own sake, but for effective project management. To achieve this goal, the project manager also need tools for *monitoring* and *controlling* all aspects of the project's progress.

Consequently, once the project has started, the role of the manager changes from planner to manager. His main task now is to ensure that the project is on track for a satisfactory completion. As shown in Figure 3-13, to manage the project effectively, the project manager must update his plans regularly, and this usually involves the operation of recording and managing progress, the management of information, and control action.

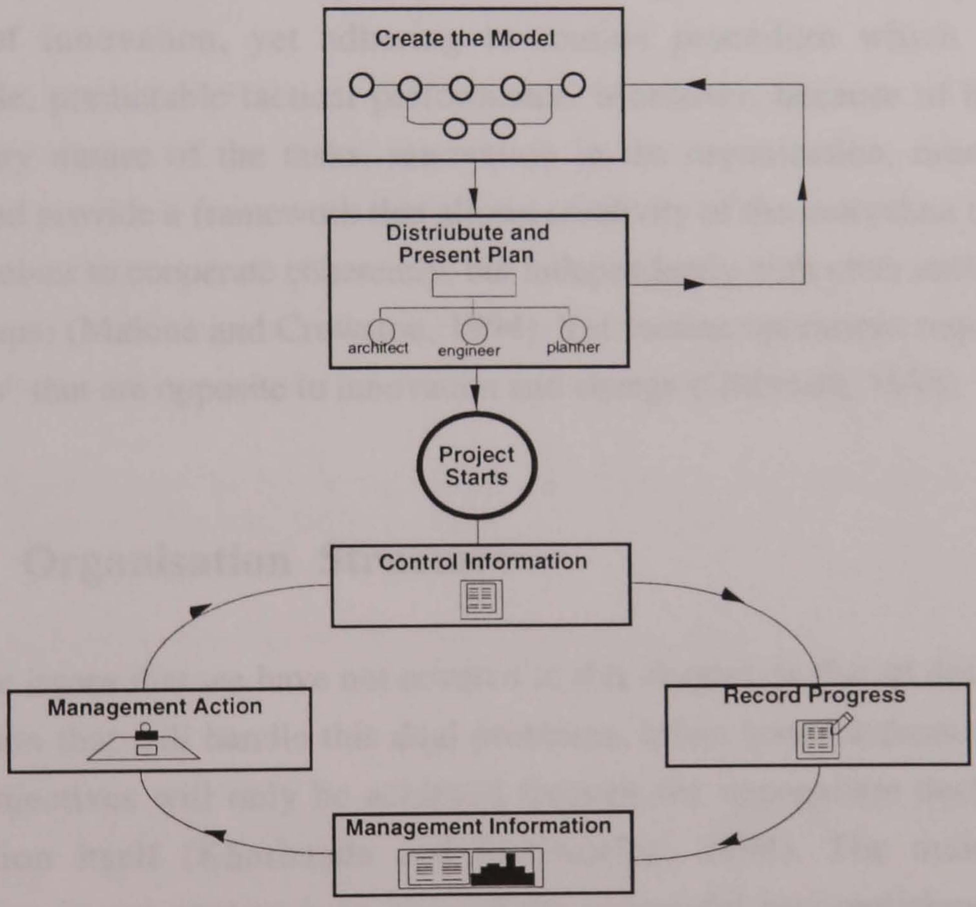


Figure 3-13 Project Monitoring Cycle
(after Micro Planner, 1990)

Project progress needs to be recorded, and this includes the actual start and finish dates. Having done this, the network model needs to be updated and reanalysed. The output from this analysis (progress report) is used for comparing performance against the planned scheduled. This management action includes the identification of the project's problems.

Armed with all this information, the project manager then can take management decisions and actions if, for example, delays, and consequently the project deadline, can be rescheduled. Options can then be simulated to see if, for example, the duration of the project can be shortened, or, if the deadlines set are really attainable. This process may involve a number of simulation to establish the best possible options and solutions. Once a revised plan of action has be established, all that remains is to communicate the modified plan once again, to the project team and the whole control process is continuously updated until the projects objectives are achieved.

3.5 Project Organisation and Development Control

The organisation that manages applications for development control, typically involve a combination of complex problem solving with the need for a certain amount of innovation, yet adhering to routine procedure which calls for dependable, predictable tactical performance. Moreover, because of the multi-disciplinary nature of the tasks, innovation in the organisation, must include support and provide a framework that allows creativity of the individual (or group) problem solver to cooperate coherently, but independently with other authors (from other groups) (Malone and Crowston, 1994). Yet routine operations require 'fixed conditions' that are opposite to innovation and change (Gilbreath, 1988).

3.5.1 Organisation Structure

One of the issues that we have not covered in this chapter, is that of design of the organisation that will handle this dual problems. Infact some authors argue that project objectives will only be achieved through the appropriate design of the organisation itself (Kharbanda and Stallworthy, 1994). The main aim of organisation in our context is to *support* the successful accomplishment of the project. Here, an organisation has been defined by Drucker (1988) as:

> "The structure of authority and responsibility relationships in a cohesive social systems that is a seperate entity purposely set up to achieve a specific objective (p.15)

In relating to project management Young (1994) provides us with two related definitions; firstly, as:

> "the systematic arrangement or division of work, activities or tasks between individuals and groups with the necessary allocation of duties and responsibilities among them to achieve common objectives" (p.14)

and secondly, as

> " the total aggregation of human and material resources that can be distinguished as a seperate entity, combined together to achieve specific objectives, such as a construction project (p.19).

From the above observations, we can conclude therefore that, organisations have specific objectives, a formal structure of authority with some person in leadership roles, and others in subordinate roles. It has a division of work which entails specialisation by members in various activities or functions. An organisation also has a formal system of communications, and generally a set of formal procedures and customs that distinguish them from other social entities.

Without proper and logical organisation, there would be inefficiency, waste, and possibly chaos and ultimately delays on the project. Without effective organisation, the efforts of personnes are duplicated and conflicts and frustration occur. In project management, the purpose of organisation is clear; that is to achieve the project in the most efficient, economical and effective manner. As two of the pioneers of organisation theory observed:

> "Organisation is but a means to an end; it provides a method" (March and Simon, 1957, p. 36)

The end of course is the successful completion of the project.

3.5.2 Roles and Responsibilites of the Project Manager in an Organisation

We have established that one of the main roles of a project manager in an organisation that is multi-disciplinary in nature, is to give the organisation a common vision - ie. a view of the whole (Drucker, 1988). Organisations need this vision so that there will be a *focus* that can be shared among the many and different professional specialist. The ability of the project manager to have this wholistic view and operate effectively therefore, must depend on the responsibility and authority that he commands in the organisation. We will now look at the various 'positions' of the project manager in relation to the organisation. Before that, the roles and activities of those who are directly involved in the decision making process will be examined.

3.5.3 The Three Parties to a Project - The Client, Managing and Operating System

In relating to the process of development control, the varying 'bodies' involved in the undertaking of a typical project (submission), namely the Client System, Managing System, and Operating System, can be depicted as in Figure 3-12.

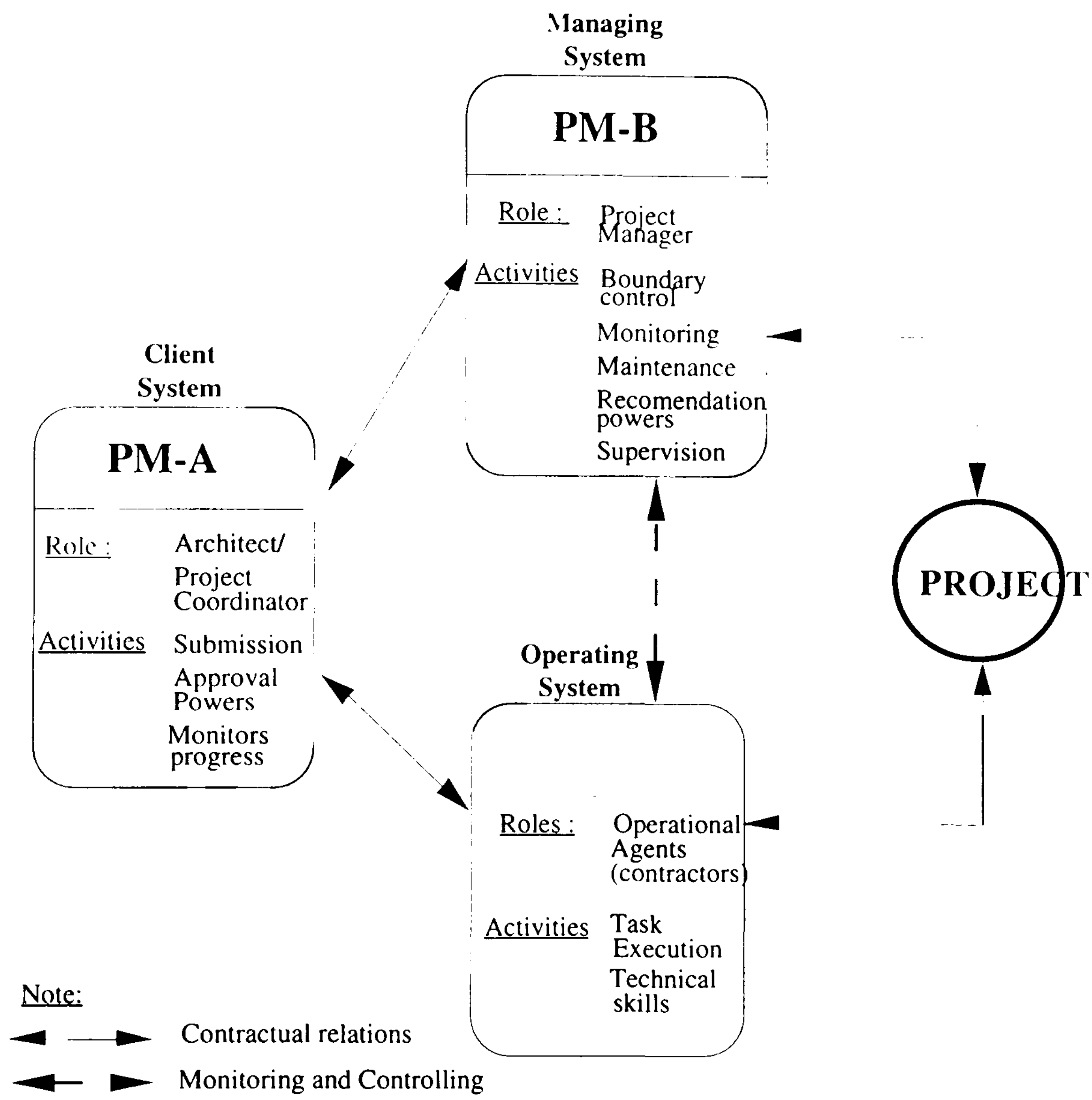


Figure: 3-12 - Distribution of Roles and Activities
(after Walker, 1984)

This proposal (for managing development control process), is based on the traditional construction project involving the client, architect, and contractor (Burgess, 1979). Here a client (who wants a building) will approach and appoint an architect firstly, to design the building, and secondly, delegate the responsibility for monitoring, co-ordinating, and managing the project from start to finish. In the latter role, the architect also functions as a project manager. To help realise the building, contractors which have technical expertise, will be appointed to construct the building, and the role of the project manager (architect) is to ensure that the project objectives are achieved in cost and on time.

3.5.3.1 The Client System

Refering to the concepts of project management, here a *client system* can be defined as the 'body of authority able to make decisions regarding the project's form, expenditure, timing, and cost' (Allinson, 1993). The client for example can be an individual client where he can be both the owner and occupier (a building he wants built for himself, eg. a house), the corporate client (includes all companies and firms controlled other than by a sole principle), or the public client (includes all publically owned organisations, eg. local authority, government agencies, etc).

In all the three cases described above, the client usually appoints a body of authority to help realise the project. This is usually a specialist in the design and management aspect of the project. In most cases this can either be a *project architect* or a *project co-ordinator* . He will act as the *client's agent* and is responsible for making the applications and seeking planning approvals on behalf of the client for development to take place.

The project architect's role, identified as PM-A in Figure 3-12, would be more of a monitor, progress chaser, reporter and expediter. PM-A's duty would be to keep the management of the client system informed of progress, (expenditure), and likely delays on the project. He is the key person to contact in the organisation on all matters relating to the project. In our context, PM-A acts as the *link* or *interface* mechanism between the client and the City Council.

3.5.3.2 The Operating System and Managing System

The operating system is the system of activity through which the project is achieved. The operating system is managed by the managing system which carries out the decision making, maintenance and regulatory activities that keeps the operating system going (Cleland and King, 1972). It is differentiated on the basis of *skill* from the operating system. The skill of the managing system is *management*, and those of the operating system are *professional* and *technical*. The person responsible for managing the managing system is the *project manager*, represented as PM-B in Figure 3-12

PM-B's role would be comprehensive since, he is responsible for receiving and managing all applications made by the client's agent. As manager, PM-B will treat all applications as a series of *projects* and its responsibilities include devising methods of ensuring that all the projects are completed according to the client's and organisation's (City Council) objectives. Since the managing system is the second party involved in the whole process, there is a *contractual* relation between the client system and managing system.

However, to process the application (ie execute the project), a *third party,* i.e. the operating system represented by expert consultants (technical departments), in the City Council must be involved. These *operating agents* or *contractors* will make up the *project team,* and will have the necessary resources, experience and expertise, to execute the project. Either by *tendering* or by *negotiation*, a contractual relation is also established between the client system, and the contractor.

Since there will be a number of contractors (departments) involved, PM-B will be responsible for distributing and integrating the contribution from the various contractors in the operating system. As mentioned these responsibilities include maintenence activities to keep the operating system going. The task involves planning, preparation of contract documents, contract administration, coordinating the quality and progress, and exercising the supervision of the project. PM-B will act on behalf of the client system to supervise the project to be carried out by the operating system. He may also be invove in the negotiation and supervision of sub-contractors (other departments), whose cooperation is necessary in implementing the project.

Having recognised that there could be a number of different responsibilities that a project manager could assume, we can now identify five major classes of responsibility, as follows:

1. project expediter, monitor, or reporter.
2. project planner
3. project co-ordinator
4. project supervisor or controller
5. project manager, administrator, or director.

3.5.4 The Client System Relationship with the Managing and Operating System

As much as the client system needing to understand the City Council's operation and management objectives, using the principles of *feedback*, it is imperative that the operating and managing system itself be designed to include the capability to respond to the client system's environment during the approval process.

As noted, the managing systems (PM-B) does this by *controlling* and *monitoring* the operation systems 'boundary' and ensures that they are compatible with the clients requirements. However, it will be easier to integrate with some clients than with others. For example, clients who have submission experience (building expertise), will be easier to integrate than clients without i.e. submitting for the first time.

As we have seen in Section 3.2.1 in terms of the relationship with client, there are two ends of the spectrum, at the one end, all agents of the *operating system have direct access* to the client. In this arrangement, the operating system's project manager will coordinate the instruction and advice given, or at the other end, the *managing system as the only point of contact* between the team and the client with all instructions and advice being passed through this channel. We are now going to look at the existing organisation structure that deals with development control and analyse the two alternative relationship between the client system and the organisation.

3.5.4.1 The Conventional Structure.

The conventional structure of development control in the City Council is of the *planning department* responsible for managing the input and output of the agents (departments) in the operating system, and also directly responsible to the client system, is illustrated diagramatically in Figure 3-13 (McLoughlin, 1971, and Walker, 1984). The various operating agents are organised along (independent) departmental lines, yet the agents will act *interdependently* in the execution of the project. The more complex the client system and/or the project, the more interdependent will be the tasks to be carried out in achieving the project objectives, and the more the contributors will rely upon each other to carry out the task (decision) satisfactorily.

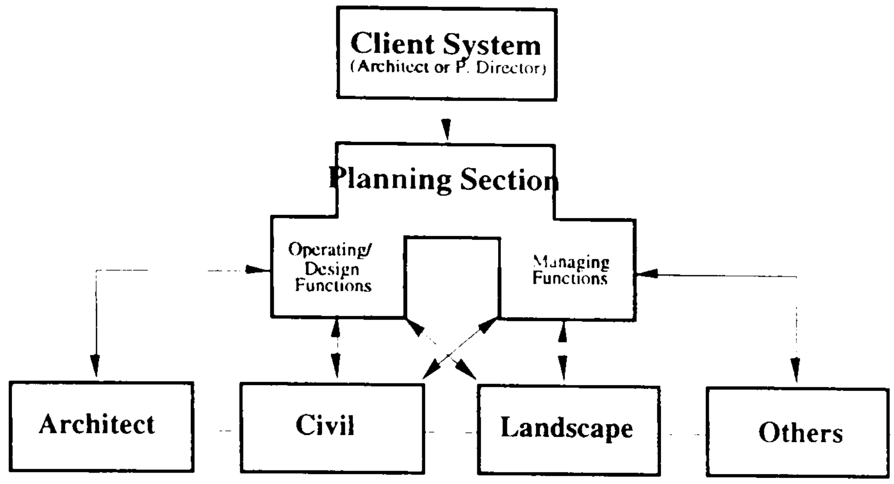


Figure: 3-13 - Existing Conventional Structure at City Council

Such a structure produces a high level of *differentiation* between the operating systems' agents, and therefore demands a higher level of integration. The problem towards integration is compounded by the fact that the managing system is not differentiated from the operating system. ie. the planner is attempting to fulfill dual roles - one as a member of the operating systems, and the other in the management of the project. There is therefore a high potential for a planner in this position not to be able to exercise objectivity in decision making (Walker, 1984).

Also such a structure has the tendency to restrict access of the operating agents, to the client system and vise versa, and hence reduces the *clarity* in the decision making process. The perceived personal relationship between the client system and the planning department, particularly with clients new in submission procedures, can inhibit the client system from approaching the others for advice.

Integration within the operating systems can therefore be difficult to achieve in this structure, as can the integration of the agents with the client system. However if the client comes from within the oganisation itself (eg. from within the City Council itself) then the problem of integration will be omitted, since the client system and the operating agents will be under the same organisational umbrella. Consequently different types of problem can arise, for example, control, motivation, and eventually the conflict of interest.

3.5.4.2 Non-Executive Project Management (the co-ordinator)

A structure often adopted by the interdisplinary practices in the construction industry, is one that includes a *non-executive* project manager sometimes called an integrator or a co-ordinator, who works in parallel with other agents as illustrated in Figure 3-14. As we have seen in section 3.2.1, the role undertaken by the person in this position is based upon *'communication and coordination activities and not concerned with decision making'* (Galbraith, 1973). In this circumstance, there is less pressure to identify the role of the project manager, and therefore his authority within the team.

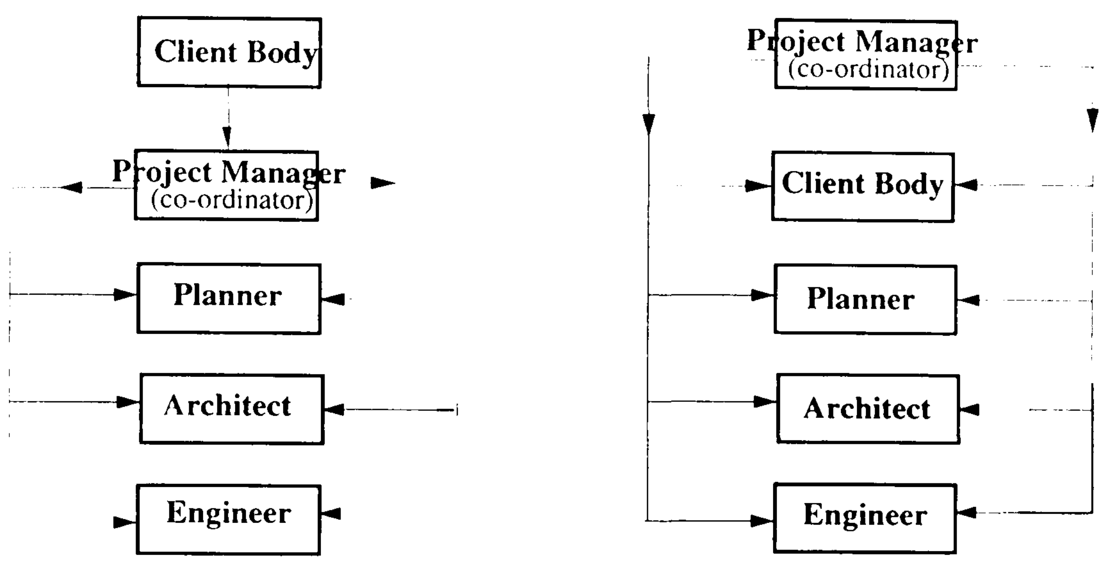


Figure 3-14 Two Examples of Non-Executive Project Management Structure

Such a role is unlikely to have a significant effect upon the quality of integration of the operating system with the client system. However if exercised with skill and received positively by the various agents, it can assist in integrating the decision making team (Morris, 1988). The authority of the non-executive project manager is likely to be weak and hence his ability to contribute will determine the commitment and attitude of the individual members of the decision making team to his role.

3.5.4.3 Executive Project Management (full project manager)

An *executive* project management role is undertaken by a person independent[10] of the other agents, as illustrated in Figure 3-14. In such a structure, the project management activity occupies a dominant role in relation to other agents, and although they operate as a team, the project manager will make the decisions that are within the range of the agents. He will be the sole *formal* point of reference to the client system for the purpose of agreeing and transmitting the decisions that must be made by the operating system. In addition of course, the project manager will be concerned with controlling, monitoring, and maintaining the project team, as discussed previously. These activities are far more dynamic and purposeful than the co-ordination and communication activities of the non-executive project manager.

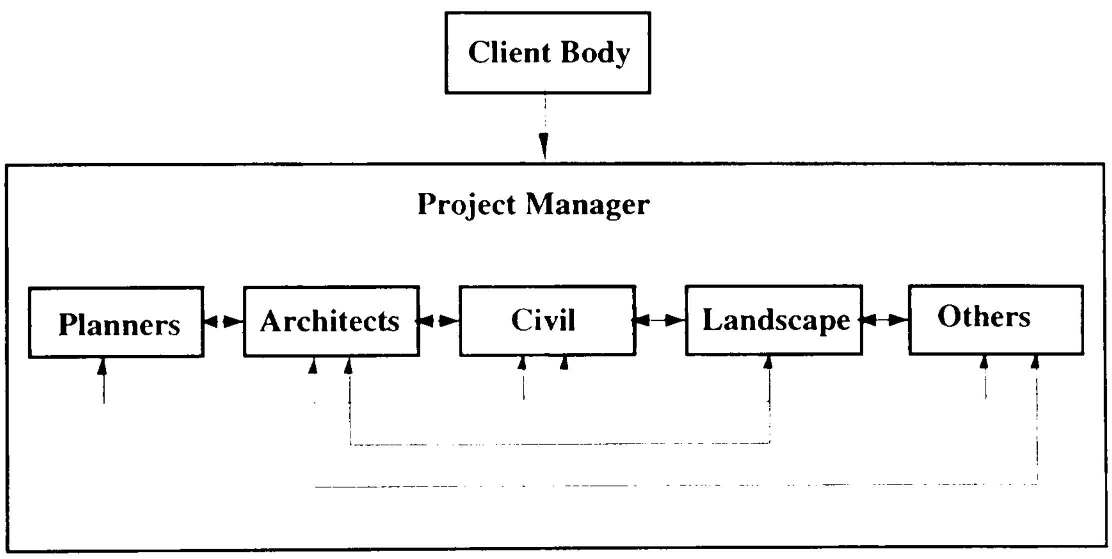


Figure 3-14 Executive Project Management Structure

It is necessary that the individual or body undertaking this role ensures that responsibility and authority are clearly established with both the client system and the operating system to the project. Although this might be difficult to achieve, the benefits of producing a situation in which the roles of the contributors are clearly established, are significant (Walker, 1984).

It is unrealistic of course, for the managing system to accept responsibility for the technical work of the agents. However, it is the managers' responsibility to report back to the client if the operating agents are not performing satisfactory. In practice,

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10 It is imperative here to point out that if the application is from within the City Council itself, the suggestion is that the task of managing the application will be undertaken by an independent member (or body).

the project manager should work in a *collaborative* manner with the agents and his major role should be one of facilitating the work of all the contributors (agents and clients) so that the project is developed by a *team approach* (Miller, 1988). His primary concern would be that appropriate decisons are taken by both the client and the project team at the right time.

Needless to say, the major benefit of the executive project management structure is that management becomes clearly separated from the operating system. This allows concentration upon the management needs of the project and makes it possible for conflicting professional advice to be considered more objectively in the best interest of the project.

This structure facilitates integration with the client because the person responsible for the submission on behalf of the client system (project architect), can readily identify the management responsibility within the decision making team. As we have seen, wrong integration can cause conflicts and consequently result in the project being aborted (Allinson, 1993, Gilbreath, 1988, Kerzner, 1984).

3.6 Participation and Managing the Urban Systems

One of the issues that we have not covered so far, is that of the role and contribution of the participants of the environment to provide feedbacks to the systems. To recall, participants are identified as those who are directly or indirectly affected by any changes that may happen to the system, due to the decisions by the managers of the environment. Directly, these include the applicants (client system) who interact and 'disturb' the system through development proposals; indirectly, are those who live, work, invest, or just visitors to the city. We have also confirmed that the urban system is everchanging and that the managers responsible for the maintainenance of it must be able, not just to stabilise the environment by using *controls* but also to be *responsive* to the environment in order to anticipate and promote growth.

At the most basic level, this implies that there is a need for the organisation of this nature to be *knowledgeble* about the environment or *market* for the services that they are providing, in order to operate efficiently and effectively. In systems' language, feedbacks (as a means of control) from participants are vital if the system wants to continue to survive. This knowledge can be gain through, for example, formal or informal consultation mechanism, or by conducting scientific market research (Miner, 1973). Most private producers of goods or services for example, constantly monitor sales so as to refine products and service delivery, hence maximising profit potential (Drucker, 1988). Not to do so would simply be poor management.

However, amongst the organisations concerned with urban development and management, there seems to be a reluctance either to consult or research effective clients needs before decisions are taken or to monitor their effects afterwards (McLoughlin 1973, Couch, 1990).

In our analysis of the type of organisation that is needed to manage the urban environment, it has been suggested that it has to be *open* to receive feedbacks from the external environment. One way to achieving this is through *consultation* and *participation.* This in turn implies that there will be substantial consultation within the organisation with the participants from all parts and levels of the organisation in decision making. In another argument drawn from organisation theory, Tannenbaum (1966) observed that:

> " Participation reduces disaffection and increases the identification of members with the organisation .... Paradoxically, through participation, management increases control by giving up some of its authority. (p.52)

Infact adapting Tannenbaums (1966) arguments, it could be suggested that *control* over the urban development process might be increased through wider participation in the decision made by all organisations concerned. It can also be suggested that inter-organisation and *client* participation should lead to greater individual identification with the aims and implementation of urban development and better decisions between urban managers and the participants.

In a recent paper that seeks to apply lessons from good private sector management practice to the British local government context, Donnelly (1987), while acknowledging the difficulties and limitation of such transfer, develops a comparison between the principles of good management practice identified by Peters and Waterman (1982) and what Donnelly regards as 'the prevailing culture of local authority'. Among the eight principles that Peters and Waterman outline which characterise good management, includes an organisation that is bias towards action and one that is close to the customer. By contrast, the organisation of City Councils in Britain are characterised by Donnelly (1987), among others, as having low corporate qualities, does not encourage innovation, authoritarian in its management style, and does not sought feedback from their client (participants). These findings are somewhat similar to the results of the surveys by McLoughlin

(1971) in looking at the ways decisions are made at City Council level with regards to the process of Develeopment Control, more than twenty years earlier.

Organisation carrying out of the task and responsible for developing and managing the urban fabric, need to interact and establish feedbacks with their external environment. The next question is *how* far organisation should involve the client (participation) of the external environment in decision making process; in *what* form should the involvement be; and *when* in the decision making process should they come in. We will again visit these issue in the next chapter when we elaborate on the role and effectiveness of participation in relation to the issues faced by the Johor Bahru City Council in Malaysia.

3.7 Summary

The ability of the city to be responsive to the demands of the participants and the flux in the changes in the environment has forced us to redefine the role of the managers and the organisation within which they operates. This chapter has outlined three approaches to deal with these demands, firstly, through organisation design, secondly through the management of the cooperations among members that operate within the organisation itself, and thirdly, thorough the use of the contract to enfore the act cooperation.

i) In order for organisation to be responsive to the changes in demands, the *project* structure has shown to be the best. Unlike the fixed hierarchical nature of traditional organisation which are operation based, projects evolve continuously.

ii) Since a project is a *mutual team* effort, its success therefore depends on the ability of the various team members to *cooperate coherently.* More importantly, the flexible and adaptive nature of projects can best support and allow creativity of the individual problem solver to cooperate *independently.* Indeed, it is essential that the roles of the various contributors to the system are clearly defined and identified for the project to be successful. It is not the system, but the people who operate within it, which produce result. For the contribution to be successful none can work in isolation.

iii) To enforce the commitment of the various parties to cooperate and reach a consensus within the time constraints, we proposed the idea of the *contract*. Here a contract is an *agreement* to ensure that things happen according to plan and schedule.

Managing the various cooperation among the members of the organisation therefore is paramount. Decisions are arrived at by a mixture of cooperation and leadership. Cooperation is necessary because of the *limitation* of rationality, the neccessity to meet *constraints*, and existence of *interdependencies*. It is the role of the project manager to subsumes what is probably the most important role, that of *integrator* of all contributors.

Successful integration can only be achieved through *planning*. The benefit of project planning is that the manager will gain a *wholistic* understanding of the projects *objectives*, *tasks*, *resources*, and *schedules*. Effective planning early in the life cycle of the project can also assist in forecasting and perhaps minimise a number of potential problem areas, such as *conflicts*, that are likely to affect the project's performance. Accordingly, it is the role of the project manager to ensure that the project objectives are executed on *time* (and within budget), using available resources. Consequently, planning can also be used as a *yardstick* for which to assess the project's performance and progress.

Finally, it is the role of the project manager to give the organisation its overall vision, for without a focus, contributions will be at best ad-hoc, rather than coordinated as a gestalt whole. Only through these approaches can the manager, not only be able to maintain and enhance the organisations performance, but also ensures its survival.

Chapter 4
Case Study - Development Control in Malaysia

Chapter 4

Case Study - Development Control in Malaysia

4.0 Introduction

It has been predicted that the 21st Century will belong to Asia (Dobb-Hoginson, 1994; Simone and Feraru, 1995; So and Chiu, 1995). The new cities of Asia, particularly in the developing economies of East Asia, will be the urban centres of the future, similar to those experienced by the post-industrial cities of Europe and North American, which rose to greatness at the height of the industrial revolution. Either in Europe or in Asia, the underlying trend, as we have seen in Chapter 2, is that these cities are never static and constantly changing: either expanding, contracting or undergoing internal restructuring in response to economic and social pressures. If the problems of cities in Europe and America are due to lack of investment, added by the decline of its heavy industries, those faced by the new economies of Asia is opposite in nature. While the issues in European cities is *regeneration* and *redevlopment* to overcome urban blight, those in Asia is often related to *uncontrolled growth* due to *over development.* Moreover, behind the facade of many booming developing metropolies, lies tell-tale evidence of urban decadence, chronic traffic congestion spured by haphazard and often chaotic development.

Even though the problems posed by both scenarios are of the opposite spectrum in the evolution of modern cities as we know today, it is fair to conclude that the common denominator in both cases is one of the same, i.e. related to the issue of *management* and *control* . Firstly, how to make best use of existing structure to *manage* and *revive* the past glory of these cities, and secondly, how to *manage* and *control* the fast pace of intervention of new development.

4.0.1 Johor Bahru - The Southern Gateway City of Malaysia.

In many ways, Malaysia's second largest city, Johor Bahru epitomises the new Asian City, teeming with live changes and promises of a new age. Indeed to meet these demands, it has to realign and transform its traditional role to fit into this new internationalism. Johor Bahru is now being developed into, and promoted as an 'international city', even capable of competing with neighbouring Singapore in the future. With a contruction industry experiencing an impressive growth averaging 10% in the past five years or so, the target seems achievable.

However, there is a flip side to progress and prosperity in this southern gateway city to Malaysia. While towering sky scarapers, mega shopping complexes, luxury condominiums and posh hotels sprout everywhere, the fundamental problems of traffic congestion, rising cost of living, added by the woes of squatters, hawkers and petty traders, continue to plague the city.

Moreover as Malaysia targets to achieve a developed nation status by the year 2020, additional goals and priorities are being included and set by the people. The country hopes its society would be united and just, technologically advanced, with strong and stable cultural values. It would be a moral and ethical society which promote caring among the people, (Mohammed, 1991).

These aspirations present architects, planners developers, and City Councils, responsible for designing, developing and managing the cities, with some of the most significant and intractable problems and challanges, as Johor Bahru enters the new millennium. The traditional functions of Johor Bahru, as an administrative center and places for commuters to do business or shopping is changing. The physical arrrangement of cities, must provide an avenue and encouragement for social enrichment activities and expression of internal discipline, in line with the country's ambitions. Current design practices and controlling methods used to regulate the development of the cities are being scrutinised more than ever. This places greater demand on those responsible for developing and managing Johor Bahru to respond to society's needs and the nations vision to achieve these objectives.

This chapter will look at the issues of development control as being practised in Malaysia in general, and in Johor Bahru in particular. Related issues such as the historical background, the country's policy to redistribute wealth, the political and hierarchy in decision making and criticism of current system will be analysed. In particular, the analysis will help the author to have a first hand understanding of the problems faced by all the parties involved, and towards developing and proposing a comprehensive and efficient system for managing development control in the Johor Bahru City Council.

4.1 Overview of Development Control

In Malaysia, the year 1921 was the turning point in the establishment of a formal physical planning with the setting up of the Department of Town Planning initiated by an Englishmen, C.C Reade (Goh, 1988). A staunch advocate of the *garden city movement*[1] (Ebenezer, 1964), Reades was appointed as the government's first town planner. His first task was to establish a system and machinery through which urban planning could be implemented. More importantly, Reade promoted the idea of the need for Malaya at that time, to have a comprehensive statutory town planning blueprint for development. The earliest planning legislation was the Town Planning and Develeopment of 1923, to be followed by the Town Planning Act 1927. The 1923 Act was a very comprehensive Urban Planning Act incorporating provisions for planning, development control and powers to implement town improvement schemes. It also has provisions to *regulate* buildings including the extension of houses, and incorporating financial policy with regard to town improvement or town development. The latter Act was however, watered down due to political pressure and transformed town planning from a comprehensive exercise of land management and planning into an exercise only of demarcation of communication lines and land-use zones (Goh, 1988).

The Japanese occupation of Malaya again saw a shift in the thinking in planning, whereby planning was for security reason, i.e efforts were directed towards anti-guerilla warefare, contributed to the creation of resettlement 'new villages' (Siaw, 1983). These largely military imperative entailed massive displacement and regroupment of scattered rural predominantly Chinese population into new settlement areas.

After independence from the British in 1957, Malaysia began to establish her own new town programmes, and national and regional planning assumed a high profile. The enacting of the comprehensive National Land Code in 1965 has a significant implication on land use control. McCoubrey (1988) regarded this as an innovative form of planning control embracing both rural as well as urban land. The land use-based planning system advocated by Reade, remained until the enactment of the Town and Country Planning Act 1976. This Act was to provide a comprehensive basis for planning and control for the country as we know today.

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[1] Advocated in the early 1900 by the Englishman Howard Ebenezer, the garden city was promoted as an alternative to the overgrown and over congested industrial city and the depressed depopulated countryside. Ebenezers vision was the design of cities with limited area and population, and laid out systematically with wide street, public parks and gardens, and in a rural setting (Ward, 1992).

On the issues of developement control today, there has not been much debate, empirical studies, or discussion done, hence the difficulty in documenting the evolving issues and perceptions. Focus on the issues of control however, has largely centred on the political side of it such as long delays in procedures, cost implication, arbitrary conditions imposed, resource allocation and insufficient policy guidelines (Bruton, 1982).

4.1.1 Sources of Policy for Control - The Country and the New Economic Policy (NEP)

It can be concluded that the strategic policy of control for the past two decades or so, was based on the New Economic Policy (NEP)[2] , with a two pronged goal, namely the restructuring of society and the eradication of poverty via the promotion of economic growth. Launched in 1971, the NEP is a sensitive political agenda as it tries to address the socio-economic imbalances of ethnic groups through *positive discrimination.* There was and still is a marked difference between the ethnic

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[2] After independence from Britain in 1957, Malaysia's racial balance was poised on a knife-edge. The Malays, who made up 51% of the population and lived mainly in the contryside feared dominance by the economically powerful Chinese, who inhabited the towns. Those tensions exploded on May 13, 1969, after a general election saw the Chinese-dominated opposition make sizable gains at the expense of the Malay-dominated ruling coalition. The Malays, already mostly living in poverty, seems to be losing their political power as well. The riots persuaded the government that a heavy hand would not be enough to keep the lid on ethnic violence; the underlying causes had to be tackled. The NEP, henced was launched. As one political writer observed,

> "If the goal was to prevent further bloodshed, the grand social experiment was suceeding. Reducing poverty, giving the Malays a stake in the economy, creating a large middle class - all these factors helped keep peace" (Jayasankaran, 1995, p.25).

Extending the argument of the importance and contribution of social cohesion to the current economic performance enjoyed by the country, the BBC reporter Stourton (1996) observed that the NEP methods:

> "..may be extreme, but then so was the challenge it faced....At the time of the 1969 raceriots, the Malays made up more than 50% of the population, but owned only 2% of the counntry's wealth".

It is said that in terms of social engineering, the NEP has been on a scale unprecedented in the world. Education was the main thrust of this policy and has created a large Malay middle class which is crucial to social stability. Critics argue that the down side of this policy is to develop a 'culture of mediocrity' and has actually hindered the economic development of the country. Proponents however, argued that political stability is far more important for long term economic prosperity of Malaysia. Again Sturton made these observation:

> "These stabilty have made it possible to achieve the social cohesion they need to keep growing. The Chinese ..seems to accept it partly because of the cultural tradition that sees the nation as an extension of the family and partly because of a pragmatic calculation about the consequences of racial rancour"

composition and their economic well-being between urban and rural areas, and between states in a regional framework.

The objectives of the NEP are translated into hierarchical plans, programmes, and projects. These will make up the strategies for both urban and regional development, to direct and reshape the physical development with social and economic change to areas where maximum benefit in terms of the NEP is likely to be achieved. On a wider perspectives, Bruton (1982), see the NEP as a set of national policies essentially to:

> "...a) define quite clearly the social and economic direction in which the country is going; ii) establishes the longer term social, economic and physical perspectives of the country within which the implications of the day to day decisions can be considered; iii) provide guidence for the coordination of the decisions and actions of private agencies and iv) provide a control mechanism for the public sector through the allocation of finance needed to implement physical development proposals" (p. 317)

4.2 Government and Development Control

To help us understand the way decisions are made with regards to development control in Malaysia, it is imperative that we look briefly at the underlying political thinking behind it. This section will analyse the ways the Federal government runs the country as a whole, its influences on the State and finally, the impact of these factors on decision making at the Local Authority level.

4.2.1 Hierarchy in Decision Making

Malaysia adopts a constitutional monarchial democratic system of elected Parlimentary and State Assemblies. The head of country is rotated amongst the nine hereditary rulers who will elect the Supreme Ruler. The governmental structure is a hierarchical three-tiered system comprising of the Federal, State (both elected) and appointed Local Governments, (Figure 4-1).

stationed at the States, who act as the *overseer* of State projects on behalf of the Federal Government.

In urban areas, a Federal government agency namely the Urban Development Authority (UDA) concentrates on development and/or redevelopment schemes aim at restructuring society in urban sector. Organisationally, UDA's are situated outside the jurisdiction of local authority area. Their role can be seen as complementing the 'areal coverage of local authority establishments', (Goh, 1991). The UDA's carries out their own planning and urban development in towns and cities on a commercial basis. Their interaction in practice with the Local Authorities is on a consultative basis.

At the State level, the State Economic Development Corporation (SEDC) is a close resemblance in function of the UDA. Infact, these organisations are 'creatures' of the respective States and function within a state. They act as States' enterprise engaging in various physical and economic development ventures within a state. The Johor SEDC for example, has ventured into the development and management of a completely new town, i.e Pasir Gudang, and also act as the town's local authority.

UDA's are like the new Urban Development Corporations (UDC) in England, set up under the Thatcher government of the 1980's. The key concern of these corporations, for example the Liverpool Dockland and the London Docklands, are economic and physical regeneration of decayed areas (Ogden, 1992). This is achieved by stimulating development by the private sectors through the provision of land with enhanced infrastructure and services, environment conditions, and economic initiatives including financial support. One distinct feature of the UDC's which is relevant to our discussion, is that they become the local planning authorities for development control in their assigned areas, superseeding the elected local authority (Docklands Consulatative Committee, 1988). The argument is that they need the executive powers and to be freed from the burueacratic style of decision making being adopted by Local Authorities, if development were to be done on a comprehensive and efficent manner. However, critics argue that accountability to the system should be the paramount consideration of these Corporations.

4.2.2 Development Control and Local Authority.

Under the present three-tier system of government mentioned above, the development control procedures regulates on the principles and scope of administrative powers and control. The Federal Government is solely responsible for such matters as foreign affairs, defence and education. The State Government, on the other hand, is responsible for religion and land. Land includes the following:

> " a) Land tenure; relation of landlord and tenent; registration of titles and deeds relating to land; colonisation; land improvement and soil conservation; rent restriction; b) Malay reservations....; c) Permits and licenses for prospecting for mines; mining leases and certificates; d) compulsory acquisition of land; e) transfer of land; easement; f) Escheat; treasure trove excluding antiquities" - (The Federal Constitution, (1976); 9th Schedule, List II , Entry 2)

Matters related to local government and urban planning are in what is called the 'concurrent list' (Goh, 1991), meaning that they are the concurrent responsibility of both federal and state governments. In other words, in urban planning matters, the federal government can pass legislation which would ensure *uniformity* in the planning system in all the states. However, these legislations are in principle, not operative until and unless they are *adopted* by the individual State Government. In practice through, the Federal Government exerts a very strong influence over running of the state governments and through them the local authorities. This is done through the dispensing or witholding of Federal grants (Quazi, 1984).

The control of local authority by the state government is even stronger. Firstly, the President or Chairman and members of the local councils are appointed on the recomendations of the state government. As such, the views of the state government are closely followed by the local authority. Secondly, the local authority is the creation of the state government. Hence, the areas and powers of the local authority are defined by the state government. Furthermore, powers of the local authority are based on what is termed as the *decentralised competence system*, which means that it can only do what is specifically empowered to do. Among the powers given to local authority are that of preparing development plans, namely structure plans and local plans, and controlling them.

Importing ideas from England, the statutory structure plans and local plans, form the main instruments in planning (Bristow, 1988). These plans are prepared by the Local Authorities and is to be approved by the State Authority. To recall, the function of the *structure plan*, as described in Chapter 2.2.4, is to outline the Local

Authorities policies, strategies, and general proposals for the planning and development of the designated areas. These must take into account the current strategies and policies of the State and Federal Governments. The *local plan* which is a more detailed plan and map can be adopted by the local planning authority for development, and control purposes (Planning Advisory Group, 1956).

4.2.3 Organisation Structure and Decision Making

Development control administration at the State level is very elaborate in its organisational structure but largely diffused in the hierarchy of authority and division of functions. There is no need to elaborate on the function of each elements of the hierarchy, except to point that they are machines of the political masters and the organisation is structured to achieve the agenda of the day.

Legally, development control at the local level, are the responsibility of local government. The Local Government Act 1976 (Act 171) empowers the local authorities to provide *maintenance-based* services and to:

> "....regulate, control, and plan the development and use of all lands and buildings within its areas." (Part II, Section 6(a))

However, this in practice is limited by the Local Authority's own ambitions and resources (Goh, 1991) and in light of the existing local authorities structure in Malaysia, which Mawhood (1987), aptly described it as a:

> " mixed system of local administration which seeks public support and identification of the state, employing structures of grass root participations, but *not* granting real power to the local authority"

The carrying out of development function is also limited with the strong presence of Federal and State statutory bodies who possesed the bulk of information, hence the power. Critics argued that the local autonomy, initiatives, accountability, and participations would suffer in light of these. The need for political stability and strong government was the counter argument.

The limited organisational capacity and resources have retarded the planning, development control, and building control roles of most Local Authorities as depicted in the organisational structure of the Town Planning and Architecture Department at the Johor Bahru City Council (JBCC) (Figures4-3 and 4-4). One glaring point to be noted in these Figures is the level of professional staffing.

Because of the renumeration structure in Local Authorities, most of the professional staff posts are still vacant. Currently, these responsibilities, especially in these two departments are shouldered by *technical assistance* (sub-professional). As in January 1995 there are only two qualified planners and one architect serving a growing population of 429,000. Moreover, out of the three local authorities in the state of Johore, only the JBCC has a planning and an architecture section which deals with the issues of control. It is fair to conclude that the problem experienced at JBCC is a typical one and in many ways, a representation of the state of Local Authorities in the country as a whole.

Another main feature of the local authorities in this country, is that members of the Council, who are the highest decision making body in local authorities are not elected, but appointed.They usually represents the political and ethnic mixture of the country and as such, are usually political appointments. In the Johor Bahru City Council structure, the Chief Minister is the Head, whilst the appointed councillor consist of 9 United Malay Organisation (UMNO), 9 Malaysian Chinese Association (MCA), and 2 Malaysian Indian Congress (MIC), all representative of the coalition ruling parties, National Front, and one each from the Factories and Hawkers Association. The councillors work on a committee system and meetings are held once a month and is normally chaired by the Mayor himself (Figure4-2). These meetings however, *are not open to the public.*

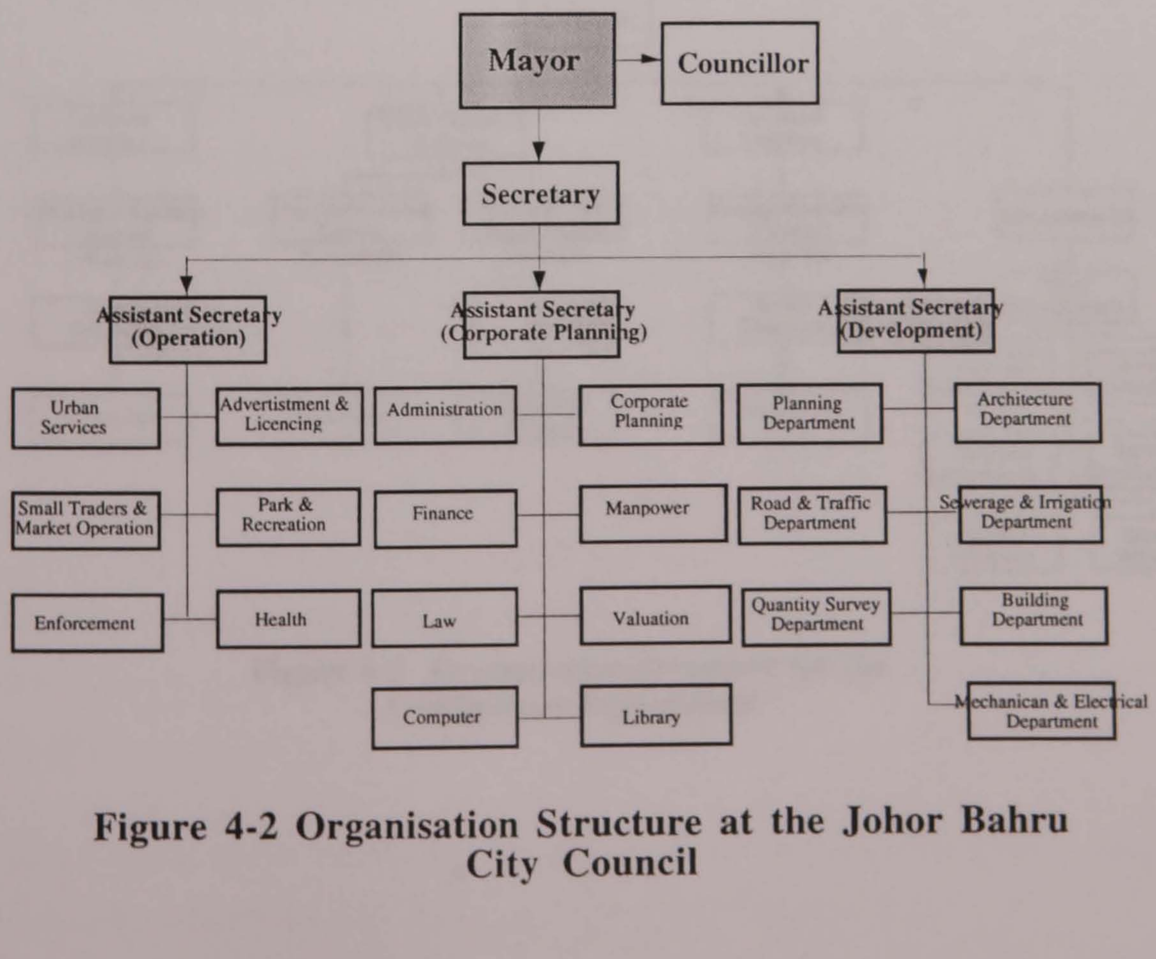

Figure 4-2 Organisation Structure at the Johor Bahru City Council

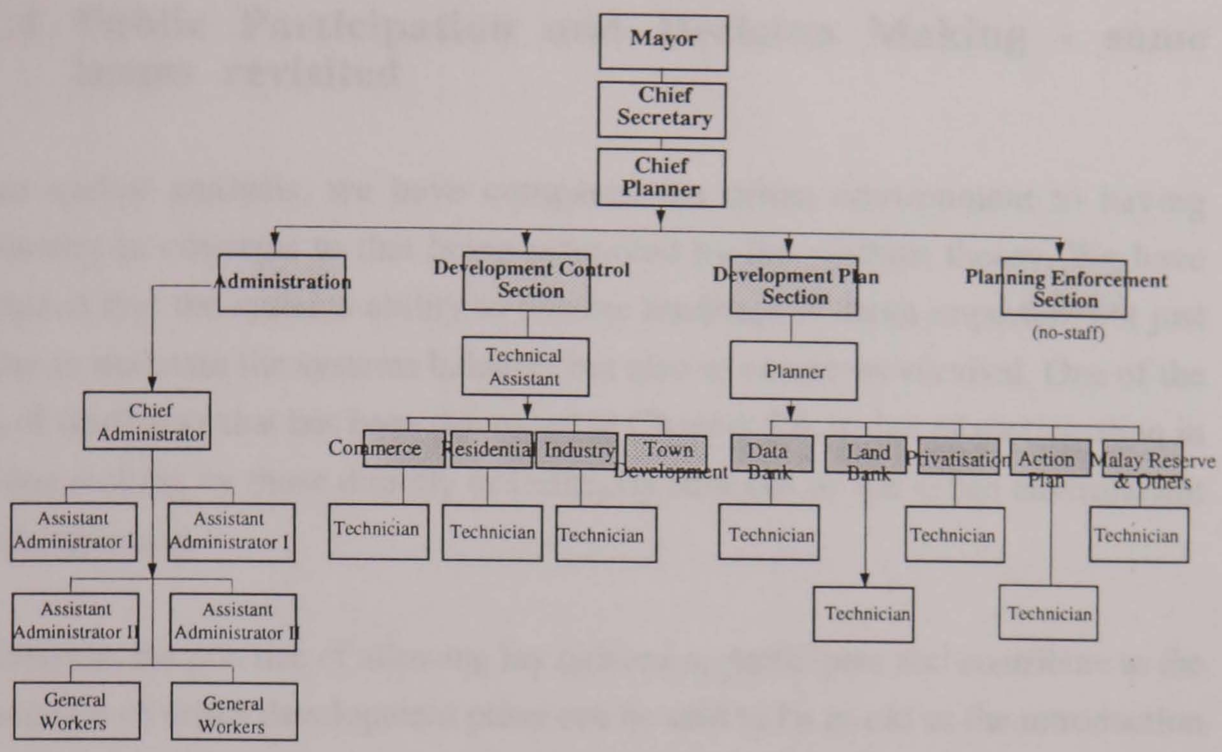

Figure 4-3 Organisation Structure for the Town and Planning Department

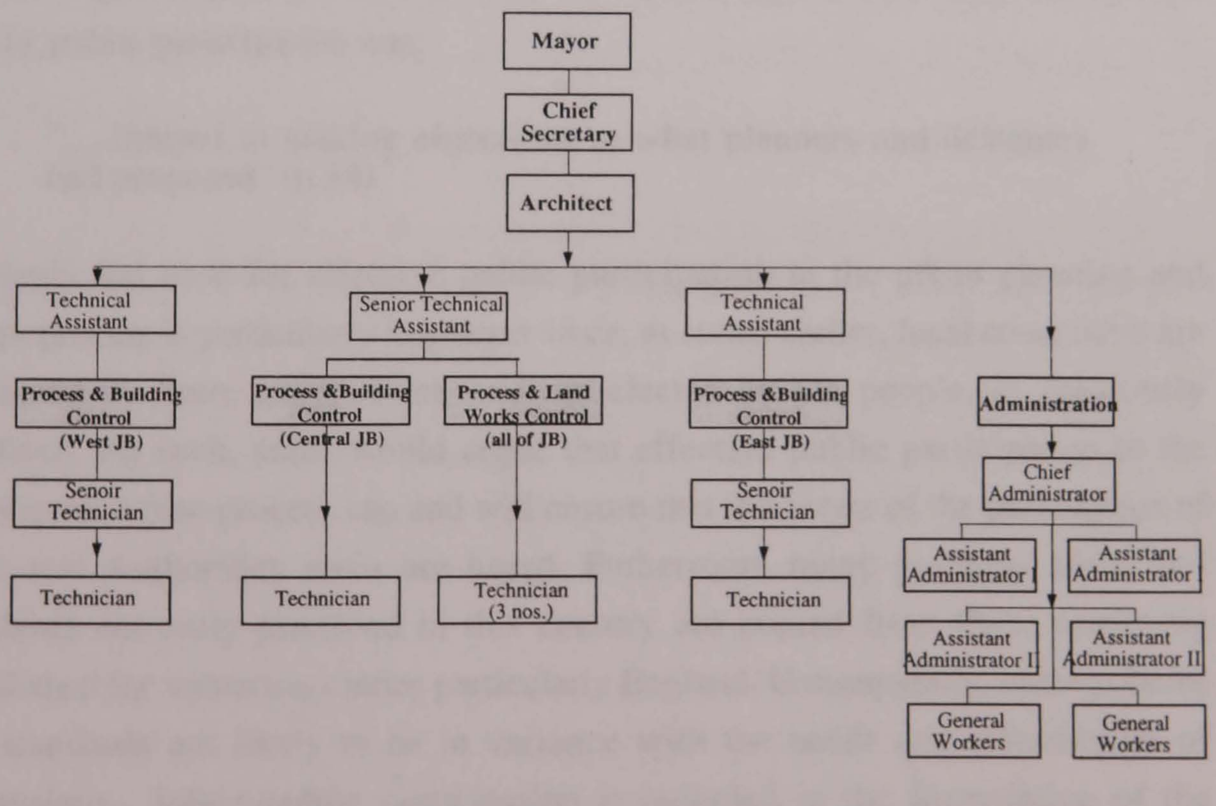

Figure 4-3 Organisation Structure for the Architecture Department

4.2.4 Public Participation and Decision Making - some issues revisited

In our earlier analysis, we have compared the urban environment to having similarities in concepts to that being promoted by the systems theory. We have concluded that the systems ability to receive feedback is deem important not just inorder to maintain the systems balance, but also to ensure its survival. One of the form of feedbacks that has been discussed in Chapter 3.6, is that of participation in decision making by those directly or indirectly affected by the urban environment and changes to it.

In Malaysia, the practice of allowing lay citizens to participate and contribute to the formulation of urban development plans can be said to be as old as the introduction of urban planning to the country itself. The Town Planning Enactment of the Federated Malay States of 1927 provided for general town plans to be displayed for the public to make objections and to propose recomendations on how to overcome the objections (Tan, 1971). However it should be noted that the public is only allowed to participate *after* a draft plan has been completed. As observed by Goh (1991), public participation was:

> ".....limited to making objections to what planners and designers had proposed" (p.34)

Currently the need for effective public participation in the urban planning and design process is particularly important since, as stated earlier, local councillors are appointed by State government, and not elected by the people, as previously practiced. As such, some would argue that effective public participation in the development plan process can and will ensure that the views of the participants of the Local Authorities areas are heard. Futhermore many planning ideas and standards currently practiced in this country are copied from those originally established for western societies particularly England. Consequently, some policies and standards are likely to be in variance with the needs and affordibility of Malaysians. Infact public participation is included in the formulation of the structure plan is just another case of what was good for England was also good for Malaysia.

However critics argue that public participation will only be effective in Malaysia with the existence of the following four ingredients (Goh, 1991):

1. *Knowledge of Planning and Design Process* - Malaysians generally do not know the current urban planning and design practice, let alone the numerous substantive areas upon which decisions are based.

2. *Availability of Information* - it is fair to say that Malaysians do not have access to important and useful information primarily because the government, which is the biggest source of data, is rather stringent in disseminating them. The Official Secret Act of 1968 only serves to cement the widespread belief that politicians wants secrecy. This is likely to lead to even stricter control of information flow from the government to the public. Lately, however, we have seen the reverse in attitude of the government who now accepts that freedom for its citizens to have access to information is important to the nations development and progress.

3. *Representativeness of Participants* - only a few people bother to visit the structure plan exhibition once its being displayed for the public. The Johor Bahru Structure Plan of 1985 for example, only attracted 4% of the total JB population of 285,400 at that time, and fewer people still, i.e 436 bought a copy of the structure plan report (Sen, 1983). Since its publication in late January 95, only 25 copies of the Alteration to the Structure Plan report has been sold (source: JBCC).

4. *High Degree of Political Sophistication* - people must be aware of their rights to influence decision makers, and that this right should be a continuous process rather than once every five years (voting in an election). Unfortunately, in Malaysia, lay citizens have been brought up under the belief that they have little or no influence in the government decision making process. Before the colonial period, the Sultans had absolute powers and the term "the king can do no wrong" is very much adhere to in the society. During the colonial era, decision making powers were concentrated in the British Residents and their appointed officials. Malaysians did not even have a say as to who was to be their ruler. Independence have brought about a certain power to the people, but this is also limited to casting their votes in General election. In local authorities, even the choice of local councillors as mentioned, has been taken away by the abolition of local government elections.

The situation is best sum up by Goh (1991) who observed that:

> "In Malaysia, where power is very concentrated and centralised in the hands of a few people and the culture of sharing power is almost non-existent, it is very difficult to envisage a situation where the public can participate effectively in the development plan making process" (p. 116)

Participation so far, is more in the form of *informing* the public than sharing powers to decide on the policies and strategies. However, some critics argue that the tasks of developing and designing a better system and thus better urban environment, can only be fullfilled by the co-operative and collaborative work of all the major actors in the current system, namely the politicians, planners, designers, and the lay citizens (Levin, 1972)

A note of caution is however, necessary. There is no guarantee that public participation will become more effective or more acceptable to the current power-holders. Infact, Goh (1991) argues that too much participation is not desirable. In theory at least, public participation in the planning and design process is promoted as a good and progressive exercise. In practice, it can degenerate into a futile expensive exercise. It can lead to even more *anti-social* plans and therefore bring about a backlash against public participation. It is also possible that the process of power sharing between the officials and the participants may be abruptly halted or even reverse.

In a young democratic country like Malaysia, it only takes a few unscrupulous politicians, or religious and racial bigots, under the cloaks of nationalism or religious pursuits, to undermine the stability of the nation. The race riots of 1969 mentioned earlier, are a constant reminder to the country as a whole, of the effect of such rancour. Once stability is threatened, public participation in the planning process, together with many ideals of a democratic society, will easily be forgotten or ignored.

4.3 The Johor Bahru Structure Plan

In Section 4.2.2, we have seen that one of the ways in which Local Authority use to guide development under its management is through the use of structure plans and local plans. To summarise, structure plans are statements that outlines JBCC policies, strategies and general proposals for the city. Among others, the structure plan has to anticipate how much development is likely to take place, and what types of development should be encourage or discourage, in what general area it should be located as well as identify areas with development potential.

In 1985 the JBCC structure plan that was to guide development until the year 2005, was gazetted after five years of preparation. However development of the past fifteen months or so, has made the 1985 plan rather outdated. The adpotion of the twinning concept for development with Singapore[3], the completion of the North-South Expressway, and the construction of the second linkage between Singapore and Johor Bahru, to name a few, are development not anticipated by the Structure Plan of 1985. In early 1993, a team of consultants were appointed to review the 1985 Structure Plan and in December 1994 the alteration to the 1985 plan was gazetted.

The preparations of structure plans is to be preceeded by that of Local Plans. Local Plans are more detailed plan and maps to be adopted by the local authority for development and control purposes. To date, there has been no attempt by JBCC to prepare any Local Plans for the areas under its jurisdiction. The unavailability of a detail blueprint for development has created '*uncertainty*' in the type of development that can be proposed. The results of this is already having a serious impact on the efficiency in areas such as the City Centre, caused by the deteriorating traffic congestions, and interruptions of water and power supply, all of which have adversely affected the quality of life for the inhabitants of Johor Bahru.

4.3.1 Study Area - The City Centre

The city of Johor Bahru (JB) as we know today, has grown over the years from a small settlement to become Malaysia's second largest city. The original town with its logical layout and distribution of activities has been engulfed by subsequent development. This has led to two major land-use problems, namely:

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[3] Being close to Singapore, Johor Bahru has benefitted in many respects, from the spillover effects of its neighbour's development. In 1990 the state government make a policy to acquire some of the positive features that Singapore has to offer. For example, it is hoped that by tapping Singapore's transportation and communication linkage will help induce faster growth to Johor's commercial activities including transforming itself into an important regional base for national and multi-national companies in the manufacturing, distributive, professional and other value-added businesses.

i) some uses are no longer in the most appropriate locations

ii) existing activities are not able to expand to a size which can cater for the increased demand.

The area under the jurisdiction of the JBCC is approximately 185 square kilometers with a population totalling 429,000 presently. However, the thesis will concentrate only on the development affecting the Central Business District (CBD), from now on called the City Centre, totalling some 45 hectars (Figure 4-5). The focus is due to the following three considerations:

a. One of the major criticism about Johor Bahru (JB) presently is that it has 'lost' its importance and focus as a traditional centre for *commerce, administration*, and *culture* for the state of Johor (Nordin, 1995). Currently, Johor Bahru is being developed into an *International Centre* and its future and success depends to a large extend, on its ability to strenghten these traditional roles. This worrying trend is confirmed by the 1994 Structure Plan alteration report which iterated that this strenghtening of its roles has not been achieved since development is being dispersed around a much wider area outside the City Centre. These factors are enhanced by the drop in its population due to its inability, for example, to:

> "provide satisfacory quality of live for its inhabitant in the form of meeting place and public recreation spaces, making it unfriendly and unattractive" (section 7.2.2).

JB's City Centre's population has decreased steadily over the last 22 years, from 36,921 in 1970 to 28,221 in 1980 to a current estimate of 25,800 in 1992. The older part of the city seems to be worst affected. The report went further;

> "The townscape of Johor Bahru is influenced by the form, height, colour and layout of its buildings, by landscaping and street furniture, by signage as well as by its pedestrian/vehicular circulation networks and the condition in which they are kept. A harmonious relationship between these elements creates a city which is pleasant to live and work in. *Unfortunately, this harmony is lacking in JB*". (section 7-9)

b. It is being forecasted that 46% of all vital and major development involving the building of offices, hotels, shopping, and recreation centres up to the year 2010, will occur in the City Centre area. These development will only put a tremendous pressure on the physical infrastucture of JB, but will also have a significant visual impact on the skyline of Johor Bahru. The control and coordination of development in City Centre area will be another factor that will determine the success of Johor Bahru.

c. Finally, is about the accessibility to information vital to the research. The authors' access to information, some confidential, and getting the participations of the two main groups directly involved in the development of the City Centre, namely i) the *submitting architects* representing the developer (client), wanting to *disturb* the environment through the development proposals (project submission), and ii) the *technical departments* representing the Johor Bahru City Council and outside organisation, given the tasks to manage and limit these disturbances to the environment by using *controls* .

4.3.1.1 Major Problems of the City Centre

Before the City Centre can be transformed into an established nucleus, there are however a few problems that it has to overcome, namely:

a. *Existence of Physical Barriers*

The City Centre is confined by a small area due to the existence of physical barriers, i.e the railway lines on the east, the Straits of Johor in the south, and the hill of Bukit Timbalan on the west. Because of these, the development in the City Centre has followed a primarily north-south direction. The present organic growth of the City Centre has placed great pressure on the existing infrastructure of JB. Unless these physical barriers are removed or development strictly regulated, development will continue to grow in a linear fashion along major arterial route. If these *ribbon type* development is allowed to continue, problems of congestions and environment degradation will persist in JB.

b. *Lack of Feedback Study*

The Structural Plan Alteration Report criticises the way development is being controlled in Johor Bahru. This is made worst by the lack of feedback studies, and therefore allowing development to proceed *intermittently, piecemeal* and on a *speculative* basis. Developments are unintegrated and this has led to the difficulty in forecasting the provision of efficient social and physical infra-structure.

c) *Lack of Certain Vital Type of Development*

The study has identified certain shortfalls in certain facilities and attractions needed to serve its resident especially recreation facilities and places for gathering.

i) *Commercial Development - Offices, Hotels and Shopping*

It must be noted that the Johor Bahru City Councils, categorise all development in the City Centre involving offices, hotels, and shopping, and leisure activities, as being under one *use-class* i.e. *commercial.* In our context, commercial development proposals in the City Centre, therefore forms the bulk of all applications received by JBCC. This has led to the misrepresentation of the true amount of floorspace each of the commercial categories is contributing. Since each of these uses has different impacts on their environment, each with different locational, spatial, access and parking requirement, it is imperative that a new classification technique is developed.

However, based on the this 'old' use-class classification, in 1980 there were around 760,000 square meters of commercial space in JB. Existing supply of commercial floorspace in the City Johor Bahru amounts to about 1.936 million square meters, representing an annual increase of 7.2%. Currently there is around 1.0 million square meters of commercial floorspace proposed (i.e under construction or with approval). A further 1.3 million square meters has been planned for the development of the largescale waterfront area over the Johor Straits, making the total committed floor space to reach an additional 2.3 million.

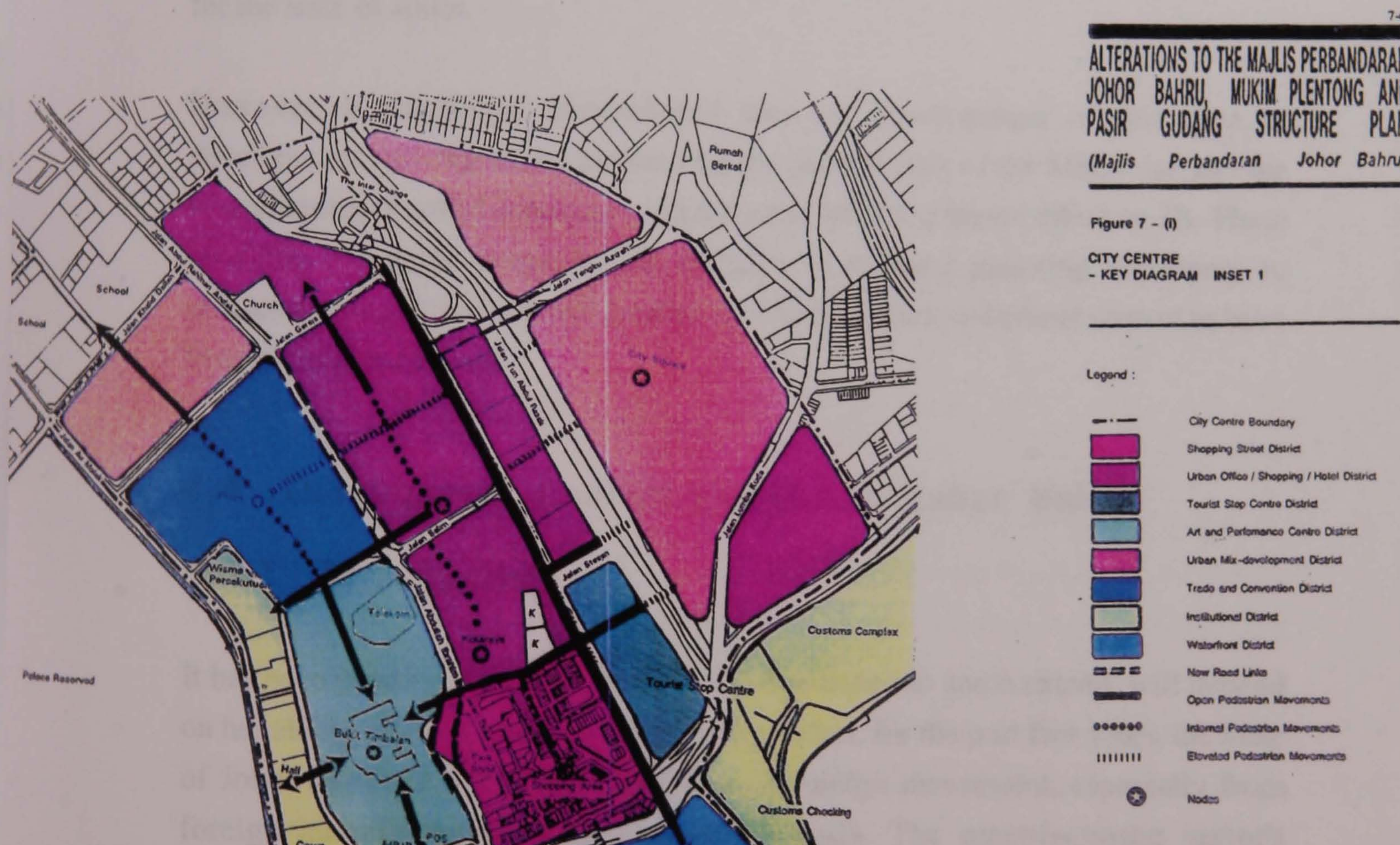
ii) *Projection 1992-2010*

According to the Structure Plan (1994), the demand for future floorspace in JB depends on how successful JB is in accelerating the *internationalised process.* To achieve this, Johor Bahru has assumed a rigorous approach towards its development, whereby only selected type of development that is 'comprehensive' and of 'high-quality' will be allowed.

Commercial floorspace in Johor Bahru is estimated to increase from 1.9 million square meters in 1992 to 5.3 million square meters in the year 2010. Based on a new use-class list for classifying the type of activities, it has been forecasted that during this 18 years period, commercial floorspace is estimated to increase at a rate of 5.7% per year, as tabulated in Table 4-A.

The Location of Johor Bahru

Johor Bahru Metropolitan



City Centre Area

Figure 4-5

Sector	1992	1995	2000	2005	2010	Annual Growth Rate (%)
Office	739,000	1,010,000	1,240,000	1,718,000	2,456,000	6.90
Retail & Wholesale	1,092,000	1,261,000	1,578,000	1,958,000	2,412,000	4.50
Hotel	105,000	123,000	240,000	320,000	422,000	8.03
Total	1,936,000	2,394,000	3,058,000	3,996,000	5,290,000	5.74

Table 4-A Forecast for Commercial Floor Space
(Source: JBCC and 1994 Structure Plan Alteration)

The City Centre is gazetted to provide 46 % of the total floor area tabulated above. This will be mainly be for international finance and business concerns, luxury and speciality shopping, tourist, entertainment and cultural facilities, gathering place for ceremonial occasion serving a wide catchment area, and will be the primary centre for the state of Johor.

However, it should be remembered that the development of this type of development will depend on factors like the general state of the Malaysian and the neighbouring countrys economy which tend to have a spillover effect on JB. These problems are made worse by the inability of existing planning machinery to efficiently control the pace and location of commercial development control as have been highlighted above.

4.4 Development Control Practice in Johor Bahru

4.4.1 Introduction

It has been perceived that the success of Johor Bahru to some extend, will depend on her ability to attact investment to the city. Infact, for the past five years, the State of Johor has been the biggest recepient of foreign investment, especially from foreign manufacturing companies in Malaysia. The manufacturing sector's contribution to the State of Johor's Gross Development Product for example is projected to grow from 29% in 1991 to 41% in the year 2000. The former Chief Minister of Johor, aptly sums up the way foward for Johor Bahru when he said that:

> "Johor Bahru intends to exploit its advantages in respect of its greater land availability, lower rental, better access to first class recreational facilities, cheaper housing, good infrastructure plus easy

> and total access to excellent communication and transportation facilities in Singapore to induce faster growth of its commercial activities including transforming itself into an important regional base for national and multi-national companies in the manufacturing, distributive, professional and other business" (Yassin, 1992)

However, the emergence of competing locations for development within the Johor State itself like the Gelang Patah City Centre, where the new Second crossing to Singapore is presently under construction and from the Island of Batam, Indonesia, south of Singapore has meant that more than ever, JB has to position itself strategically to fend off these competitors. Already there have been reports in the media that these locations are giving out incentives to attract investors. Cheap land, and even guaranteed approval of development projects within two months by the local authorities of the areas are loudly advertised. (Far Eastern Economic Review, Vol. 7, July, 1993). In our contexts of discussions, these locations will be the new 'London Docklands' to investors where profits and quick return of investment will be one of its main attractions.

This section will look at development control as being practiced by the Johor Bahru City Council, the problems it faces as manager of the system, the criticism of the system from the viewpoint of the submitting architects, and finally, a proposal for a management system to process applications for development under its jurisdiction.

4.4.2 Development Control Practice

Development control in the state of Johor follows a two-stage procedure based on the *one-stop agency* concept. It has been implemented since March, 1983. Before this, all applications were processed based on the 1971 Town Board Enactment (section IX), whereby Local Authorities are only required to provide 'advice for development' (Wahab, 1991). As such, these advices were not legally binding. The one-stop agency procedure was apparently introduced for the purpose of speeding up the process of getting appoval, whilst reducing speculative and uncertainty without heavy financial commitment (Sen, 1986).

The *first-stage* involve the applicant seeking 'in-principle' approval from the State authority related to *land matters* and involves the modification or issuance of new titles. The State Land and Mines Office acts as the co-ordinating body and it prepares a report and recomendation to the State Authority (Figure 4-6). The first stage 'in-principle' application expires 3 months after approval.

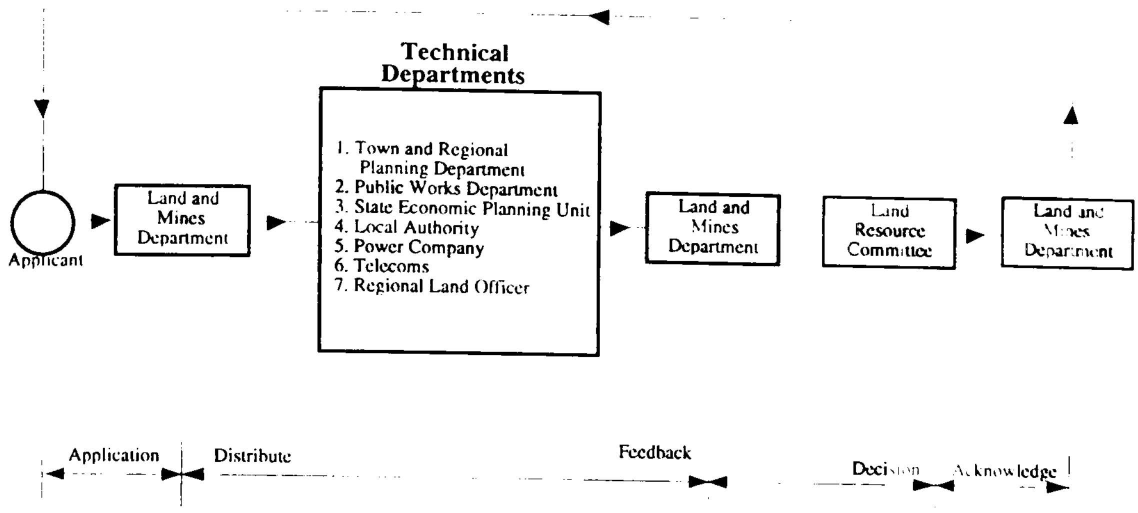


Figure 4-6 One-Stop Agency Procedure
First Stage - Land and Mines Department

The *second-stage* involves relevant approvals from the Local Authority related to *planning* and *building controls*. These involves the necessary approval for layout plan, and the Town Planning Department at the Local Authority acts as a co-ordinating body, as illustrated in Figure 4-7.

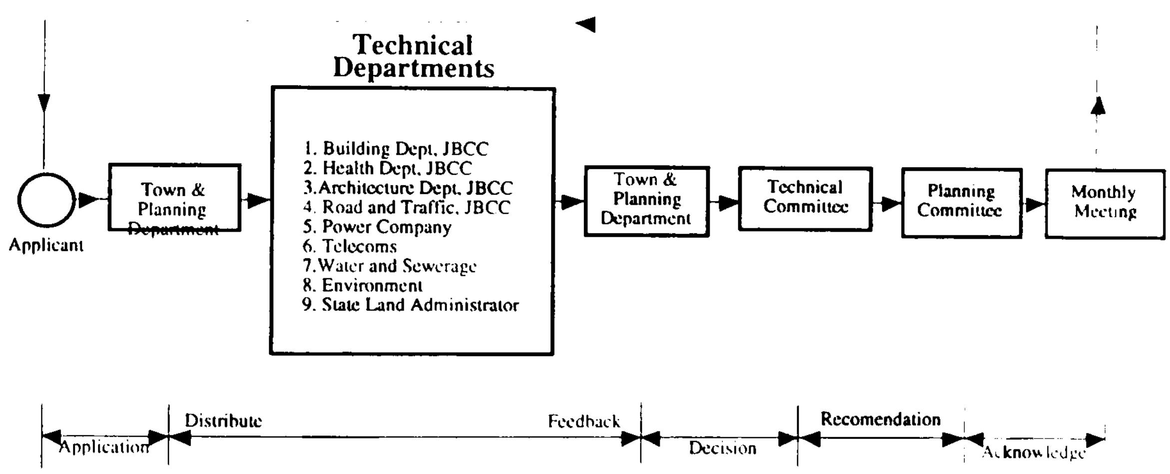


Figure 4-7 One-Stop Agency Procedure
Second Stage - Planning Permission Application

Planning permission granted under this second stage lapsed after 12 months. It is interesting to note that the JBCC regards the need for planning permission which involve the erection of a building limited to the following:

a) Commercial development exceeding 4 storey or 4 units;
b) Residential development exceeding 4 units;
c) Industrial development exceeding 4 units;
d) Recreation development ; and
e) Flatted industrial development.

In other cases, the planning control procedures are waived, but they are, however, subjected to building control co-ordinated by the Architecture Department (Figure 4-

8). This is despite the fact that they are within the scope of the definition of development under the Town and Country Planning Act (TCPA) 1976 and therefore must have planning permission.

As the bulk of the applications i.e approximately 65%, are for development outside the above categories, this implies that the bulk of development in Johor Bahru are not subjected to development control. Although this is done for pragmatic reasons, it calls into question the implementation of the TCPA in respect to development control.

The Town Planning Department at JBCC received a total of 470 applications in 1993, of which outright application for planning permission involving development control, totalling 168 or about 35.7% (Table 2). The rest or 302 are applications send by the Land and Mines Office (first-stage) and the Architectural Department for the purpose of seeking advice in the building control process.

Type	Residential	Commercial	Industry	Others	Total
Numbers	103	**13**	41	11	168
% of Total	61.3	**7.7**	24.4	6.6	100

Table 4-B: Applications Involving Development Control Procedures in 1993 - (Source JBCC)
(Note: Only 9 applications or 5.3% are within the City Centre area)

Only after getting approval from the Town Planning Department, can the applicant submit a detail proposal for building control purpose to the Architecture Section, as depicted in Figure 4-9.

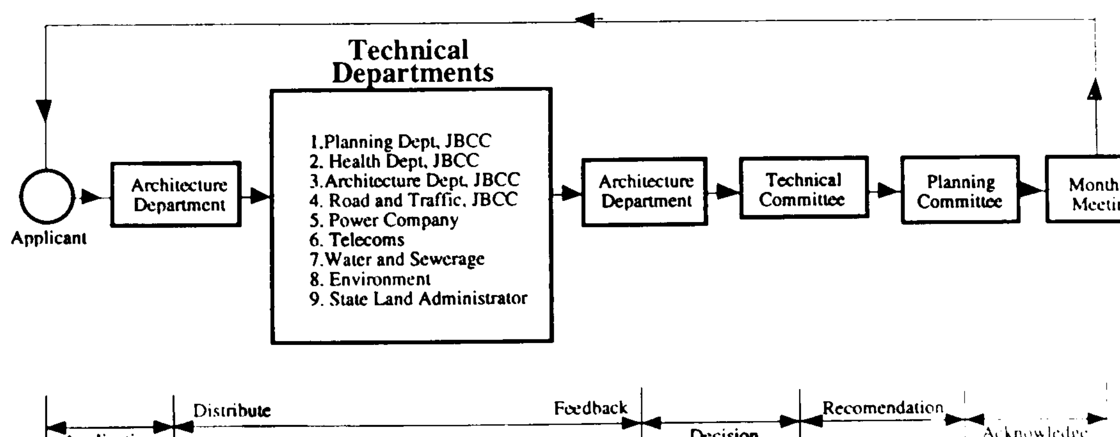


Figure 4-8 One Stop Agency Proedure
Second Stage - Building Control Procedure

The architectural section receives 819 applications to build new or for conversion purposes, of which 497 or 60.7% involves extension.

Type	Residential	Commerce	Industry	Others	Extension	Total
Numbers	154	**67**	65	36	497	819
% of Total	18.8	**8.2**	7.9	4.4	60.7	100

Table 4-C: Application Received by the Architecture Department in 1993 - (Source: JBCC)
(Note: Only 21 applications or 2.6 % are within the City Centre area)

It is interesting to note that of the total numbers of applications tabulated above, those involving the development in the City Centre is minimal; i.e 9 applications for planning permission, all involving commercial projects, and 21 application submitted for buiding control approvals.

4.4.3 Application Processing

Almost 95% of applications are submitted by hand, through the counter service provided at the City Council. The remainder, i.e 5% of applications are submitted via post. There is no definite legal time frame for the JBCC to come to a decision, although this must be done in the *best time possible*. Lately however, there has been effort by JBCC to set a 'time-limit' for all applications to be processed. For example, the Town Planning Department as the 'coordinating body' for the *second-stage* application, has limited the time taken for decision making in the planning permission stage to three months.

There is no specific method in processing planning applications. However we can categorise the whole process into three main stages, namely, *administrative* and *consultation stage*, *coordination stage*, and finally the *recommendation stage*, as depicted in Figures 4-9 and 4-10.

4.4.3.1 Administrative and Consultation Stage

Administrative work usually involves the *filing*, *advertising* and the *distribution* of applications for consultation. Consultations will be carried out with a number of consultees consisting of the technical departments within JBCC such as the Engineering and Architecture Department and organisations outside JBCC such as the Power Company. The objective of the consultation is to make sure that these departments and organisations with specialist knowledge and responsibilites for implementation of policies, are informed of the current proposals and their likely impact. These organisations are then needed to send in *feedbacks* in the form of *opinions* or *viewpoints* to be discussed at the Planning Committee.

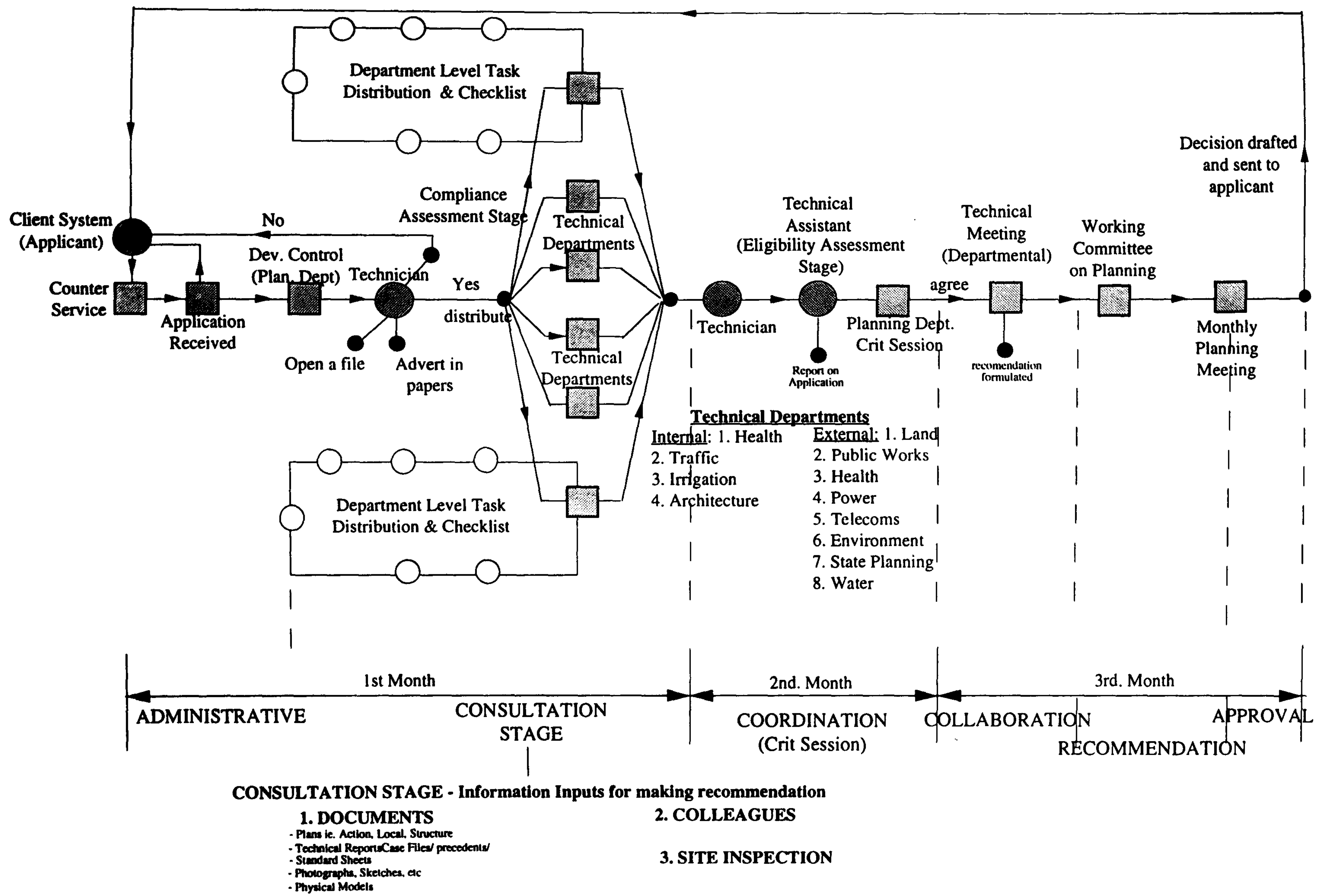


Figure 4- 9 Application File Path in the Planning Department

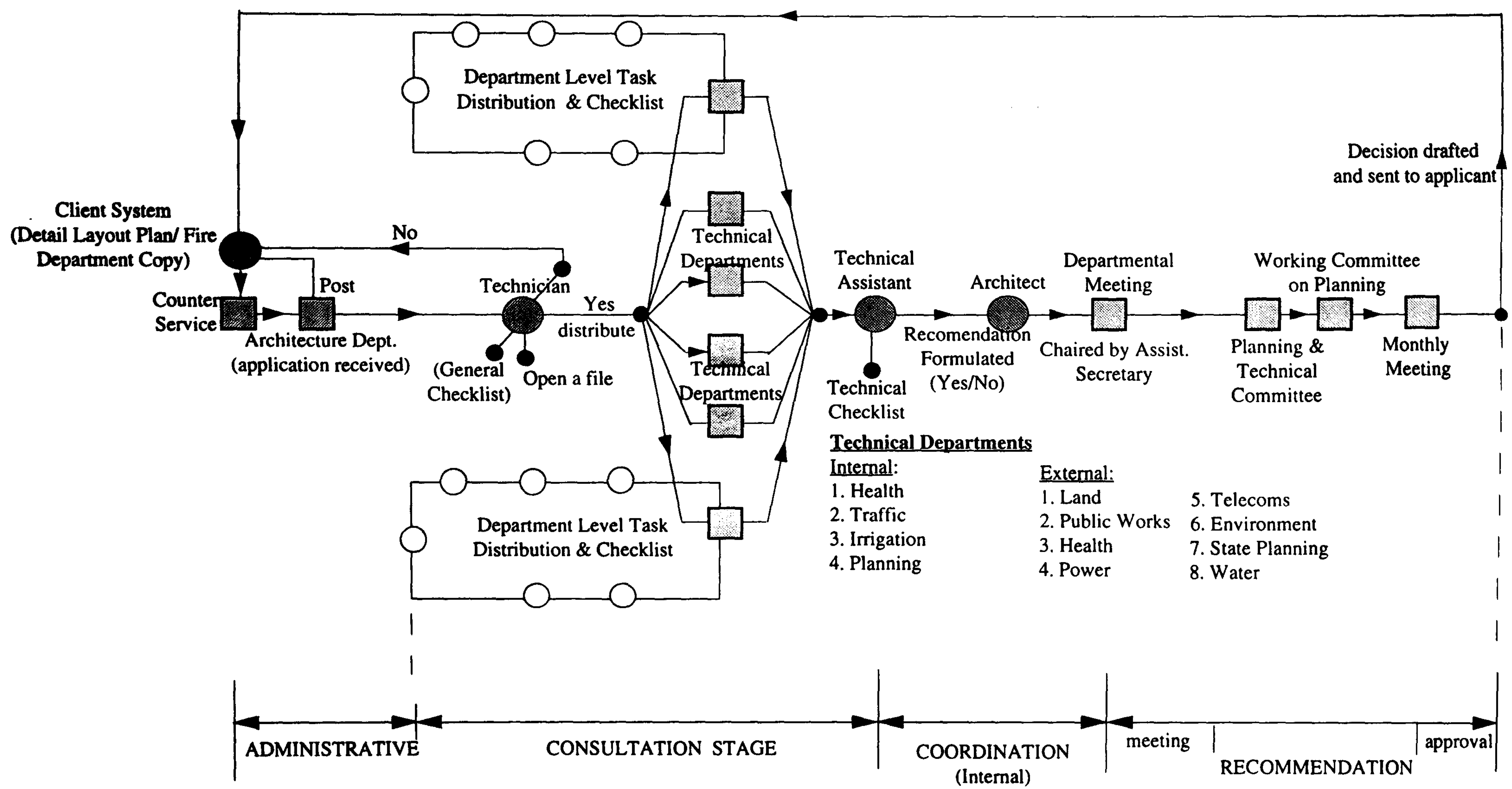


Figure 4 - 10 Application File Path for Building Approval

The person responsible inspecting applications, i.e processing, making consultations with other organisations, and finally formulating recommendations on the applications, are the *caseworkers* called *technicians* and *technical assistants*. As mentioned earlier, these are sub-professionals personnel. The *inspecting process* involves three main assessments, namely, assessment of *compliance*, assessment of *adequacy*, and assessment of *eligibility* (JBCC Internal Documents), (Figure 4-11).

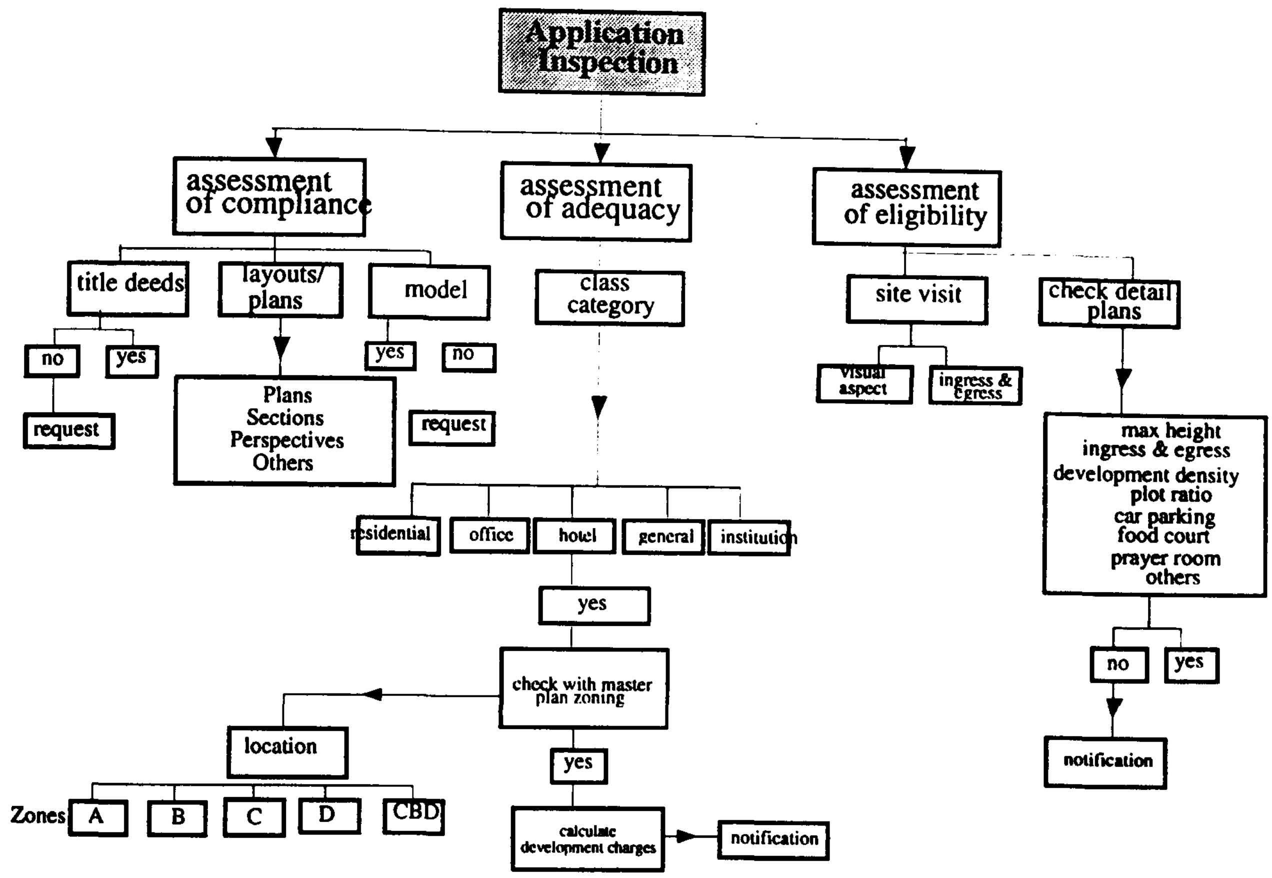


Figure 4-11 - The Inspection to Assess for Compliance, Adequecy, and Eligibility
(after JBCC)

During the initial stage of inspection i.e *compliance assessment*, the *technicians* responsible are required to follow a formal set of *checklist* requirement. These checklist include the availability of title deeds, and layout-plans. *Assessment of adequecy* includes checking the submissions (project's) adherence to the Master Plan, or other form of development plan blueprint. This second stage also requires the *technician* in charge to make assessment for planning gains, and subsequently the calculation for development charges. The third stage i.e *assessment of eligibility* involve 'subjective' assessment and the major source of guidance in making recomendations by the *technical assistants* are past records, site visits, and engaging in discussions with the applicant. These considerations include the assessment of plot-ratio, the height of building, and the suitability of the project on site.

In applications that involve major development, clients or submitting architects, may request for a discussion to be held before submitting. Topics raised during discussions with applicants during this initial stage includes matters regarding the compliance stage requirements, and clarification with the development zones requirements. Further discussions can be arranged between the two parties, and topics of discussions might involve clarification of points of details, and engagement in *negotiations on planning gains*, culminating in an amended applications.

4.4.3.1.1 Negotiations and Development Charges

As described above, one of the major issues often discussed during the initial stage in development control is that of *planning gains*. However the unique feature as practiced in Malaysia is based on the concept of development charges. *Development charges* are levied at a prescibed rate, in lieu of conforming to development plan and development control policies of the JBCC in the following cases:

a) development involving an excess over the floor area or the average residential density specified in the development plan;

b) development subject to condition requiring the provision of spaces for car parking ;

c) development involving change of land use which is not in conformity with the development plan ;

d) development involving change of density zoning.

The argument for the charges is that clients (developers) will increase the value of the land by not conforming to the development procedures and also the opportunity to compromise on the provisions stated. The theoretical underpinning here is that the social costs are being compensated and the role of the Local Authority is to mitigate the external effects by making good the provisions. However, these flexibilities in approach may have adverse outcomes when developers are more willing to pay rather than provide, and the Local Authority less capable of filling the gap in services.

4.4.3.2 'File-Chasers' and Decision Making

A 'peculiar' practice in processing development control applications in Malaysia, is the existence of 'file-chasers'. File-chasers are usually 'agents' (outside the City Council) hired by the client to follow up on the progress of a submission. The final decision on an application can only be formulated once all the different technical department has been consulted and give their opinions and viewpoints. As there can be up to 7000 active files handled by a department, this can contribute to delay in processing the application. The job of the file-chaser is to ensure that the client's casefile will receive the required attention (comments) by every technical department in the City Council, by 'physically' fowarding the casefile from one department to the other.

4.4.3.3 Coordination Stage and Recomendation Stage

The technical assistant is responsible for coordinating all the various opinions and viewpoints from the technical departments (both internal and external). Once all the feedback has been compiled, he will make a report for the consideration of the Chief Planner, who will subsequently, organise an informal departmental *crit-session* to deliberate on the *recommendations*. The Chief Planner is then responsible for bringing these recommendations to the attention of the Planning Committee who is the highest decision making body at JBCC. The decision of the Planning Committee can be either:

i) Permission granted
ii) Permission granted with conditions
iii) Refusal of permission with reasons.

It must be pointed out however, that the practice of *involving* and *discussing* with applicants during the pre-submission and initial stage of submission, is not something that happens often. This is because, once application has been submitted, JBCC is obliged to inform the applicants only after the outcome of their application has been decided by the Planning Committee. The '*uncertainty*' created by this procedure has encouraged the practice of clients appointing 'file-chasers' described earlier. Figure 4-9 and Figure 4-10, illustrates the file-path for the Planning Permission and Building Control Application at JBCC.

Chapter 5
Surveys and Interviews

Chapter 5

Surveys and Interviews

5.0 Introduction

This chapter will analyse the result of the interviews and discussions held by the author with the various parties involved in the development control process. The purpose of the surveys was to identify the issues, processes, knowledge, tasks, and people's relationships, among others, that will give the author a better understanding of the 'elements' that need to be considered in designing *a management system for development control* at JBCC. The hope is that the system will not just speed up the decision making process but also enhances it and ultimately improve Johor Bahru's overall urban system performance. A comprehensive summary of the surveys is enclosed in Appendix 3-A.

5.1 Methods Used

Refering to the concepts used in Chapter 3.5, participants for the survey were representing the following categories i.e from:

i. Managing System - the chief planner at JBCC who acts as the *coordinator.*

ii. Operating System - the *technical departments-* consisting of three levels in the organisation structure; firstly the head of department, secondly, the technicians who are responsible for making recomendations during the *compliance* and *adequecy assesment.*, and thirdly, the senior technical assistants who are responsible in making recomendations during the *assesment of eligibility* stage

iii. Client System - the *submitting architects* including three architects practising in Johor Bahru each with different 'experiences' of dealing with JBCC and have projects at different 'stages' of application. Two of them have projects in the City Centre area.

5.1.1 The Operating System

Meetings were conducted with the Town Planning Department (the co-ordinator), Architecture Department and Engineering Department within the JBCC, and the Power Company and the Telecoms Company representing the organisation outside JBCC. Persons interviewed include the chief planner, architect and chief engineer, or representative of the respective departments. The Planning and Architecture Department were also represented by their senior technical assistants involve in the assessment of eligibility, and technicians and clerks processing the compliance stage applications. Both the external organisation are represented by their technical officer.

5.1.2 The Client System

Meetings were conducted with three practicing architects with offices in Johor Bahru. They include:

i) Principal Architect of *HAJ Architect* - a mid-size practice with about 25 staff. His practice is currently working with JBCC to develop and construct a 19-storey office building in the City Centre. A former academicians, he has strong views on the problems and challenges facing Johor Bahru.

ii) Principal Architect - *IMAAR Architec*t - a mid-size practice of about 45 staff. His firm has been awarded to develop some of the public amenities facilities project under the jurisdiction of JBCC, such as town halls, markets, community centres, etc.

iii) Principal Architect - *Abdul Latiff Muzammil Architect (ALMA)* - a mid-size practice with about 30 staff. Doing projects mostly for private sector clients. Most of the firm's projects are at the inception stage and a few are waiting for JBCC and other related authorities approvals. He is also one of the few architects practising in JB who has an academic degree in urban design.

During these meetings, participants were requested to select a specific planning application to discuss eg. a specific building type that they are familiar with, especially in the City Centre. The session began by asking the participants to describe his or her background, previous experiences, current position, responsibilities and duties. All questions were asked in an 'open-ended' mannner. Participants were encouraged to cite and recall examples from other previous applications. Related departmental documents, case-files, reports, meeting minutes, manuals, and checklists, were frequently refered to. Sessions were audio taped with the consent of the participants, giving them assurances that the discussion within each session would remain confidential.

5.2 Major Findings

5.2.1 Summary

As a summary, there were two critical issues that have persistently emerged during the discussions, firstly *procedural* and secondly *decision making*. In both these issues the topic of *delay* and *uncertainty* respectively, were the two main points of concern. Further investigations revealed that these findings were not unique to Johor Bahru, and somewhat a reflection of other Local Authorities in the country.

5.2.1.1 Procedural

Procedural wise, *delay in control* was the major concern of all parties. The adoption of the *one-stop* agency procedure by the State Authority and JBCC had somewhat reduced the time taken to process applications. For example, in a survey done by the Johor State Government, the first stage process now takes 2.5 months, whilst the second stage takes 12.5 months (PTG, Johor, 1983). In another study by the Federal Town and Country Planning (1987), on the conversion and subdivision of housing land, the average time taken in coming to a decision after the adoption of the one-stop agency procedures in Johor Bahru is 11 months against an average of 3 years previously (Table: 5-5). However, this is still inadequate, as the practice is fraught with unreasonable delays due to complexity at the consultation process, and the lack of proper dissemination of information on planning procedures and requirement (Sen, 1986).

State/District	**Shortest** (months)	**Longest** (months)	**Average** (months)
Johor Bahru	5.5 (12.5)	18.5 (59.5)	11.0 (36.0)
Other District	5.0 (13.0)	27.0 (108.0)	7.5-21.0(39.0-76.0)

Table: 5-5 - Actual Time Taken for Conversion and Subdivision of Housing Land in the State of Johor
(Source : Federal Town and Country Planning Department, 1987)

Note: Approvals before the 'one-stop' agency process were adopted are in brackets. Data is based on 50 sample size per district for the period of applications/decisions 1970-1985.

The pressure asserted to reduce the time further by both applicants (clients) and the Federal Government on Local Authoritiues lately, has somewhat put the issue of delay, back on the agenda. Local Authorities are now required to prepare a 'citizen charter', that spells out among others, the time that it promised to arrive and inform the client of the outcome of the applications.

5.2.1.1 Decision Making

The *discretionary* and *overlapping* nature of the control systems, have made decision making one of the most prominent issues. Decisions are being made by different people and committees, and at different levels and stages; a reflection of the ineffeciency of existing hierarchical organisation structure practiced in Local Authorities. Development control decisions, are seen almost entirely from the viewpoint of control-officers, and councillors, and little effort is being made to understand the client (applicants) requirements. References used as a basis for interpretation in control, provides avenues for conflicting judgements and considerations. Consequently, *the process can be as uncertain as the outcome.*

There was also no attempt to make this decision making process more transparent in nature. It was also clear that much of the frustration for all parties, stemmed from the lack of communication, especially the failure to engage the client in the process at the right level and at the right time. Similarly, trust and cooperation was also lacking and needs to be built up on both sides. Since the process can be costly to both the client and JBCC, the need to reduce uncertainties, and therefore 'cost' due to the length of time taken to make decisions have more than ever been demanded. In fact there has even been a call for the development control process to be *privatised* in order to increase efficiency in the system (Berita Arkitek, October, 1995).

5.3 Empirical Findings

5.3.1 The Coordinator and Technical Departments

5.3.1.1 Main Issues

i. Delay and Timing

The majority of those interviewed stated that the reason for *delay* is mostly due to the client system's fault in not adhering to submitting procedures. They however do not think that these procedures are too stringent to follow. Internally, each department now has a 'time-frame' guideline in processing applications. However most agreed that it is difficult to be imposed as it is too general and there is 'no authoritative body to ensure that the guideline is adhere to'.

Three other reasons for delays in the processing and approvals of plans were highlighted, namely:

a) verifications by JBCC on technical requirements.

b) calculations of financial contributions and various charges by JBCC

c) re-checking of the requirements after plans are returned to JBCC (subsequent stage).

Late in receiving *feedback* from the various technical departments during the *consultation stage*, especially from those organisations 'outside' the control of JBCC such as the Power Company, was also mentioned. When approached, most of these organisations however, do not see the need to have a special section (or task force) to deal with issues relating to development control (foward planning). The Power Company spokesman when interviewed even iterated that "they are in the business of providing power supply not approving plans".

Another reason cited was the number of *active files*. The Architecture Department for example, highlighted that eventhough they received 819 applications for building control purposes in 1993 alone, there are infact currently, approximately 7000 active files to be managed at any one time. These files are for ***new development*** ranging from bungalow to multi-million commercial projects (about 15%), ***renovation work*** (55%), ***temporary approval*** eg. temporary structure such as site office (10%), and commencement of ***old projects*** (20%). They welcome any system devised to enhance the management of the existing filing system.

ii. Uncertainty and Transparency in Decision Making

When the issues related to transparency in decision making was brough up, all those questioned were rather 'evasive' in their reply. Reluctantly, everyone agreed that the current methods were being scrutinised now more than ever, and that the process has to be made more *open* in the near future. This was summed up by the following statement from a techical assistant:

> "It is not something that we will look foward to. It is like having somebody over looking your shoulder all the time when you work. (a parrot). Decision making like design is rather personal"

Nonetheless, most of them want a limit as to how 'open' the process should be. They were rather 'cautious' to the idea of involving clients (participation) in decision making. Infact two stressed that they do not mind the present 'file-chaser' system, since "it shows that the client really wants to develop his building".

One control-officer cited the lack of a clear blueprint as a guiding principle for development control especially in the City Centre Area. The present method of using structure plans to guide development, is too vague and at times creates *uncertainty*. Everyone agreed with the urgent need to prepare a Local-Plan especially of the City Centre but was hindered by the lack of professional staff to help them.

The senior technical assistant at the Architecture Department also cited the problem of *overlapping* during processing of application. Subsequently, he proposed that the building control approval process should be done *concurrently* during the planning permission approval process. This is because, clients normally submit a detail building layout plan during planning permission application stage and that the architecture department was already consulted during this stage.

iii. Feedback and Control in Development

A majority of those interviewed felt that it is difficult to control the numbers of developments due to external factors such as the state of the economy, and the political environment. Even though they had approved some of the projects as early as 1980, it was very difficult to determine when or if these projects will ever be constructed. One example given was that a total of 8000 units of high-quality condominiums units were approved during the 1990-93 period. However, up to December 1995, only 1200 units have been built. One even suggested that the JBCC should stop processing and approving any more new application for this type of development until all the projects that received development orders have make good their approvals.

One cited the presence of 'property speculators' as the main reason for not being able to do an accurate feedback study. Organisationally, they do have a section called "Planning Enforcement" (Figure 4-3) set up to do specific works involving enforcement and to some extend feedback. However, the section is not in operation because they have not been successful in attracting 'qualified and talented staff' to run it.

There was an overwhelming support to the idea of using *model* as the 'technical heart' for feedback studies and for visual simulation to give an overall picture, as an immediate and long term solution. It will also allow them to do comprehensive 'test studies' rather than the present methods which one decribed as 'piece meal' and 'ad-hoc' basis.

5.3.1.2 Other Issues

i. *JBCC Need to Provide Leadership and Focus*

The need to focus JB's development, with respect to the competition coming from its competitors, such as the development of the new city of Gelang Patah, west of Johor Bahru, from the Island of Batam Indonesia located south of Singapore, and from Singapore itself. Related to this problem is the frustration, often voiced by everyone that there was no concerted effort to redefine the role of JB. The success of JB's City Centre area is seen as the most critical. The disadvantage is the *polarisation* of its role.

Organisationally, this *focus* will help all departments to do some foward planning, to guide its effort in helping to build a better JB. Both the architect and planner suggested that JBCC should take the initiative in providing *leadership* to developing Johor Bahru. Currently, they felt that JBCC is only playing a 'reactive' role and should instead be more 'intentional' and 'proactive' in its approach to developing Johor Bahru.

ii. *Innovative Organisation Structure and Ownership in Decision Making*

Three of those interviewed felt that the *hierarchical organisation structure* adopted by JBCC is not flexible enough and consequently does not prepare them to response to changing demands. This is because decision are made at the Planning Committee levels and are not *delegated*, resulting in the lack of '*ownership*' to the decisions made. Consequently, any new proposal for developments were perceived as 'adding to their already existing 7000 *active files*' Significantly important was the suggestions that client need to be respected and seen and accepted as *partners* in development. Moreover, with new '*incentives*' given by JB's neighbouring cities competing for investments, clients are running away.

These 'competitors' are usually unburdened by, for example, the social costs and other problems like traffic congestion, or lack of urban spaces for recreation. They can start from 'a clean sheet of paper' and as such can be more reponsive to the changing needs. As a result, there are 'less' stringent rule for development.

iii. *Structure Plan being too Rigid*

"It should never have been gazetted" was two of the reactions. With the current rate of development of JB, they suggested that it was very difficult to plan more than two or three years in advance. Since the recomendations in the structure plan is *statutory*, there was no room for 'creative decision making'. Instead they suggested that the strcture plan should be treated as a Council 'policy guideline'. For example, in the last structure plan of 1985, it was forecasted (and gazetted), that future development will take place in the east-side of Johor Bahru, i.e an area close to the city's Port in Pasir Gudang. However this did not materialise, and development had instead focused on the west-side of JB which is in line with the devlopment of the second causeway.

iv. *Information Technology (IT) as a Tool to Aid and Enhance Decision Making*

The notion of using IT as a tool to aid decision making, receive a cautious response. A majority felt that decision making is still a 'personal communication' between two parties. They, however, felt that the current methods used especially during consultation stage, do not allow and encourage them to collaborate and communicate among themselves and especially with the client.

5.3.2 The Submitting Architects

5.3.2.1 Main Issues

i. Unpredictablity in Development Control Process

The single most critical issue to emerge from the interviews was the need to make the development control procedure more *predictable*. Two suggestions was for the JBCC to establish a *centre* where all information related to development made easily accessible to all end-users of the city, i.e. developers, consultants, inhabitants, even visitors. An architect even commented that the current procedure was like 'playing a Snake and Ladder game'. Related to this problem was the unavability of Local Plan to refer to, and therefore made it difficult for clients and architects to make concrete proposals.

The uncertainty has also resulted in the emergence of a new category of '*approval agents*', offering their services to obtain approvals from the relevant authorities for the desired change of land-use, increase in development densities, reduced car parking requirements, and other planning gains issues. This is to the distinct disadvantage of bona fide consultants who are 'impotent' in advising their clients on these matters, while the new 'approval agents' can, in some cases even guarantee the outcome of a submission.

Detailed control plans (eg. Local Plans) therefore, should be made available over the counter at local authorities, to overcome abuses of the system. This lack of transparency, not only discredits the entire development control procedure, but also compels practitioners to enter blind-folded into a labyrinth of impervious walls with many hidden dead-ends and traps, to secure the desired Planning Approval.

One highlighted his experience when, after waiting for almost six months since submitting, was told by JBCC that his "plans was lost". He was then required to submit a replacement set incurring loss of time and additional costs. "Sometimes it is faster to build than to get approval" he asserted.

ii. Excruciatingly Slow and Uncertain Procedures

Current procedures has become incredibly complex, ad-hoc, vague and repeatedly variable. The requirement to enclosed excessive detail at too early a stage (i.e during planning approval stage), when general acceptability of proposal has still to be established, is a gross waste of time and effort. The need for an *Approval Centre* that encompasses the function of both the first-stage and second-stage 'one-stop' approval process currently practiced, was again highlighted. The architects also voiced the opinion that the centre can help increase productivity and make better use of limited human resources.

It was clear for the need to have easier access to the decision making person, especially during the initial stage of the process. Subsequently, they would like to be informed of the application's status *progessively*, rather than at the *end* of application process, which can be time consuming. However all agreed for the need to device a *transparent procedure* and a *communication channel* to transmit queries that need to be answered (feedback) during processing. Some of the issues raised as reasons for delays can be overcome easily if such a 'procedure' and a 'communication channel' was established, for example, in getting clarification on vital issues that are related to the project.

On the three 'technical requirement' given by JBCC as reasons for delay in processing applications, one raised the issue of *professional trust*. The argument is that if JBCC were to *trust* the datas and information as stated on their applications and accept it 'face-value', then decision making can easily be speeded up. After all, the same datas were provided and checked at every stage, i.e development control, building control, and during the Certificate of Fitness (CF) application.

5.3.2.2 Other Issues

i. *Unsystematic Land-Use Approval Procedures.*

Since land is under the jurisdiction of the State information related to land matters are not 'accessible' to JBCC. The unavailabity of these information makes it difficult to propose specific types of development. A rather cynical view was fowarded in that in many cases, the State was only interested to know the monetary returns that a development has to offer, eventhough the development proposed is against the guidelines set out by the structure plan. One person has sympathy with JBCC because the power to implement the structure plan is beyond their control.

ii. *Structure Plan System being too Vague*

This point was again highlighted by those interviewed. The unavailability of a detail blueprint to guide development, has resulted in an environment of uncertainty, leading to widespread speculation and encouraging malpractice. The lack of data necessary for the foward planning of infrastructure services was also also raised.

iii. *Difficulty in Fowarding 'Innovative' Solutions*

The unrealistic requirements made by JBCC had prevented the development of *innovative solutions*. All of them felt that this may also be due to the lack of key personnel in local authority. As before, two architects suggested that the present hierarchical organisation structure, does not encourage innovative solutions to be considered. Moreover, all the *power to make decision*, has been delegated to the Planning Committee, instead of the control-officer. This was made worst when they have to deal with too many authorities with varying requirements. The proposal for the *approval centre* that co-ordinate and manage all matters related to their applications was once again suggested. This will also overcome the problem of them having to employ 'file-chasers'. The issue of 'privatisation' was also proposed to increase efficiency.

iv. *New Guidelines Being 'Invented'*

It seems that there are always a 'new' Uniform Building Bye-Law (UBBL) requirements that submitting architects need to fullfill, which sometimes "caught them by surprise". It is recomended that all Guidelines and other documents used by processing personnel should be made available (printed out) for public information which will be in the interest of both the Authority and submitting persons.

v. *Authority Without Responsibility*

One raised a fundamental issue of accountability of Local Authorities in Malaysia in general, what he termed as *authority without responsibility*. Although authority has been vested in the Local Authorities, this is without any responsibility. He quoted the Building Act 1975, which expressly exempt Local Authorities from any responsibility. The 1975 Act section 95 (2) provides:

> *"The state Authority, local authority and any public officer or officer or employee of the local authority shall not be the subject of any action, claim, liabilities of demand whatsoever arising out of any building or other works carried out in accordance with the provisions of this Act or any by-laws made thereunder or by reason of the fact that such building works or the plans thereof are subject to inspection and approval by the State Authority, local authority.....and nothing in this Act or by-laws made thereunder shall make it obligatory for the State Authority or the local authority to inspect any building.........to ascertain that the provisions of this Act .....are complied with or that plans, certificates and notices submitted to him are accurate. "*

"If the country is serious in making our Local Authorities to be more accountable in the near future, maybe its time that we start reviewing this Act" he iterated.

Chapter 6
Cooperating Experts and Distributed Systems

Chapter 6

Cooperating Experts and Distributed Systems

6.0 Introduction

"All real systems are distributed" (Hayes-Roth, 1981, p.61)

Previous chapters identified *integration in decision making* as the main aim for the project manager, especially in a multi-disciplinary environment like development control. The task of integration is made more difficult because of the differences of opinions, goals, and objectives of individual problem solvers leading to conflicts. Accordingly, the success of a project depends on the ability of the project manager to handle these *conflicts*. It is also determined by the 'position' and 'authority' of the integrator within the organisational structure. We have seen in chapater 3, that this can range from a *liaison* position, to a *coordinator*, to an *executive project manager*, with each position providing a stronger integration capability than the last.

The authority of the planning department at the Johor Bahru City Council (JBCC), as defined in chapter 4, is one of a *coordinator*. Besides being responsible for receiving, distributing and coordinating all applications, the department is also a member of the *operating systems* required to make technical inputs. The consequences of these dual role has created a conflict of interest and weakened the planning department's position to exercise objectivity in decision making. Moreover as a coordinator, the planning department can only exercise its authority over the decision making process, and *not* over the actual decision makers themselves (Thomson, 1967; Walker, 1984)

We therefore suggested an independent and seperate entity consisting of a *managing system,* headed by an executive approval manager with the responsibility and authority of an *executive* project manager. Besides being the *sole formal point of reference* between the *client system* and *operating system*, the manager is responsible for managing and controlling all activities related to the process of decision making in development control. A communication channel to support the client systems participation will be established. The manager is also given the tasks to maintain, update, and enhance the overall systems performance using models.

Since problems in development control are a combination of systematic and ill-structured ones, we have concluded in previous chapters that the decision making process demands a dual approach. Solving systematic and routine problems, such as the time limit to process an application, requires resource scheduling (Allinson, 1993; Kerzner, 1984). 'Ill-structured' (Simon, 1973) and 'wicked' problems (Rittell and Webber, 1973) on the other hand, require judgement and innovative solutions. We therefore proposed that project and group integration can be achieved by using two methods, firstly *planning* and *schedules* to support routine procedures, and secondly through *organisation design* based on *project teams* using *mutual adjustments* to support innovation in decision making.

The project manager uses planning and schedules to ensure integration for sequential interdependency. He does this by designing a *plan* that outlines the activities (and sub-activities) of the various participants and distributes the plan for consultation. Distribution is necessary because the problem to be solved is complex and requires the cooperation and opinions from the various technical departments. Each of these departments has the *distinct* and *related* expert knowledge to make *assessments* and solve a part of problem, and none of them have the ability (and knowledge) to solve the problem *as a whole*. Such cooperative work is needed because of the interdependencies between participants actions. For example, the planning department's consideration for an application to increase the plot ratio for a development, is usually conditional (and dependent) on the traffic department's expert opinions. This is because the increase in plot ratio will contribute to an increase numbers of car park and therefore traffic on the site.

The consequences of these differences of opinion is that participants in a project team environment need to *iteratively negotiate, compromise* and *make adjustments* before a final plan and decision can be agreed. Negotiation is necessary for example, to reach agreement on a common master-plan (time, resources, etc), to be used as a basis for project execution and control. Negotiation is also important to get consensus for example, on the *conditions* for planning approval among the technical departments, and also to reach *agreement* on issues such as planning gains with the clients.

The result of the negotiation is a binding agreement i.e. a *contract* between two parties, that will outline among other things the *responsiblities* and *commitments* of each party. The contract, for example, will stipulate the agreed schedule and time for the completion of application (project) processing. Consequently, the project manager can use the contract as a basis to manage the cooperation among the various participants.

It is therefore fair to conclude that all activities that involve more than one participant require the following:

i) some way of dividing activities among the different participants.

ii) some way of managing the interdependencies among the the different activities (March and Simon (1968); Lawrence and Lorsch (1967).

As a summary, we propose to use the concept of project management for managing the application process for two main reasons, firstly to *organise* (plan) and *distribute* (subdivide) the work (applications), and secondly to *control* and *integrate* the various co-operations among the participants. To formalise and make explicit the act of cooperation, we suggest the use of contracts. Project management is vital to ensure that all contracts are executed (completed) on time, utilising available resources.

In designing a management system for development control, we will now turn our attention to the field of computer science. In particular, we will analyse the ways computer science deals with the issues related to the decision making processs described above namely *planning, distribution*, *cooperation*, *negotiation, communication*, and *coordination* i.e. a new field classified as Distributed Artificial Intelligence (DAI).

6.0.1 Artificial Intelligence (AI) and Distributed Arificial Intelligence (DAI)

A subfield of Artificial Intelligence, generally, DAI aims to construct systems of intelligent entities that interact productively with one another. If the main aim of project management is to achieve project *integration*, DAI is concerned with studying a broad range of issues related to the *distribution* and *coordination* of knowledge and actions in environments involving multiple entities (Bond and Gasser, 1988). These entities, called *agents*, can be viewed collectively as a society (Gasser, 1991; Hayes-Roth, 1981; Huhns, 1987). Agents collaborate and communicate to achieve their own goals, as well as the goal of the society as a whole (Werner, 1989).

6.0.2 Agents - some definitions

With names like softbot (Kautz, et. al, 1994), knowbot (Rennie, J, 1996), and intelligence interface (Ricken, 1994), the research on agents has generated much interest lately. Ricken (1994) summarises that this explosion is basically:

> "...to develop software systems which *engage* and *help* all types of end users to perform routine personal tasks, including hiding the complexity of difficult tasks, on the user's behalf" (p.4)

Perhaps, McGregor (1992) research on *prescient agents* best describe the current thinking when he compares the design of past systems which have been largely *passive*, with new systems which are becoming more *participative*. Instead of having systems which acts as mere *slave* that do only precisely what they are told, new systems will participate more like clerks or secretaries to the users. According to him, agents can improve the productivity of both individuals and groups by leading them towards :

> ".....interfaces that monitor actions and anticipate needs, automatically reconfiguring themselves to facilitate future actions " (p. 228)

The metaphor used is that of a personal assistant who is collaborating with the user in the same work environment. The assistant becomes gradually more effective as it learns the users interests, habits, and preferences. Relating to our problem, agents for example, can assist the project manager to manage and ensure that the conditions of a contract are adhere to.

A related definition is provided by Rennie (1996), when he defines an agent on the Internet as:

> " a software that serves as an electronic secretary and native guide in cyberspace. Knowing your habits and wishes, it would act without explicit instructions to organise data, hunt for information, protect confidential information and disable viruses that infect your computer" (p. 7)

Refering to Smith and Davis (1983) reseach on DAI, Branski and Bridges (1993) explain that the role of agents will take different forms, including:

"...assist(ing) the players in carrying out tasks,....(by) simply aiding the players in decomposing the tasks into one or more sub-tasks" (p. 226)

Taking their cue from Artificial Intelligence studies, Rich and Knight (1992) see agents being either *collective* (eg. corporations) or *individuals* (eg, people). Agents have a number of properties, one of which is belief, which they often ascribe to other agents in order to facilitate communication (Werner, 1989). We will look at this concept later in section 6.2.3.1.

6.0.3 Agents and DAI

For many years, research in AI has been mostly oriented towards single agent environments (Bond and Gasser, 1988), to support people's individual and isolated tasks (Greenberg, 1991). This approach has been proven insufficient due to the inevitable presence of a number of agents in the real world (Smith and Davis, 1981, Decker, 1987, Gasser and Huhns, 1989). Moreover, it is also now clear that many classes of complex problem cannot be solved in isolation (Chaib-Draa and Moulin, 1992).

Most of the work done in the area of DAI has been aimed at sensory networks such as air-traffic control or robotics systems (Cammarata et al, 1983, Davis, 1982, Fehling, 1983, Durfee, et. al, 1987). The main reason is that these applications necessitate a distributed interpretation and distributed planning by means of different intelligent sensors. For example, in air-traffic control, a plan for guiding an aircraft must be coordinated with the *plans* of nearby aircraft to avoid collisons (Cammarata et al, 1983). Therefore, the best way to eliminate imprecision and uncertainty, is to engage in cooperation with the neighbouring groups of sensors to evaluate and to interprete the available data.

Other researchers have also investigated the application of DAI techniques to, for example, cooperation between experts systems in engineering (Bond, 1989) computer supported cooperative work (Malone,1990; Gronbaek et al, 1993), electricity distribution (Jennings, 1996), and collaborative planning system (Schiffer, 1993). Most of this research discusses many important concepts such as ***negotiation*** (Davis and Smith, 1983, Sathi and Fox 1989), ***commitment*** (Gasser, 1991), *cooperation* and *distribution* (Decker, 1987), *coherence* (Gasser, 1991, Durfee, et al 1987), *coordination* (Malone, et. al, 1994), *understanding* other agents (Robertson, et. al, 1990) and *intentions* (Jennings, 1993 and 1996) among others.

This chapter will try to outline the issues currently relevant to DAI research. It must be pointed out however, that it is not an attempt to provide a comprehensive and complete taxonomy on DAI research but seeks to address the issues relevant to the thesis, namely the *distribution*, *coordination* and *behaviour* of agents to support group decision making. Those who wish to have a complete taxonomy, should refer to work by Smith and Davis (1981), Decker (1987) and more recently Chaib-Draa and Moulin (1992) among others.

In our attempt to integrate DAI techniques to the management systems for development control, this chapter will present two main research topics on current DAI fields (Figure 6-1);

i) firstly, *distributed problem solving* (DPS), in particular those which deals with *problem decomposition* and assigning agents to tasks such as those promoted by Smith and Davis (1981).

ii) secondly, *multi-agent systems* (MAS), in particular those which deal with the *social systems* of autonomous and heterogeneous agents such as those promoted by Chaib-Draa (1992) and Werner (1989), and group behaviour by Malone (1990) and Watson et al, (1994).

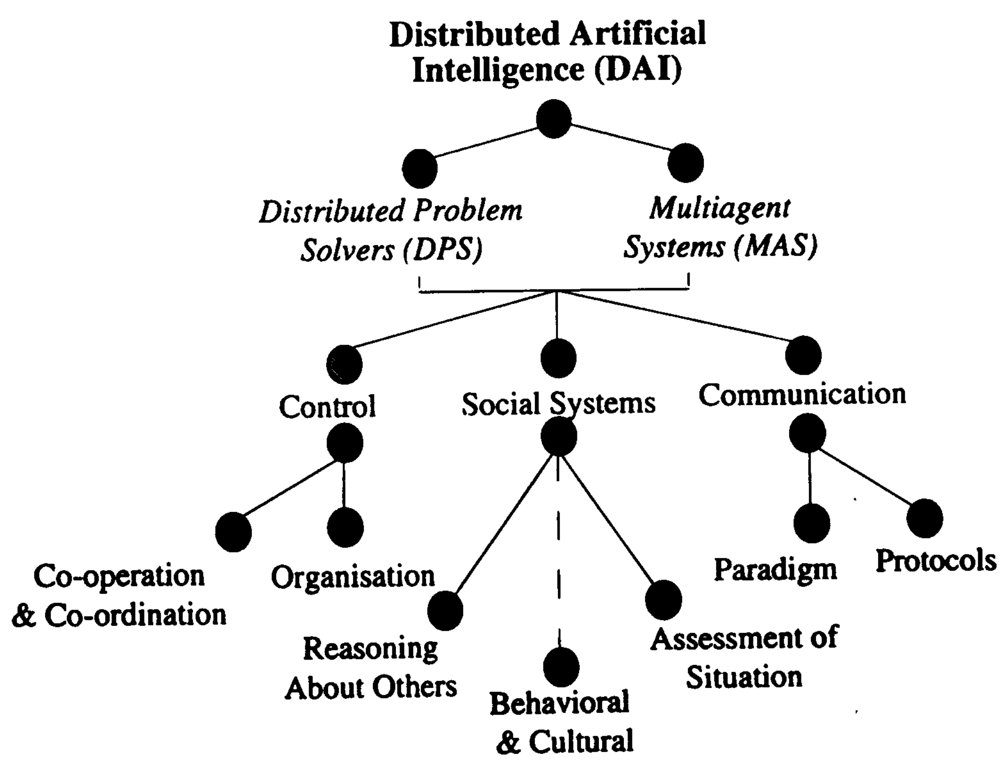


Figure 6-1 Main Research Components on Distributed Artificial Intelligence
(after Decker (1987) and Chaib-Draa and Moulin (1992))

6.1 A Framework for Distributed Artificial Intelligence

6.1.1 Distributed Problem Solving (DPS)

Early DPS work concentrated on applying the concept of *networked systems* to a problem as exemplified by a three-phase nomenclature in Figure 6-2 (Smith and Davis 1981).

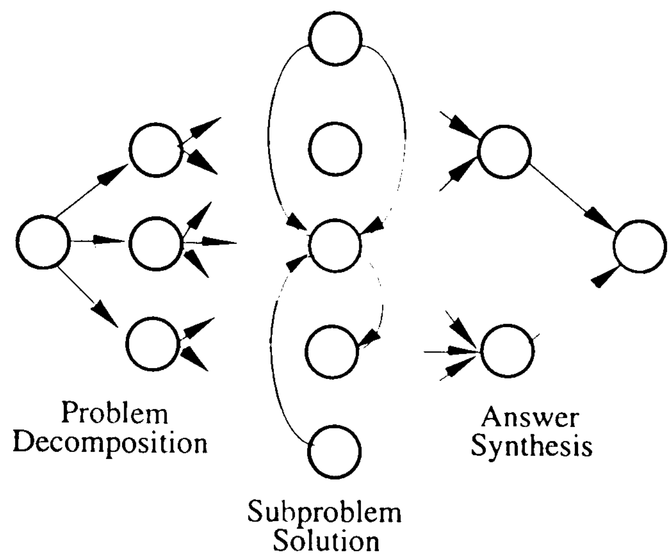


Figure 6-2 Phases of Distributed Problem Solving
(after Smith and Davis, 1981)

In the first phase, the problem is *decomposed* into *subproblems*. The decompostion process may involve a hierarchy of partitions. The second phase involves solving the *kernel problems* through agents that communicate and cooperate as needed. Finally, the results are *coordinated* to produce an overall solution. In summary, all DPS work emphasises the *problem* and how to get multiple intelligent entities (eg. programmed computers) to work together to solve it in an efficient manner (Durfee and Rosenchein, 1994).

6.1.2 Multi-agent Systems (MAS)

In MAS, the agents are *autonomous* i.e. acting independently, and typically *heterogeneous* i.e. diverse in character, (Riecken, 1994; Werner, 1989). Research here is concerned with coordinating intelligent *behaviour* among a collection of agents i.e., how these agents coordinate their knowledge, goals, skills, and plans to take action and to solve a problem. In this environment, the agents may be working toward *a single global goal* or toward *separate individual goals that interact.* Like solvers in DPS, agents in MAS might share knowledge about tasks and partial works. Unlike DPS work, where the emphasis is on the problem, MAS focusses on the agent and its *characteristics* in multi-agent environments. The process of *coordination* is also central to multi-agent systems; without it, the benefits of interaction vanish, and the behaviour of the group of agents may become chaotic (Malone and Crowston, 1994).

6.2 Control, Communication and Social Systems

We have further divided the the topics of DAI into three main issues that such architecture addresses i) how *control is distributed* among agents ii) how agents *communicate* with one another, and iii) how agents *behave* and *assess* a distributed situation (Figure 6-1). For each issue, the relevant questions and choices are first examined, and the theory (or theories) behind them is/are briefly summarised. Examples related to the development control process will be given as appropriate.

6.2.1 Control

The control of a distributed system can vary along two dimensions. The first is the *organisation* of agents, given that they cooperate to some degree, and the second dimension relates to the amount of *cooperation* between agents and the amount of *coordination* needed.

6.2.1.1 Organisation

Two views on organisation are promoted namely, structured and less structured. The *structured* view of organisation is similar to the definitions we have fowarded in Chapter 2, by authors such as Drucker's (1988) and Young's (1989b). Relating to these definitions, we can conclude that an organisation in our context can consists of the following:

i. a group of agents.
ii. a set of activities performed by the agents
iii. a set of connections among the agents (interdependencies and formal structure)
iv. a set of objectives (goals) or evaluation criteria by which the combined activities of the agents are evaluated

For the project manager, the main aim of organising is to (Malone, 1990)

i. establish (either explicitly or implicitly) the goals for the organisation. Here the goals can, for example be to achieve an agreement on the completion time for processing application.

ii. segment the goals into seperate activities to be performed by different agents. This may involve dividing the activities along departmental (specialist) lines.

iii. connect (synthesis) the different agents and activities so the overall goals are achieved according to the contract (agreement).

Relating to a multi-agent environment, a *structure* can be defined as;

> "the pattern of information and control relationships that exist between agents, and the distribution of problem solving capabilities among them" (Chai-Draa and Moulin, p.43)

So in cooperative distributed problem solving like the development control process for example, a structure gives each agent a high-level view of how the group solves the problems and the role that each agent plays within the structure (Fox, 1981). Within this view, Corkill (1983) has proposed that agents must meet the three conditions that are essential to successful problem solving, namely *coverage*, *connectivity,* and *capability* .

To ensure the coverage, the structure could assign *roles* to agents according to their competences and knowledge of a given subproblem. The structure must then also indicate the *connectivity* information to the agents so that they can distribute subproblems to competent agents. This connectivity information should also allow agents with overlapping *capabilities* to avoid duplication of effort when solving the same problem.

Gasser (1986) however, took an opposite view from Corkill (1983), in that he sees an organisation for DAI as being *less structured.* Indeed, he views an organisation as :

> " a particular set of settled and unsettled questions about *beliefs* and *actions* through which agents view other agents. Organisational change means opening and/or settling some different set of questions in a different way, giving individual agents new problems to solve and...a different base of assumptions about the beliefs and actions of other agents" (p.207).

Clearly here, organisation has been viewed as embeded in the beliefs, intentions, and commitments of the agents themselves. In other words, an organisation is defined as a set of agents with *mutual beliefs, joint intentions* (Jennings, 1996), and eventually *mutual* and *global commitments* where these agents act together to achieve a given goal (Chaib-Draa et.al, 1992).

6.2.1.2 Cooperation and Coordination

The degree of cooperation between agents can range from *fully cooperative* to *antagonistic* (Decker, 1987). Cooperation is an important part of DAI and occurs when each agents believes that it will benefit more by cooperating than by acting some other way. Indeed, agents cooperate to solve problems that are beyond their individual capabilities (Malone, 1990). In this case, each agent is capable of resolving complex problems and can work independently, but the problems faced by the agents cannot be completed without total cooperation.

This concept is similar to the ways caseworkers cooperate during the consultation stage in development control. Total cooperation is necessary because firstly, no single caseworker has the sufficient knowledge and resources to solve the given problem independently, and secondly, caseworkers cooperate for mutual benefit of the system as a whole, and to improve their own self-interest (Durfee et al, 1987b).

Conversely, *antagonistic* systems may not cooperate at all and may even block each others' goals (except where similar goals are being pursued). Such systems usually have no communication costs (Decker, 1987).

6.2.1.2.1 Coordination

If the main objective in project management is *integration*, the single most critical issue in DAI is *coordination*. The design of any distributed system needs to analyse how the actions of the individual agents can be *coordinated* so that they work together effectively. The National Science Foundation (1989) has provided two definitions of cooperation, firstly as :

> "the joint efforts of independent communicating actors towards mutually defined goals"

and secondly as a :

> "networks of human actions and commitments that are enabled by computer and communication technologies" (quoted in Malone and Crowston, 1994)

A parallel definition has been provided by Malone (1990) who described it as :

> "the integration and harmonious adjustment of individual work efforts towards the accomplishment of a larger goal"

Perhaps the following definitions by Malone and Crowston (1994) provides us with the clearest and most appropriate guide when they see coordination as :

"The act of working together"

and as;

" the process of managing dependencies between activities" (p.100).

Both of their definitions are consistent with our own observation in previous chapters, i.e. *if there is no interdependence, there is nothing to coordinate.*

There are a variety of approaches to coordination that can be taken here including the following (Durfee et al, 1987b; Malone and Crowston, 1994; Zachary, 1990)

a) One agent is in charge i.e. a *master agent* (eg. a manager) *makes a plan and distributes pieces of the plan to other 'slave' agents*, who then do as they are told and report back their results. They may also communicate with other slave agents if necessary to accomplish their goals.

b) One agent is in charge, and that agent *decomposes* the problems into subproblems, but then *negotiation* occurs to decide what agents will take responsibility for which sub-tasks.

c) No one agent is in charge, although there is *a single shared goal or objective* among all the agents (eg. organisational goals that tell them what to do and how to behave). They must cooperate both in forming a plan and in executing it.

d) No one agent is in charge, and there is no guarantee that a single goal will be shared among all the agents. They may even compete with each other (antagonist).

The above approaches can be categorised into three main methods used to improve coordination among cooperating agents. These approaches, which are by no means exclusive are; (Smith and Davis, 1981; Malone, 1990);

a. Planning for Multi-agent Execution
b. Planning and Negotiation
c. Distributed Control and Communication

6.2.1.2.2.1 Planning for Multi-agent Execution

Also known as a *multi-agent planning* approach (Chaib-Draa and Moulin, 1992) the agents typically choose an agent from among themselves (perhaps through negotiation or appointment) to coordinate their planning problem, and send this agent all pertinent information. Characterised by a ***hierarchical coordination*** *structure* (Cammarata et al, 1983, Smith and Davis, 1983), multi-agent planning is the least distributed form of control (Decker, 1987). The *coordinator* agent then forms a multi-agent *plan* (Suchman, 1987), that specifies the actions each agent should take, and allocates and distributes the plan among the agents. Allocations are made along the individual capabilities of the various agents. This is to ensure that allocation of tasks are made to agents that are best able to perform them. Once tasks have been distributed, *local adjustment* and *synchronisation* of the plan is made by the coordinator on the basis of *feedbacks* from the individual agents.

Since the multi-agent plan is based on a global view of the problem, all important interactions between agents can be predicted. This hierarchical approach seems suitable in domains such as *air traffic control,* where it is imperative that agents interact to detect and avoid dire consequences such as aeroplane collision (Cammarata et al, 1983). This approach is also suitable for decision making processes such as development control, where agents need to interact to *confirm and negate assumptions* during the decision making process. We will discuss this approach in detail in the next chapter.

Unfortunately the main criticism of a central planning agent is two fold. Firstly, achieving a global view of the problem might be extremely costly both in communication resources and in time (Durfee et al, 1987a, and 1987b), and secondly, since the performance of the entire network depends on the planning (central) agent and would be compromised if that agent fails (Miner, 1973; Simon, 1976).

6.2.1.2.2.2 Planning and Negotiation

In development control, we have observed that a joint solution for 'conditions of approval' is generated through the process of negotiation of the different participants. In DAI, agents negotiate with each other to determine *who* will execute *which* sub-tasks after the tasks have been decomposed by an agent. Considered as a ***slightly more distributed kind of control***, agents are classified as having a ***loosely coupled structure*** and depend on a massive amount of communication and mutual adjustment to achieve a consensus (Smith and Davis, 1983). Unfortunately, negotiation, like other human concepts, is difficult to define. Sycara (1988) for example states that :

> "the negotiation process involves identifying potential interactions either through communication or by reasoning about the curent

states and intentions of other agents in the system, and modifying the intentions of these agents to avoid harmful interactions or create cooperative situations (pp. 121)

Durfee, et al (1987b) defines negotiation as :

> "the process of improving agreement (reducing inconsistency and uncertainty) on common viewpoints or plans through the structured exchange of relevant information" (p.30).

Although these two descriptions of negotiation capture much of our understanding about human negotiation, they are too vague to provide techniques for how to get agents to negotiate. One of the most studied protocols (techniques) for negotiation goes back to the human organisation methaphor (Smith and Davis, 1983). The activity modelled by this protocol, termed *contract-nets*, is task sharing, where agents help each other by sharing the computation involved in the sub-tasks for a problem.

In a contract net, there are two roles that an agent can assume:

i) *manager* - who decomposes a problem, looks for contractors to attack (solve) pieces of the problem, and monitors the problem's execution

ii) *contractor* - who executes a sub-task, possibly by actually doing the job and possibly by recursively becoming a manager and sub-contracting sub-parts of the job to other contractors.

Agents in need of services (ie. the manager), distribute requests for proposals to other agents. The recepients of these messages (contractors), evaluate those requests and submit *bids* to the originating agents. The originator (manager) use these bids to decide which agents are the most qualified and then *award* contracts to those agents.

The disadvantage of this approach however, is two fold, firstly, the cost of broadcasting and processing bids becomes prohibitive, especially when the number of agents increases (eg. in the Internet), and secondly, there is no one agent responsible for managing and synthesising the negotiation process into a complete whole. We will study Davis and Smith (1983) contract-net in detail in section 6.3.

6.2.1.2.2.3 Distributed Control and Communication

So far we have focused on systems in which there is a single agent who maintains control of a part or the overall problem-solving process. We now look at the problem of distributed planning, in which there is *no centralised controller*.

Coordination is featured by a *non hierarchical structure* and a *process of mutual adjustment* (Malone, 1990). There are two classes of approaches to this problem (Genesereth et al, 1987); firstly, planning *without communication*, and secondly, planning *with communication.*

The first approach is one in which we assume that the agent cannot communicate. This may seem to be a very serious restriction, but it is useful to consider it both because it does sometimes arise in extreme cases, for example, because the agents are geographically isolated, or because the cost of constant communication may come to dominate the cost of actual problem solving (Genesereth, et. al, 1987). Here, agents *infer* other agents' plans without communicating with them. Tubbs (1984) terms this as *tacit bargaining* and points out that it works bests when agents goals are not conflicting.

The second approach is one in which the agents can communicate freely with each other during problem solving. Widely known as the functionally accurate, cooperative (FA/C) approach, (Lesser and Corkill, 1981), agents first express a *shared goal* that will be pursued through *joint actions*. They then formulate *tentative plans* scenarios based on their local views of the problem and on their interpretation of the organisational goal. They generate plan scenarios as if they pursued the same goal in isolation (Lesser and Corkill, 1981). These tentative *partial-plans* (Durfee et al, 1987b), from all the agents are compared to detect discrepencies. Should the descrepencies be beyond a certain threshold of acceptance, a process of *mutual adjustment* is introduced. By iteratively exchanging, comparing, and adjusting the original incompatible plans, the agents eventually converge on a set of globally consistent plans (Durfee and Montgomery, 1991; Durfee et al, 1987a & b; Hobbs and Evans, 1980; Lesser and Corkill, 1981; Malone, 1990; Suchman, 1987; 1990; Zachary, 1990). By acting on these partial but compatible plans, the individual agents are able to cooperate *independently* but *consistently* (Durfee and Montgomey, 1991; Lesser and Corkill, 1981)

Relating to our situation in development control, we can conclude therefore that this non-hierarchical approach to plan coordination is more attractive to individual problem solvers like planners and designers. These groups of people always consider design as an *individual creative process*, and do not want 'outsiders' to interfere and invade their problem solving space. Consequently they usually demand to work *independently* during the decision making process (Levin, 1972; Simon, 1973; 1976).

However, the main criticisms of this type of control is, firstly, the cost of communication can be very high since agents will continuously need to exchange plans before converging on one (Durfee et al, 1987 a & b), secondly, there is no guarantee that the resulting plan will be warranted by the recepient's agents (Chaib-Draa and Moulin, 1992), and thirdly, organised (coherence) behaviour is difficult to guarantee if control is decentralised since no one agent has a global view of all the activities.

6.2.1.2.2.4 Summary

Since decision making in development control demands a combination of solving systematic and routine problems which require planning and scheduling (Allinson, 1993; Kerzner, 1984) and ill-structured (Simon, 1973) and 'wicked' problems (Rittell and Webber, 1973) which require innovative solutions, we propose that the techniques for coordination in development control, should be the combination of the following, namely, i) *a central multi-agent planning*, ii) *the contract net* protocol, and iii) *mutual adjustment.*

However, unlike the multi-agent planning, we proposed that agents *negotiate to determine the distribution of tasks* (time and resources) and *to agree on a joint solution for the conditions of approval.* Conversely, unlike Smith and Davis's (1981 and 1983) contract-net, we proposed to look at problem solving as being *assisted by a central primary agent* known as a project manager, instead of loosely coupled structure. In addition, the manager is responsible for synthesising the input (plans) for the various specialist agents to form a complete whole and ensuring cohehence behaviour among agents. Finally agents group together and fuction as a *project team*, allowing them to pursue their independent solution space. Agents make *mutual adjustment* to reduce or eliminate discrepancies and to achieve coherent organisation goals.

6.2.2 Communication

The nature of communications in a distributed system is another important aspect. With increased cooperation and coordination, comes an increased need to communicate an increasing amount of information. The spectrum of communication methodologies can be delineated into two areas, firstly, the *paradigm* by which communication takes place, and secondly, the *protocols* adopted to effectively use the 'limited bandwith' available (Decker, 1987), as illustrated in Figure 6-1.

6.2.2.1 Paradigm

The specific communication paradigm that is being proposed to support the distributed systems falls into two classes:

i) *Blackboard systems* - in which communication takes place through a shared knowledge structure called a blackboard.

ii) *Message-passing* system - in which one agent sends messages (both requests for services and information as well as replies to such requests) to one or more other agent whose names are explicitly known.

Although on the surface, these two techniques appear quite different, they turn out in practice to offer essentially the same support for distributed systems. In fact, they can be used to stimulate each other, as we will see below. Examples of each approach will now be described.

6.2.2.1.1 Blackboard Systems

Blackboard systems are designed for the cooperation and communication between Knowledge-Based Sources in DAI. They contain three components namely i) the blackboard, ii) the knowledge sources, and iii) a control (Englemore and Morgan, 1989),

In our context, the *blackboard* can be seen as a *conference table* around which a *project manager* convenes a project *meeting* of a number of *specialist agents* representing the different departments. No single agent has the breadth and depth of knowledge to solve the shared problem in isolation from the others.

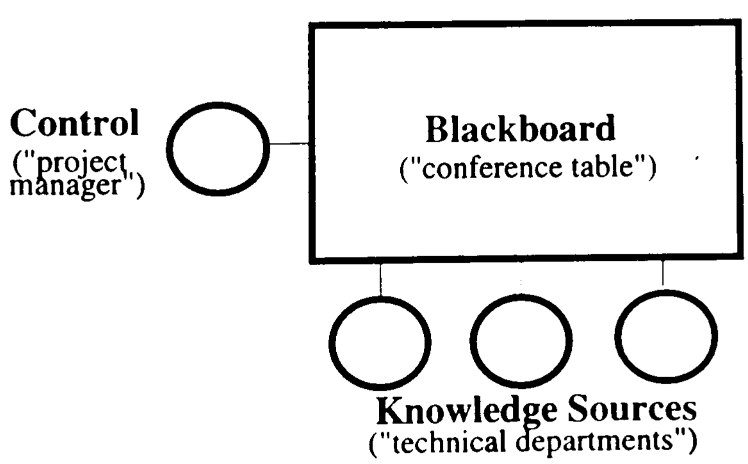


Figure 6-3 Concept of Blackboard Model
(after Hayes-Roth, 1986)

During a meeting, agents can *post* conversations and messages on the blackboard, and they can *read* and act on messages that are posted by other agents. The project manager maintains *control* over the meeting and is responsible for steering the meeting so that there will be a successful outcome. A conceptual diagramatic representation of this is illustrated in Figure 6-3.

Another useful analogy is the one provide by Nii (1986) who relates the functioning of a blackboard to a room in which several experts are trying to put together a huge jigsaw puzzle. Each expert has some pieces of the puzzle, and a special knowledge about how the pieces relate to the entire puzzle. The solution evolves *incrementally* by each expert examining the puzzle solved thus far, deciding whether he or she has something to contribute to the solution at this stage, and if some contribution can be made, moving to the central puzzle and placing specific pieces. We will discuss the blackboard model in detail, using the HEARSAY-II example in section 6.3.

6.2.2.1.2 Message-Passing Systems

Message-passing systems provide an alternative way for agents in a distributed systems to communicate with each other. This framework works in a similar way to a blackboard, except that in message-passing systems, agents tend to know more about each other than they do in a blackboard system. Here agents have the knowledge that enables them to direct their message to those who are most likely to respond. This is because agents maintain *models* of other agents, which include information such as agents name, address, role, skills, goals, and plans. An example of a message-passing system is MACE developed by Gasser et al (1987).

6.2.2.2 Protocol

There are many possible protocols for communication in DAI systems, but we can categorise them into two, i.e. *selective* and *broadcast* (Cammarata, et. al, 1983). In *selective* communication, messages are targeted to a specific receiver. This includes *on-demand* communication, where messages are only sent at the request of one agent to another. In *broadcast* communication, messages are sent so they can be read by anyone, and also include *unsolicited* communications where a party (or parties) without their prior consent (eg. e-mail on the Internet) can send communications.

One of the most studied protocols for distributed problem-solving communication is Davis and Smith (1981) *contract net* protocol. As described above, the activity being modelled by contract nets is *task sharing*, where agents help each other by sharing the computation involved in the sub-tasks of a problem.

6.2.3 Social Abilities (Chaib-Draa and Moulin, 1992)

We propose to outline the social abilities of agents involved in DAI to comprise firstly, agents abilities to *reason* about the actions and plans of others in order to predict their behaviour, and secondly, the agents abilities to *assess* a distributed situation (Chaib Draa and Moulin, 1992). The behaviour of agents is also affected by the cultural dimension of the groups (Watson et al, 1994) (Figure 6-1).

6.2.3.1 Reasoning About Others

In multi-agent systems, agents need the ability to reason about the actions and plans of other agents in order to predict their behaviour, as well as their own (Chaib-Draa, 1992). According to Sycara (1989), this ability constitutes a necessity in multi-agent negotiations. One way of how agents predict their behaviour and those of other agents is to build *models of beliefs*. (Chaib-Draa, and Moulin, 1992). For example, to facilitate communication among agents, agents usually ascribe their own beliefs to one another. An agent's beliefs may however, be incorrect. It is therefore important that agents maintain *models* of other agents as well, which include information such as agents name, address, role, skills, goals, and plans as described earlier.

An alternative form is promoted by Bond (1990), who uses the concept of *commitment* in sociology to facilitate interaction. In this framework, he proposed that commitments an agent has made in an *organisation* will determine an agent's participation and action within this setting, and can be used explicitly in negotiations between agents. A similar line was taken by Jennings (1996) when he uses the model of *joint-responsibility* as a basis to formulate the cooperation among agents. At the core of his model is the notion of *joint-intention*. Joint responsibility defines the role that joint and individual intentions play in the collaborative problem solving process. They are used both to coordinate actions and to control the execution of current ones. Jenning's model also specifies pre-conditions which must be attained before collaboration can commence and how individuals should behave during a joint-activity.

6.2.3.2 Assessment of Distributed Situation

An intelligent agent involved in DAI may have, at any moment in time, a wide variety of choices about what to believe, what knowledge can be considered as relevant, and what actions to pursue. In other words, the problem of *which* agent does *what,* and *when*, can be seen as the basic question of distributed artificial intelligence (Chaib-Draa and Moulin, 1992). To solve this problem, each individual agent (or only one agent if the control is centralised) may assess the distributed situation which involve many agents.

Refering to the decision making process in development control, a department (agent) after receiving a request for cooperation for example, needs to continuously asses if it has the capability and knowledge to execute the task (request) locally or if it needs to *consult* outside agents. Similarly, if outside help is needed, the agent also need to assess the degree of this external input, i.e. if the help requires it to engage in a full joint-action or a partial input (Jennings, 1993). Of course a department who receives a request for a joint-action, needs to first assess if it wants to be a part of the cooperation at all.

6.2.3.3 Impact of Culture on Group Behaviour

One of the most important issues that has not been researched in any DAI taxonomy is the impact of *agents cultural inclination* in group behaviour. Infact, it was difficult for the author to categorise it within the framework of this chapter, hence the representation in dotted lines as depicted in Figure 6-1. However, some of the work in this area (very little), can be found in literature related to group psychology such as groupware (Hoffman, 1992), Group Support System (GSS) (Watson et al, 1994), Organisational Decision Support System (ODSS) (Jacob and Pickul, 1992), and Computer Supported Collaborative Work (CSCW) (Connoly et al, 1994; Greenberg, 1991 Peng, 1993). For consistency, we will use ***groupware*** [1] thoughout this chapter to refer to this technology. We have defined groupware as a technology that helps people to work in teams across functional and geographical boundaries, and to make decisions, communicate, collaborate and co-operate more efficiently and effectively (Huckle and Shearmon, 1994).

[1] There are a number of terminologies used to describe the current technologies to support group work. Pioneered in the late 1960's by Doug Engelbert at Stanford Research, California, these tools are generally an integrated combination of computer and communication (Huckle and Shearmon, 1994)

As we have discovered in section 6.2, one of the most important aspects to support group decision making is communication. With increased cooperation and coordination, comes an increased need to communicate an increasing amount of information. This view is similar to the research findings by DeSanctis and Gallupe (1987), who argue that the provision of an electronic communication channel enhaces information exchange within groups and consequently will lead to better decision outcomes. The whole assumption of their thesis is that such a 'channel' will encourage (equal) participation by group members, and will result in better group performance. The argument is that since groupware supports multiple conversation, there will be a *democratisation* of the process of decision making. Here, everyone is being treated as individuals and as such will have an equal opportunity, regardless of his or her status in the hierarchy, to express an opinion. Several studies also found that groupware will increase group consensus, since it encourages and support direct communication and openness when resolving conflict or disagreement (Connolly et al, 1994; Gallupe et al, 1988, Grudin, 1994);

However, one the issues that has not been taken into consideration in the design of such systems, is whether it will have the same effect if the *cultural* nature of the groups were to be opposite to what has been outlined and assumed so far. What if, for example, 'openness' in decision making is not subscribed to or encouraged by a particular group. Indeed, what if, for example, group cohesion and harmony is more important that open conflict resolution, or when communication (messages) between members in the group uses metaphor and symbolism, rather than explicit statements. It is fair to conclude that most literature on current groupware technologies assumes that every group is the same regardless of organisational, behavioural and most importantly, cultural factors in decision making.

6.2.3.3.1 Cultural Factors in Decision Making

We can make a conclusion that the design of current tools to encourage group interaction and cooperation, are based on North American concepts of desirable group behaviour (Hoffman, 1992). Different cultures such as 'oriental' ones, surely have and indeed, require a different model of 'desirable' group behaviour. Here, culture can be defined as the 'beliefs, value systems, norms, customs, and structural elements of a given organisation, or society' (Weiss, 1988; quoted in Watson et al, 1994). While it is not the intent of this chapter to outline a comprehensive framework on culture, the importance and contribution of understanding some of the characteristcs of oriental culture in general and the Malaysian culture in particular, on the design and implementation of a management system for development control surely will be beneficial to the thesis.

6.2.3.3.2 Individualism versus Collectivism

Most observers agree that the cultures of North Americans and Europeans are characterised by high individualism (Groberg, 1994; Hoffman, 1992; Watson et al, 1994). People in this culture tend to see themselves as *I's*, and status tends to be based on personal merits and individual achievements. *Individual rights*, and *to be noticed* within a group, are seen as virtues in light of these values. Collectivism[2] , however, is opposite to the spirit of individualism, where people tend to see themselves as '*we*' and strive for group interest. Status is often based on *ranks*, *ancestry*, or *social position*. (Simone and Feraru, 1996). As a result, behavioural tendencies lean toward reverence for experience and a hierarchy based on tradition. In a *plural society* like Malaysia, the need to suppress individualism for the sake of group harmony are often promoted (Mohamad, M).

Open conflict resolution in group forums are often considered norms in an individualistic society. Moreover, direct communication in group interactions (eg. meetings) to encourage participation and information exchange is encouraged. Members tend to make statements explicit, without offering room for compromise or face saving by subordinates or colleagues. In contrast, the act of *face saving* is crucial in group relationships in collectivist group relations. In the Malay culture for example, there is a saying (advice), that the three things we never do to a Malay person are firstly, never embarass or shame him in the open and infront of his peers, secondly, never insult and look down on his family, and thirdly, never insult his religion.

In decision making processes, *collective goals* are paramount, and as such decisions are almost always group processes. This concept has its roots in traditional practices at the village level, where the inhabitants gathered to discuss and reach agreements on matters of common importance. Although the village headman may in fact exert the guiding role in determining what is acceptable to all, the appearance of equality in participation to reach agreement is not only preserved, but accorded great value.

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[2] This terminology is based on Simone and Feraru (1995) analysis of the impact of culture and idealogy on the development of the 'tiger' economies of Asia.

The cultural preference of decision making by *consensus*, usually 'behind closed doors', therefore, is very often a high priority. Indeed a leader in a collectivist culture is normally expected to build consensus to maintain group unity (Simone and Vera, 1996). Trust building and *personal* face-to-face contact in negotiation is evident. The use of *metaphors* and *symbolisms* when communicating (message) are common. Subordinates are then expected to pick out the core content of the message from its overall content and further refine (and interprete) it. Openness and transparency is a threat to territorial coherence (Groberg, 1994). Infact, this was clearly demonstrated in chapter 4, when caseworkers explicitly stated during the interviews, that they are reluctant to make the process of decision making *open* and *transparent.*

In integrating cultural aspects to the proposed management system for development control however, the features that have been outlined so far should not be interpretated in a 'literal' sense. For example, even though agents should not be 'shamed' in the open, the feature of face-saving can be used as a '*deterrent*' for agents to abide by their *contractual commitments* during cooperation. The design of '*private conflict spaces*' so that agents can arrive at a consensus, instead of disagreeing in a 'common space' (eg. of a blackboard) is also another example of integrating cultural elements in the systems setup.

As a summary, these differences affect the design and use of groupware technology in both societies at large. These cultural, and behavioural characteristics will influence the use of these tools in decision making. Oriental cultures have a different model of group behaviour and as such current groupware design, research and assumption may have unintended consequences in these settings.

6.3 Case Studies

Two examples of DAI applications will be examined in this section. These two examples relate and will aid us in developing a framework for a management system in development control. Both these examples answers the two main issues related to the proposed management system for development control, i.e. *distribution* and *coordination*.

6.3.1 Blackboard Systems and HEARSAY-II

The HEARSAY-II speech understanding system was the first system developed using the shared memory structure known as a blackboard. Its architecture was so well accepted that the term Hearsay-II *architecture* has come to mean the organisation of the original Hearsay-II more than the speech understanding system itself. The system interprets continuous speech drawn from a 1000-word vocabulary. To accomplish this goal, HEARSAY uses 12 expert modules each of which performs a seperate task. These modules work collectively by exchanging information with each other through a structure known as a blackboard. The entire system consists of three components namely: (after Englemore, 1989).

i) a set of independent modules, called knowledge sources (KSs), that contain the system's domain-specific knowledge.

ii) a blackboard, which is the shared data structure through which the knowledge sources communicate with each other. It is divided into levels like sound segments, syllables, words, phrases, and sentences,

iii) a control system known as a scheduler, which determines the order in which knowledge sources will operate on the entries on the blackboard.

Here the KSs correspond to the levels of knowledge about speech, language (syllables, words. phrases, and sentences), and the tasks being discussed. The blackboard contains hypotheses about interpretations at each of these levels. Control is performed by a specialised KS i.e. a scheduler, that reasons about such factors as cost of execution and likelihood of achieving a result.

When a KS is activated (as described below), it examines the current content of the blackboard and applies its knowledge either to create a new *hypothesis* and *write* it on the blackboard, or to modify an existing one. Although the execution of the entire HEARSAY-II system consist of the asynchronous execution of a collection of KSs, the execution of an individual KS is a sequential process. Once a KS is activated, it executes without being interrupted until it is finished.

The hypotheses on the blackboard are arranged along two dimensions (Hayes-Roth); firstly *levels*, from small, low-level hypotheses about individual sounds to large, high-level hypotheses about the meaning of an entire sentence, and secondly, *time*, corresponding to periods of the utterance being analysed. The goal of the system is to create a single hypothesis that represents a solution to a problem. For HEARSAY-II, such a solution would be an acceptable interpretation of the entire utterance. Figure 6-4 shows a snapshot of a HEARSAY-II blackboard. The levels are the following;

a. The waveform corresponding to the sentence "Are any by Feigenbaum and Feldman ?"
b. The correct words shown just for reference.
c. The sound segments
d. The syllable classes
e. The words as created by one KS
f. The words as created by a second word KS
g. Word sequences
h. Phrases

Associated with each KS is a set of triggers that specify conditions under which the KS should be activated. These triggers are an example of the general idea of a *demon,* which is conceptually, a procedure that watches for some conditions to become true and then activates an associated process.

When a trigger fires, it creates an *activation record* describing the KS that should be activated and the specific events that fired the trigger. This latter information can be used to *focus* the attention of the KS when it is actually activated. Of course, a single event, such as the addition of a particular kind of hypotheses on the blackboard, could cause several triggers to fire at once, causing several activation records to be be created. The KS that causes the triggering event to occur need not know about any of these subsequent activations.

To solve this, the actual determination of which KS should be activated next is done by a special KS, called the scheduler, on the bais of its knowledge about how best to conduct the search in the particular domain. The scheduler uses ratings supplied to it by each of the independent KSs. If the scheduler ever discovers that there are no activation records pending, then the system's execution terminates.

6.3.1.1 After HEARSAY-II

The techniques developed in HEARSAY-II have since been generalised in several multipurpose blackboard systems, including HEARSAY-III (Blazer et al, 1980; Erman et al, 1981), GBB (Corkill et al, 1987) and BB1 (Hayes-Roth, 1986; Hayes-Roth and Hewett, 1989).

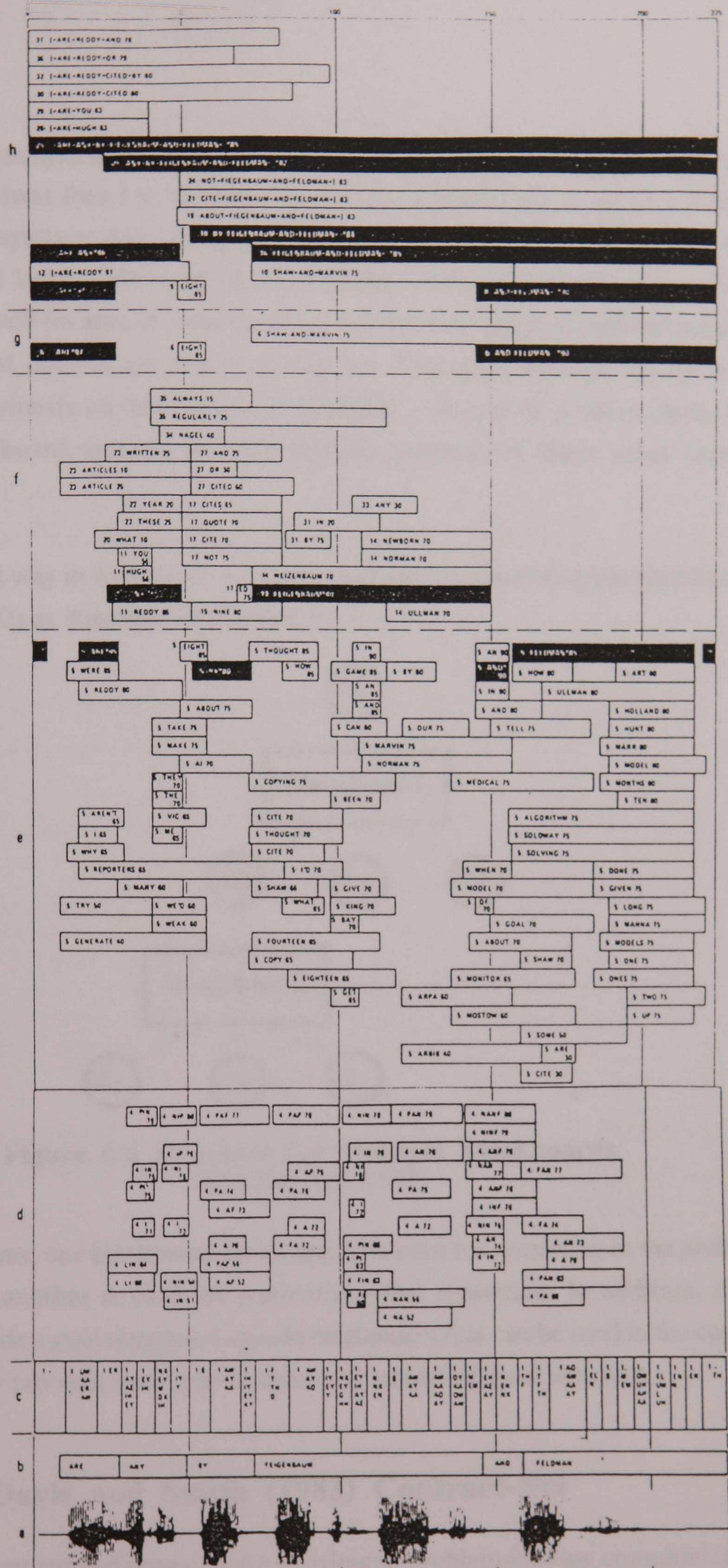

Figure 5-4

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In some of these systems, for example, the use of time as an explicit dimension on the blackboardwas found to be inappropriate. So it has been removed from these more general systems. Also, these new blackboard systems provide facilities that HEARSAY-II lacked. For example, in HEARSAY-II, control was data-driven. This worked well for speech understanding; but for other kinds of problem solving, other kinds of control are more appropriate. Examples include, as we have discussed previously on this chapter, control that is driven by goals or plans. The 'newer' blackboard systems provide explicit support for these other control mechanisms.

One important way in which they do that is to allow the use of *multiple* blackboards (Dai et al, 1992) as illustrated in Figure 6-6.

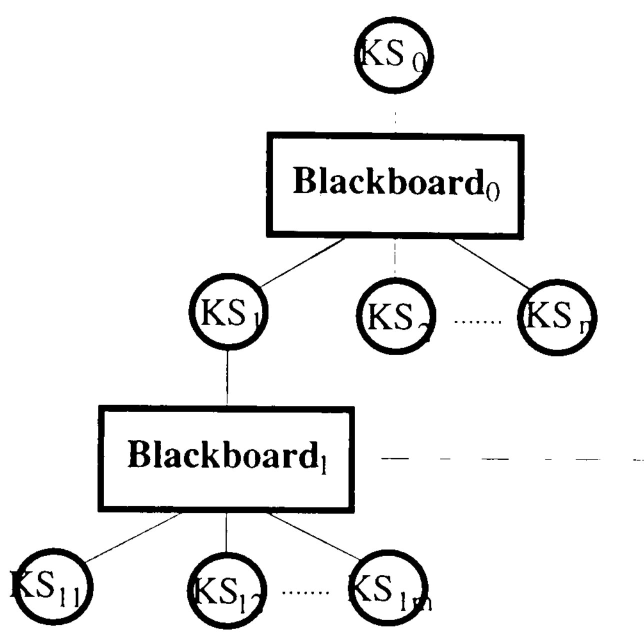


Figure 6-6 Structure for Multiple Blackboards
(after Dai et al, 1992)

In these systems, one blackboard for example, is used for *reasoning* in the problem domain, and another is used for *controlling* that reasoning. In addition, these systems provide a goal-structured agenda mechanism that can be used in the control space to allow problem solving to be driven by an explicit goal structure.

6.3.2 Davis and Smith (1983) Contract-Net

One of the most studied protocols for distributed problem-solving communication goes back to the human organisation metaphor. Davis and Smith (1981) *contract-net*, is a protocol for problem solving between agents, especially if the agents are heterogeneous (ie. possessing different abilities or information). Problem solving is viewed as involving four central activities, namely i) the *decomposition* of the problem into smaller manageble tasks (sub-tasks) ii) the *distribution* of sub-tasks involving the matching of tasks to agents capable of executing it, iii) the *solving* (solution) of sub-tasks by agents, and finally, iv) the *synthesising* of all individual contributions to form a single overall solution.

In current intelligent agent research, the concept of looking or describing the problem to be executed by different agents as *tasks*, has caught the imagination of researchers such as Polat et al (1993) and Pohl and Myers (1993) among others. It is found that agents accomplish their work through more intricate patterns of communication. This communication varies from situation to situation, according to personal preference, and changes over time. Davis and Smith (1983) called this *task-sharing*. In task-sharing, agents communicate about a 'richer database', such as *task description*, making the conversation more powerful. Once there is something rich to 'talk about', agents tend to become better at participation during communication (conversation) (Greif, 1994).

Here, a task can be assigned:

> " .....to a person (or group) by an external agent or may be self-generated. It consists of a stimulus complex and a *set of instructions* which specify what is it to be done vis a' vis the stimuli. The instructions indicate what operations are to be performed by the subject(s) with respect to the stimuli and/or what goal is to be achieved". (Hackman, 1969; p.113).

Refering to our previous theories on project management, we can extend the definition of tasks to include the *time* taken to accomplish a particular task, and the *resources* (eg. people, equipment, materials) it employs to accomplish it.

An agent in the group may request assistance because it encouters a task that is too large to handle alone because of bounded rationality (Simon, 1967), or a task for which it has no expertise or skill to execute. If the task cannot be solved even amongst groups, the agent or the group can seek outside help. Those with tasks to be executed (or those capable of executing the tasks) thus engage in a form of negotiation. Negotiation has three main components i.e. i) a two-way exchange of information, ii) each party to the negotiation evaluates the information from its own perspective, and iii) agreement is achieved by mutual selection (Powell-Smith and Chappell, 1986).

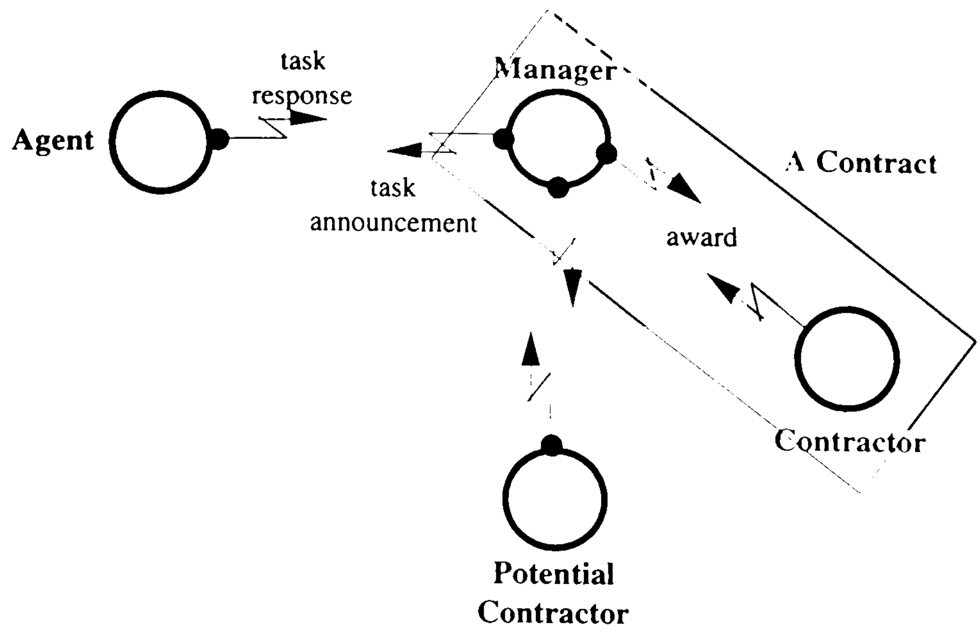


Figure 6-6 A Broadcasting/Announcement of Tasks, the Response, and Contract Making
(after Davis and Smith, 1983)

When negotiation takes place, first the agent makes a *task announcement* (usually by broadcasting to the entire system). This agent will now play the role of a manager. Agents that want to, may return *bids* for the contract (thus becoming a contractor) and in the bid, must give the reason why the agent believes it can fullfill the contract. The manager then evalutes the bid and makes an *award* based on them. The contractor may subcontract the sub-task, and so on. The manager and contractor are linked by an agreement or contract, hence the name 'contract-net'.

Once the manager has awarded a contract, he then needs to ensure that the contract is being executed as planned and according to schedule (using for example project management techniques). The manager will then synthesise the contribution of all the contractors to form a single overall solution. The broadcasting, bidding, and management of a task can happen using a HEARSAY-II blackboard architecture.

6.3.2.1 Task Message Format

Each message (task announcement) will be handled by the *message handler*, and is composed of a number of 'slots' that specify the kind of information needed in that type of message. A task broadcasting (announcement) message, for example, has 6 main slots:

Task Announcement Slots

Eligibility specification
Task abstraction
Bid specification
Expiration time

Eligibility specification is a list of criteria that an agent must meet to be eligible to participate. The task abstraction is a brief description of the task to be executed. The bid specification is a discription of the expected form of bid (participation). Finally, the expiration time is the dateline for receiving bids (participation).

i. *Manager to Potential Contractor*

To	Architecture Agent
From	Manager
Type	Skeleton Plan
Contract	No.3
Eligibility specification	Architecture agents only
Task Abstraction	Needs Joint-Action/ Contract Project No. 22/96 Class : Multi-Storey Office Location: CBD
Bid Specification	Completion or Processing Time
Expiration time	14th June 1996 (7 days today)

Figure 6-7 Example to Task Announcement

ii. *Potential Contractor's Reply*

To	Project Manager
From	Architecture Agent
Type	Feedback/ Proposals for Plans
Contract	Joint-action/ Contract
Node Abstraction	Refer to WBS Schedule (Architect Agent Schedule)

Figure 6-8 Example of an Agent Response

6.4 Conclusion and Summary

In this chapter, we discussed the distributed aspects of Artificial Intelligence. We have by no means covered all of the issues related to this subject. However, it is fair to conclude that as distributed systems become more complex, it becomes harder to see how best to organise them. One thing that has proved promising is to look at anologies in the organisation of other complex systems. The most promising sources of such analogies is the structure of human organisations, such as societies and corporations. A design team team or a Local Authority organisation such as the

Johor Bahru City Council is, after all, a distributed goal-oriented system. We have already seen proposed examples of this idea, namely a combination of i) *a central multi-agent planning*, ii) *the contract net* protocol, iii) *mutual adjustment*, and iv) utilising the *blackboard systems* for communication. Agents abilities to *reasons* about the actions and plans of others in order to predict their behaviour, and to *assess* a distributed situation is vital for group coherence. Finally we have concluded that the cultural dimensions of groups will affect the bahaviour and ultimately influence the design of our systems.

Another source of ideas is the way a single human brain functions. The book 'The Society of Minds' by Minsky (1986) explores the notion that single minds are also distributed systems, composed of collections of heterogeneous agents that simultaneously cooperate and compete. A framework for a management system for development control integrating the features that have been outlined so far, will be proposed in the next chapter.

Chapter 7
Components and Concepts for a Computer-Based Management System

Chapter 7

Components and Concepts for a Computer - Based Management System

7.0 Introduction

Like design, the interdisciplinary nature of development control has resulted in the need for the different expert agents to *cooperate* when solving problems. Moreover, the *distributed* nature of the problems means that agents need to frequently *interact* to *negotiate* and make *adjustment* before a final solution can be achieved. However, the environment upon which the agents operate, which can be classified as always in flux, means that interaction is almost certainly based on *uncertain* and *incomplete* information. The existence of *interdependencies* has augmented the problems.

In Johor Bahru, this has been highlighted by the two critical issues related to development control, namely *delay* and *uncertainty*. Approval for development proposals can only proceed once all the different technical departments have been consulted and collaborated in the decision making process. However, the process of consultation is often fraught with unreasonable *delays* due to the complexity of the problems and the lack of proper communication procedures and requirements. The discretionary and overlapping nature of control has made the process as *uncertain* as the outcome. The problem is aggrevated by a lack of communication, trust, transparency, and participation of clients.

Based on these findings, we will now specify among others, the requirements, mechanisms and specifications for the design of a computer-based management system for development control in Johor Bahru. A prototype system will be proposed in the next chapter.

Before we proceed however, it is best that we have a clear understanding of the terminology that will be used to describe the various components of the system. For clarity and consistency, the system will be divided into three different but interelated components namely, the client system, the operating system, and the managing system, as outlined in Chapter 3.4.

As a summary, the client system will be represented by a client agent who is responsible for making applications and submissions to seek approval from the Local Authority (JBCC) on behalf of an organisation (eg. a developer) for development to take place. The client agent is usually represented by the project architect. The operating system consists of operating agents working for the Local Authority who possess professional and technical skills to make recommendations and decisions, pertaining to the client agent's application. They are organised along departmental lines to represent their different specialised technical knowledge. The managing system is represented by a project manager and functions as a coordinator with executive powers.

7.1 Design Proposals

7.1.1 The Approval Centre

At the heart of the system is the *Approval Centre* that functions to reduce the uncertain and unpredictable nature of development control. The Approval Centre is to be the coordinating centre for all development approval, replacing the current 'one-stop agency' procedure (Figure 7-1). All requirements and information related to development control will be made available 'over the counter' at the Centre and will be managed by a *Project Manager.* The manager's five main roles can be summarised and outlined as follows:

i. *Establishing and making explicit the structure and line of authority in the decision making process.* The appoval manager is responsible for all matters related to the management of development control. The manager will have executive powers and will be the sole formal point of contact between the client system and the operating system and becomes the arbitrator between them for the purpose of transmitting decisions and information, and answering enquiries. Also the manager is responsible for outlining the rules and conventions for processing the application which will be made 'known' for all to see.

ii. *Establishing the rights and responsibilities through a contract* - to make explicit the rights and responsibilities of all the parties involved, the manager is to draw up a contractual agreement that will spell out not only the conditions of the contract but also the roles and commitment of those signing up to the contract. The contract will also establish the time limit upon which a decision has to be reached for the application.

iii. *To classify, decompose*, and *design a schedule skeleton plan*, and *distribute the plan along departmental lines*. The manager has to ensure that the *transaction* of cooperation (contract) during the process of plan solution *flows* as planned and must also functions as the systems *integrator.*

iv. *Encourage participation and collaboration.* He will ensure that the client agents can and will participate and are consulted progressively during the process of decision making by establishing formal communication channels. The manager is also to coordinate all collaboration during the consultation stage amongst operating agents both internal and external.

v. *Ensure the independence and protection of operating agents* - The manager must 'protect' the operating agents from outside interference making sure that they are able to work independently to achieve the organisations goals and objectives. In addition the manager must make sure that the process is more transparent and accountable.

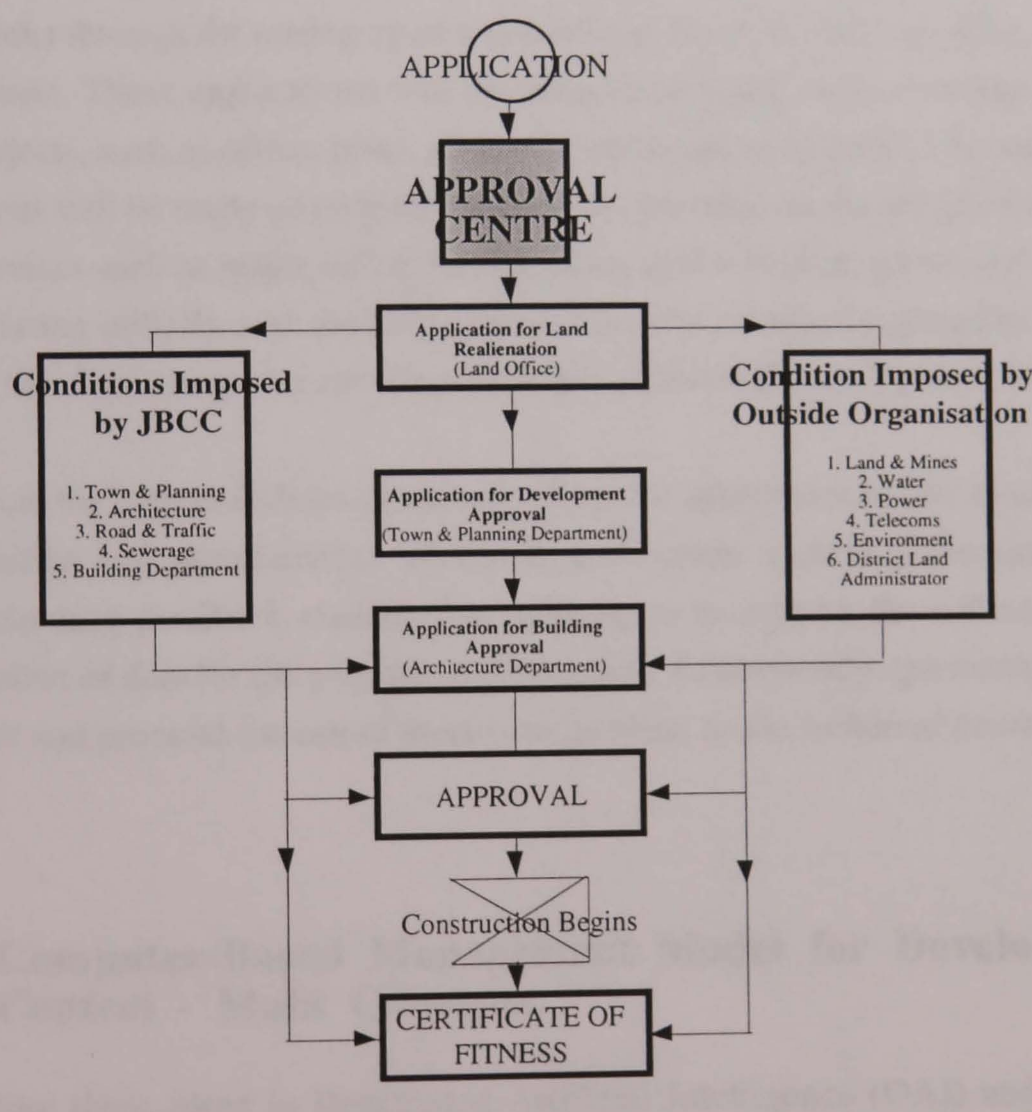


Figure 7-1 Proposed New Submission Procedure Based on the Approval Centre Concept

7.1.2 Approval Based on the Trust System

To overcome the problem of overlapping of procedure, a submission concept based on a *trust system* will be used. Using this concept, all data submitted along with applications by the client agents, will be *deemed as accurate and in compliance with relevant by-laws.* This is to solve the problem of the operating agents having to calculate and verify the data as given by the clients, which can cause delays in processing application. The processing of the application will be monitored by the approval manager *non-stop*, until approvals are received. Checking will however be carried out after commencement of work and before issuance of Certificate of Fitness by the Johor Bahru City Council (JBCC), as illustrated in Figure 7-1.

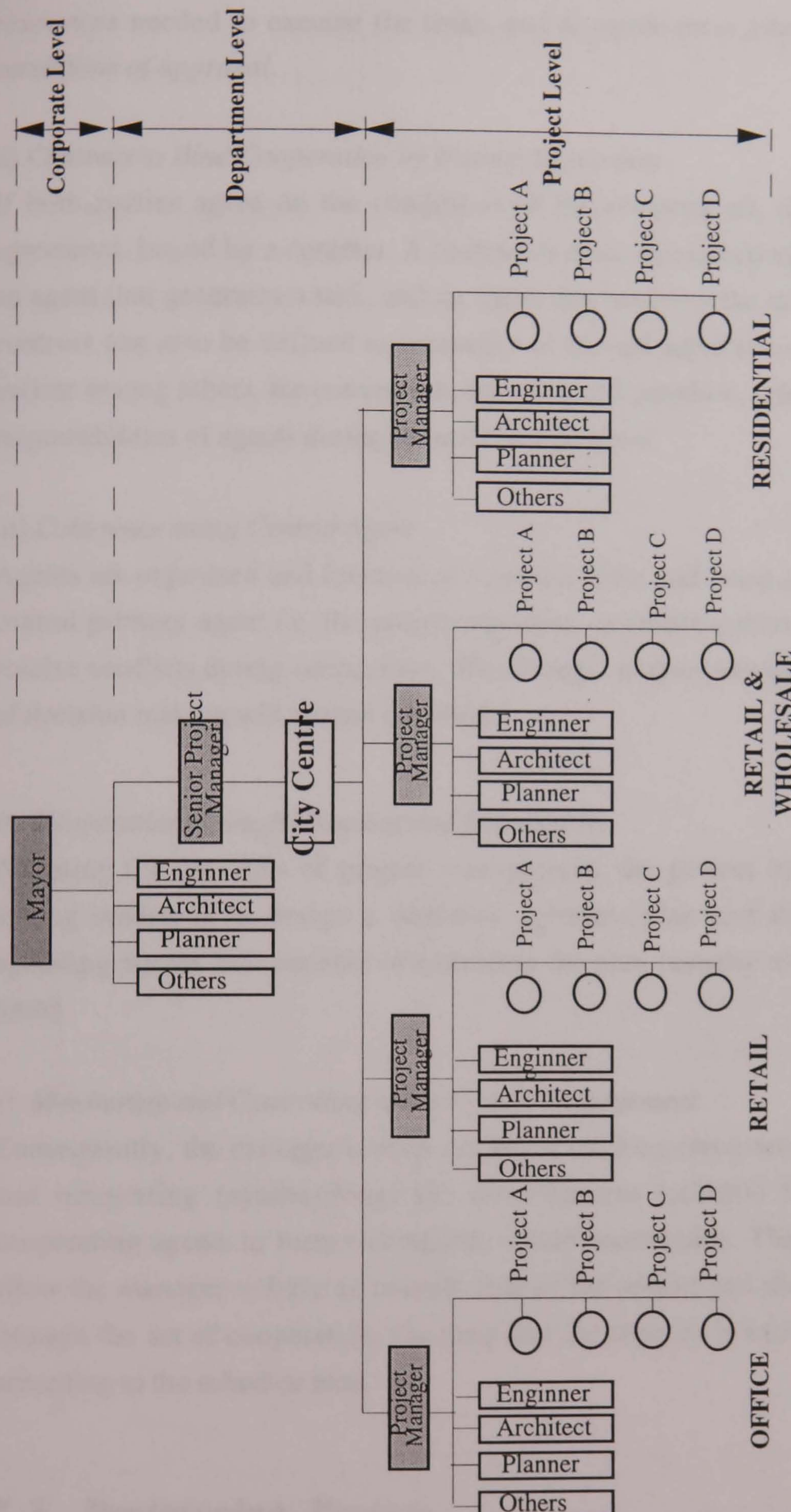
7.1.3 Other Functions

The approval manager is to concentrate on efforts to reduce the complexity of all applications through the setting up of a special *taskforce* (or unit) handling *critical* applications. These applications will be categorised based on the concept of *use*-class projects, such as office, hotel, retail and wholesale, residential, extension, and hers. Focus will be made on projects that will put pressure on the infrastructure and other services such as major office developments, and which are located in specific areas, starting initially with the City Centre. This will eventually spread to include those in the other categories covering the whole of Johor Bahru (Figure 7-2).

Apart from the responsibilities described above, the approval manager must ensure the stability and maintainence of the overall urban system performance by commissioning *feedback studies*. The manager is to support the collection and coordination of data for the purpose of this studies. Subsequently, the manager is to construct and promote the use of *models* to fucntion as the *technical heart* for the system.

7.2 Computer-Based Management Model for Development Control - Main Concepts.

Integrating these ideas in Distributed Artificial Intelligence (DAI) and project management techniques as oulined for the Approval Centre, we will now propose a computer-based management system based on the following concepts:



Note:
Each project team includes project and functional personnel under a project manger

Figure 6-2 Proposed Organisational Design Based on the Use-Class and Project Concept

i) *Cooperation through Negotiation*

The execution of projects can be defined as a process of cooperation among the operating agents. However, unlike the concept of multi-agent planning in DAI, we propose that agents *negotiate to* determine *the distribution of tasks*, the *time and* *resources* needed to execute the tasks, and *to agree on a joint solution for the conditions of approval.*

ii) *Contract to Bind Cooperation by Mutual Adjustment*

If both parties agree on the conditions of the cooperation, they enter into an agreement, bound by a contract. A contract is thus, an explicit agreement between an agent that generates a task, and an agent that executes the task. Establishing a contract can also be defined as a process of mutual adjustment. A contract will outline among others, the convention, line of communication, roles, behaviour, and responsibilities of agents during the act of cooperation.

iii) *Coherence using Central Agent*

Agents are organised and function as a *project team* and being assisted by a third central primary agent i.e. the project manager, to ensure coherent behaviour and resolve conflicts during cooperation. The manager is also to ensure that the process of decision making will remain focussed.

iv. *Cooperation through Planning and Distribution*

Adopting the concepts of project management, the project manager's function among others, is to design a 'skeleton' schedule plan and distribute it to the operating agents best capable of executing the plan (usually along departmental lines).

vi. *Monitoring and Controlling using Project Management*

Consequently, the manager is responsible for tracking (monitoring), coordinating and integrating (synthesising) the contributions (results) from the various cooperating agents to form a complete, whole master-plan. The master-plan will allow the manager to have an overall view of the project and use it to control and manage the act of cooperation, ensuring that the contract is executed on time and according to the schedule plan.

7.3 Prototyping Process

Based on the above concepts, we will now outline the components of the system as illustrated in Figure 7-3. We proposed to divide the management systems into three, namely :

a. The Multi-agent Planning, Control and Cooperation Layer
b. Specialist Departments' Knowledge and Database
c. Communication Protocol

a. The Multi-agent Planning, Control, and Cooperation Layer

This can be further subdivided into two main modules, namely i) Multi-agent Planning and Control Module, and ii) Cooperation and Assessment Module

i. Multi-agent Planning and Control Module

This module has two main objectives;

i. to design and distribute plan to team members (along department lines), and get agreement on the plan

ii. monitoring the execution of the contract, ensuring that the individual agent activities are coordinated with those of others within the project team.

ii Cooperation and Assessment Module

Its objective is to ensure that the agent domain level activities are coordinated with those of other agents within the project team. It decides which tasks should be performed locally, determines when social activity is appropriate, and receives requests for cooperation from other team members. This module can be futher subdivided into two sub-modules, namely i) situation assessment module, and ii) cooperation module

b. Specialist Department's Domain Knowledge and Database

This contains information such as the master plans, case files, past records, checklist, past decisions, etc., that will allow and support designers to do quantitative as well qualitative analysis during the assessement stage.

c. Communication Protocol

We propose to use a communication system using the blackboard protocol. The blackboard will will be arranged hierarchically, to overcome the problem of bottleneck.

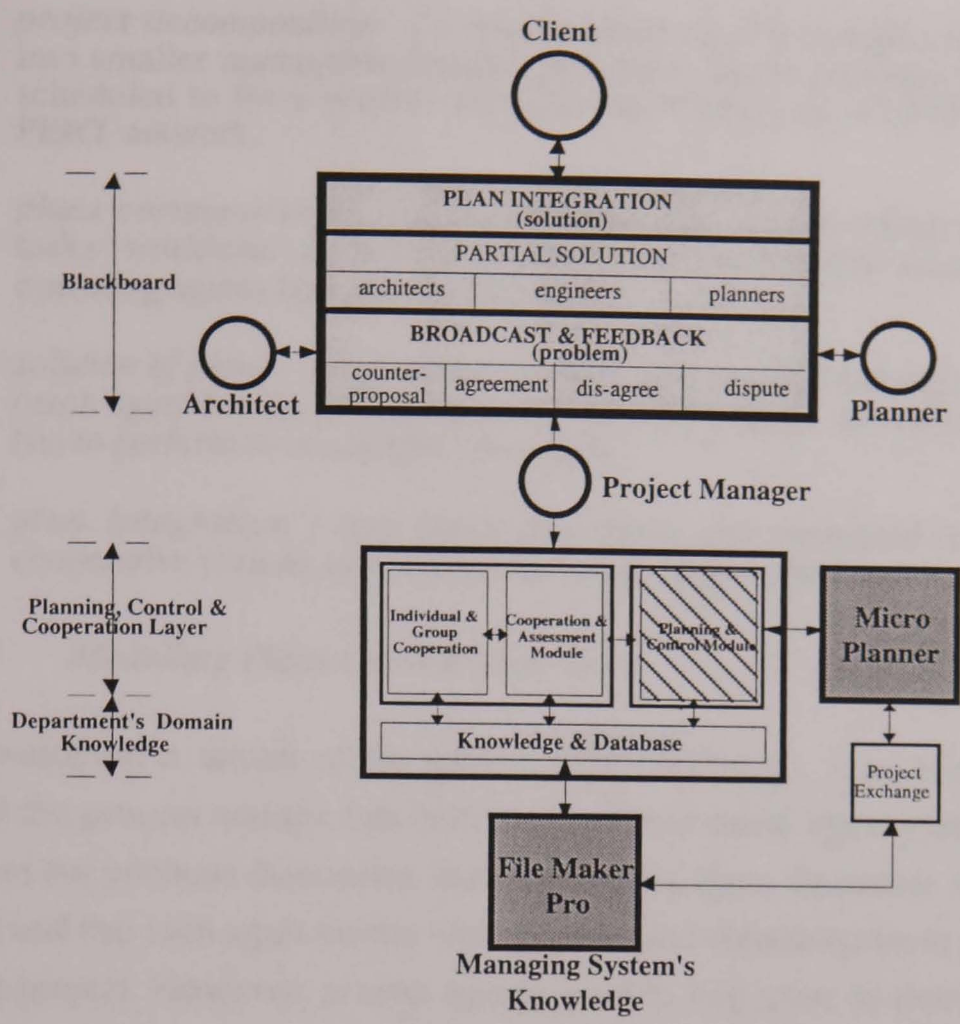


Figure 7-3 Components of the Management System and Blackboard

7.3.1 The Multi-agent Planning, Control, and Cooperation Layer

7.3.1.1 *Multi-agent Planning and Control Module*

As described earlier, one of the project manager's role, after receiving the application, is to design a schedule plan for the execution of the project. However, unlike traditional PERT/CPM model which views the project as a monolithic network of activities with prespecified durations (Kerzner, 1984; Simms, 1994; Young, 1994a, b, c), our approach (in plan design) views a project as a cooperative process among the operating agents with distinct individual goals and responsibilities. Cooperation between agents is essential, for example, because of the limited capabilities of individual agents to solve the the entire problem independently.

There are four important aspects of a multi-agent cooperative planning process that need special focus:

i. *project decomposition* - i.e. the breaking up of a complex task into smaller managable detailed activities. These activities are scheduled to for a project sub-plan (sub-tasks), eg. a CPM or PERT network.

ii. *plans communication and distribution* - the way in which the tasks workload is communicated and distributed among operating agents best able to execute it.

iii. *solution of plans* - the manner in which agents execute the plans (each agent has the knowledge and knows the major activities it has to perform to accomplish its goals)

iv. *plan integration* - how individual plans are integrated in a cooperative manner to develop the overall single plan.

7.3.1.1.1 *Modelling Plans Using Assumptions*

Before developing a model of an agent's plan (skeleton), it is necessary to understand the process and the information needed in multi-agent planning. We assume from our previous description that an operating agent represents a technical department and that each agent knows what its goals and objectives are in relation to the overall project. However, project agents need to *negotiate* to determine the resources and time needed to complete the plans. A plan therefore should outline the activities that must be accomplished in order to meet the project goals. Refering to Chapter 3, the key information needed in developing a plan are :

i. the activities and their relationships

ii. available resources that need to be allocated for the different activities

iii. time required to complete each activity conditional on the resources allocated to each activity, and

iv. activities that interface with other participants' activities and their relationship

From the above, we can conclude that the development of a skeleton-plan as a basis for subsequent negotiation, is complicated by the presence of *interdependencies* between plans. Mutual dependencies exist not only between an agent's individual activities and subtasks scheduled by the project management system, but also between the agent's own activities and those of other project agents. For example, the planning department, before approving an application for additional car parking spaces for a proposed development, may need the feedback and advice from the engineering department. The engineering department may not have this information readily available for example, until the studies done by their traffic consultants on the site is completed. In such cases, the skeleton plan development for the planning department may be delayed until the necessary information is received. In short, *incomplete information causes delays.*

Therefore we proposed that the development of the *skeleton plans* when information is incomplete are done by using *default assumptions* as part of the agent's plan. Thus, the design of the plan for the planning department in this case, may simply be *assumed* using a 'value' obtained from previous *knowledge* and/or *experience.*

The main advantage of incorporation of assumptions in negotiation, is because it obviates the need for frequent interactions between agents and eliminates consequent delay, characteristic of decision making process in Johor Bahru. It also provides a convenient means for handling incomplete information. However, it must be stressed that a cooperation process between agents (and with the manager) is necessary to *confirm or negate the assumptions.* When this occurs, the agents will have to retract their assumptions and update the plans accordingly. In addition, we are also proposing that if the default value is *not* confirmed or negated by the other agent after it has decided to be part of the project team, then this value will be considered *true*, and can be used as part of the final plan formulation. We will explain this further in the prototype example in the next chapter.

Of course, in addition to making assumptions, agents and managers incorporate concrete facts (eg. resources available), observations (a particular activity is already completed), use rules and techniques (eg. PERT models) and arrive at certain propositions regarding the completion date of their series of tasks. A basis for concrete agents plans emerges from the justifications and assumptions made during these negotiations.

7.3.1.1.2 *Summary*

The proposed model based on cooperation and assumption, departs from the traditional models for project management which regard project execution as a fixed and sequential process. While float times are *generated* for the various activities and participants using the traditional PERT/CPM techniques, in this approach, we propose that float times are *allocated* using negotiations among participants. It has been observed that, in practice, plans evolve through negotiations and are not prespecified (Sathi and Fox, 1989). Based on the negotiations among the operating agents, the plans are made more concrete (updated). Hence, we find the traditional model to be unsuitable for environments which require agents to constantly cooperate and communicate iteratively, such as in development control.

Furthermore, the rapid changes in the urban environment, coupled with uncertain and *incomplete information*, require the project managers to plan and control effectively under *time* pressure. In such situations, it has been proven that conventional project planning, schedulling, and controlling techniques do not generally provide the functionalities needed to react effectively to changing events or to give timely feedback (Kerzner, 1984).

Properly executed, we believe that the proposed system has the potential to be used generically in general project planning, scheduling, and control. One of the benefits of such a system is that it *formalises* the process of negotiation and conflict resolution, enabling participating agents to arrive at an agreed master-plan that is evolved through consensus and negotiation. Consequently, it will provide project managers the powers and abilities to make decisions, rather than relegating them to the role of observers, which was another criticism of traditional PERT tools.

7.3.1.2 Cooperation and Assessment Module

The next component that needs modelling, is the *behaviour* of the agents participating in the act of *consultation* (cooperation). In order to participate in cooperative activity, agents need to be able to reflect on their role and also that of others within the team. This leads to two distinct types of knowledge being maintained; knowledge about local capabilities (self/individual model), and knowledge about other team members with which the agent may have to interact (acquaintenace/group models) (Figure 7-3). These are represented in the agent's beliefs database, and include team agent's names, addresses, roles, goals, tasks, and plans among others.

However, what we intend to model is not an explicit model of how to cooperatively solve a problem. Rather we hoped to draw up rules that represent a straight association between an agent's problem state and its actions. We propose to provide agents with an explicit representation of the model of cooperation based on the JCT 80 outlined in chapter 3.5. Such a model should specify and outline among others;

i) under what circumstances should cooperation (and therefore contract) be initiated;

ii) what conditions need to be established before a contract can proceed;

iii) how the individual agents should behave when carrying out their local activities related to the contract (culture, etc)

iv) how agents should interact with their fellow team members;

v) when and how can a contract be repaired if there is a problem.

vi) how agents should re-organise their local activity in response to problems with the contract.

This model of approach is also consistent with organisational science doctrines, such as those promoted by Galbraith (1973) in Chapter 3, which state that the best way to tackle problems in the face of task and environmental uncertainty, is to introduce explicit rules and procedures. We believe that if everybody adopts the appropriate behaviour, the resultant aggregate response is a coherent pattern of activity.

In our proposed model, *individual-commitment* defines how each agent should *behave* with respect to its problem solving actions within the context of the contract. It also defines the *convention* with which agents should monitor their commitments. However, when an agent discovers that one of the conditions specified in this *convention* does not hold for example, it cannot simply abandon the plan because its project team members may not have been able to detect the problems for themselves.

Therefore, we proposed a *group-commitment*, which specifies among others, that when an agent drops its commitment to the contract it must endeavour to *inform* all the other team members directly or through the project manager. This enables the whole project team to reassess the plan for example, to stop at the earliest time possible, and not waste time pursuing it.

7.3.1.2.1 Implementing Group-Contract

As described, the model uses the concept of the contract as a central role for coordinating future action, and in controlling the execution of current activities. To represent this dual role, we propose to build two modules, consisting of sets of rules, namely ;

i. those which *assess* the situation of the cooperating group (i.e. the project manager and operating agents), and

ii. those which *perform* cooperative functions per se

7.3.1.2.1.1 Contract Assessment Module

This module functions to decide when cooperation on a contract is appropriate. These rules among others help to assess and

i. decide when cooperation leading to a contract is appropriate
ii. obtain agreement on a plan
iii. ensure that existing commitments are honoured
iv. ensure that new commitments are consistent with existing ones
v. monitor the problem solving state with respect to the convention for dropping commitment to a contract.
vi. decide what action should be taken if a contract is dropped

Example of these rules are as follows

Contract Completion (Match)
IF plan is executed
AND produces the desired outcome
THEN Contract is SATISFIED

Contract Completion (Select)
IF Contract (C) is SATISFIED
THEN Abandon all associated activities
Inform Cooperation Module that
Contract (C) has succesully finished

7.3.1.2.1.2 Contract Cooperation Module

Once a contract has been executed the operating agent and project manager must *track* and *monitor* the contract's progress until completion. Tracking and monitoring in this case involves sending any relevant intermediate results to all the project agents and also ensuring that, once a task has finished, a final report describing the status and results of the requested activity is sent (feedback) to all the team members. The contract cooperation module would therefore, ensure that if an activity fails, for whatever reason, all the team members (agents) are *informed* at the earliest opportunity so that replanning can commence. An example of the rule for this module is as follows;

Contract Monitor (Inform)
IF Contract has succesfully FINISHED
THEN Inform all team members

7.3.1.2.2 Summary

We propose to use the *contract* as a *convention* to guide and bind the act of cooperation, which specifies among others, under what circumstances the behaviour of agents should be re-examnined. The proposed Contract Model is comprehensive and deals fairly with the respective rights and duties, and reduces the likelihood of conflict and misunderstanding, both at 'tender' stage and during the contract execution themselves. The implementation of Clause 25 of the JCT 80 which deals with the 'extension of time' will be highlighted in the next chapter.

An associated property is that project agent's need to monitor the execution of their contract so that they can detect when the conditions specified in the *convention* pertain. This explict model of cooperation defines an agent's local behaviour when everything is progressing satisfactorily (i.e. commitment to the contract being honoured) and, through the definition of conventions, offer some insight into the types of difficulties which may arise during problem solving, and also how to solve it.

7.3.2 Specialist Department's Domain Knowledge and Database

Every department has its own specialist domain knowledge. The knowledge and data that the architecture department uses, relates to architectural problems, and those that the engineering department holds, relates to for example, traffic studies. As described in Chapter 5, these may include a series of checklists or standard sheets that it uses to assess an application. Moreover, as the main source of guidence in making recommendation by the technical department's specialist agents (caseworkers) is past records, it is important that a database of 'casefiles' are made available to enable agents to make comparisons and 'cross-reference' with past decisions. Other information that needs to be accessed by agents include maps and plans (eg. structure and local plans), technical reports, and drawings. All this data and information will help agents to make both quantitative as well as qualitative assessments of the application.

7.3.3 Communication using the Blackboard

Agents clearly need to communicate with each other during the act of cooperation and negotiation. Traditionally in a project team setup, we see that when specialists agents collaborate to execute a project, each of them brings to the team a set of knowledge and experiences. In a construction project, this normally happens in a *project room* during site meetings. Here the project room becomes the *common work space* where all activities leading to the successful completion (or failure) of the project are co-ordinated.

Refering to Chapter 7, workspaces are similar in concept to blackboard systems. To summarise, a blackboard system is a global database which is used to maintain all information about problem-solving states in the system. Communication and interaction among the specialist agents known as knowledge sources (KS) take place solely through the blackboard. KSs produce changes to the blackboard which lead *incrementally* to a solution to a problem.

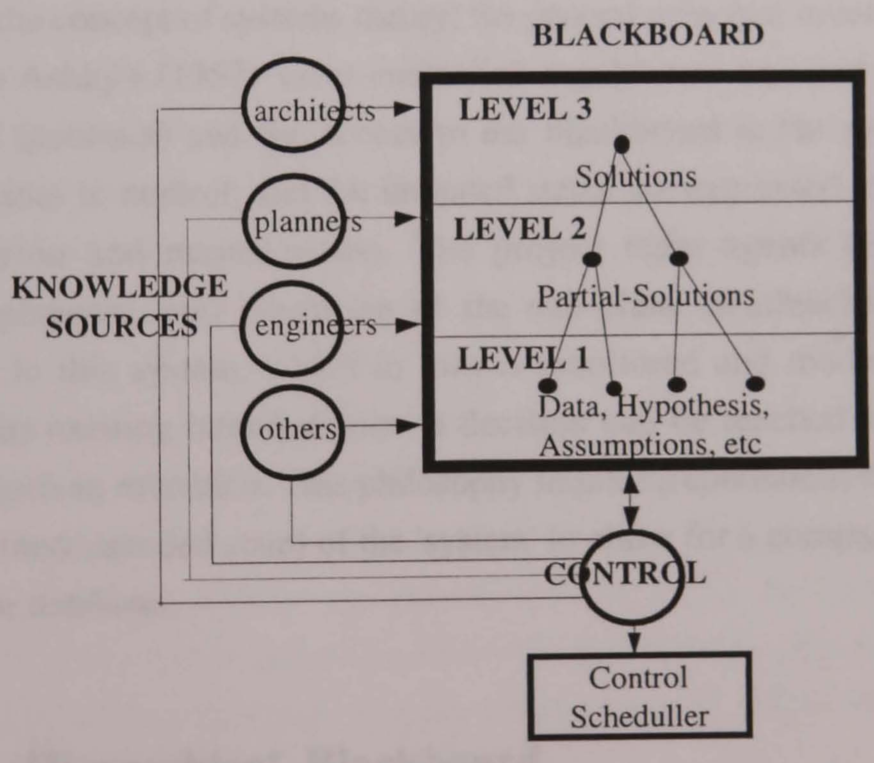


Figure 7-4 The Proposed Blackboard Architecture
(after Englemore, 1988)

Refering to Figure 7-4, the blackboard organises information into a hierarchy of 'levels'. The specialist operating agents from the different departments share information in the lowest panel while the two higher panels include levels of abstraction of the shared information and of the overall progress toward the system's goal.

a. the *bottom panel* contains what has been said, ie. what is believed or assumed. It holds data that will tend to change rapidly.

b. the *middle panel* consists of agents proposals to take actions and the managers tactics for controlling the 'meeting' (cooperation) agenda and project schedule.

c. the *highest panel* focuses on the synthesis of individual project team sub-plans to form an overall master-plan.

7.3.3.1 The Manager and Control Knowledge

The manager uses the blackboard to distibute and get agreement (contract) on the plans. Consequently, the blackboard is used to manage the cooperation involved during the execution of the project, making sure that its objectives are met and carried out as planned. The manager will use project management techniques to aid him, again to *control* the project and to track and monitor the running of the project ensuring that the project objectives are achieved.

Refering to the concept of systems theory, the general principal involved in *control* is similar to Ashby's (1957) 'error-controlled regulations' outlined in Chapter 2. The project (contract) and the access to the blackboard is the system that the manager wishes to control, and the intended states are expressed in the schedule plans (skeleton and master-plans). The project team agents (eg. architects, engineers, planners, etc) execution of the sub-plans (feedback) is seen as a disturbance to this system, which in turn is monitored and modelled. Then by comparing its existing intended state, a decision can be reached on allowing or preventing such an execution. This philosophy implies a continuous feedback to the actual state (and intended state) of the 'system' to allow for a comparison based on an up-to-date database.

7.3.3.2 Hierarchical Blackboard

Active communication among KSs, however, can cause a bottleneck if all the KSs wants to access the blackboard concurrently. To solve this a *hierarchical* blackboard structure is proposed (Dai, et al 1992). As we have described in Chapter 5.3, a blackboard system with this structure provides a convenient way to decompose complex tasks into sub-tasks and accomplish their subtasks in parallel, significantly enhancing systems performance.

In order to accomodate the different level of 'tasks' executed by the different specialist groups involved in the cooperation, we propose that three categories of blackboard be constructed ie. common project blackboard, individual design blackboard, and client blackboard (Figure 7-5 and Figure 7-7). Since we define problem solving in development control as a *creative process* , the hierarchical blackboard also solves the problem of designers demanding their own private and creative space when designing.

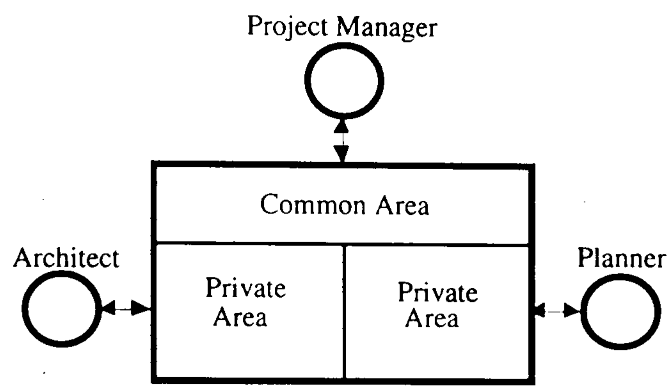


Figure 7-5 Constitution of a Blackboard
(after Dai et al, 1992)

Common Project Blackboard - is used by the project manager for broadcasting, communicating, and for the process of negotiation. Consequently, the project blackboard is used by the manager not just for co-ordination and monitoring, but also to augment the creative process. This includes the integration of the various 'problem solving states' during the process of modifying and updating the blackboards by the participants. Thus changes made by an individual or groups in a particular blackboard can help generate new alternatives by the act of combining (eg. brainstorming, comments, using euclidean transformation in design, etc).

We are also proposing that the the project blackboard be used as a channel to broadcast and 'shame' participants. As described in Chapter 5, the act of 'shaming' agents will be used as a 'deterrent' to ensure that agents keep their commitment to the contract, and will only be used as a last resort.

Private Design Blackboards - are created specifically for the various specialist individual operating agents in a design environment (eg. during the assessement stage). Upon receiving a plan from the manager, the design blackboard is used for the expression of the individuals ideas, while at the same time, working on ideas that are generated from tapping other blackboards (when permitted). Operating agents will have access to their own departments databases and knowledge,

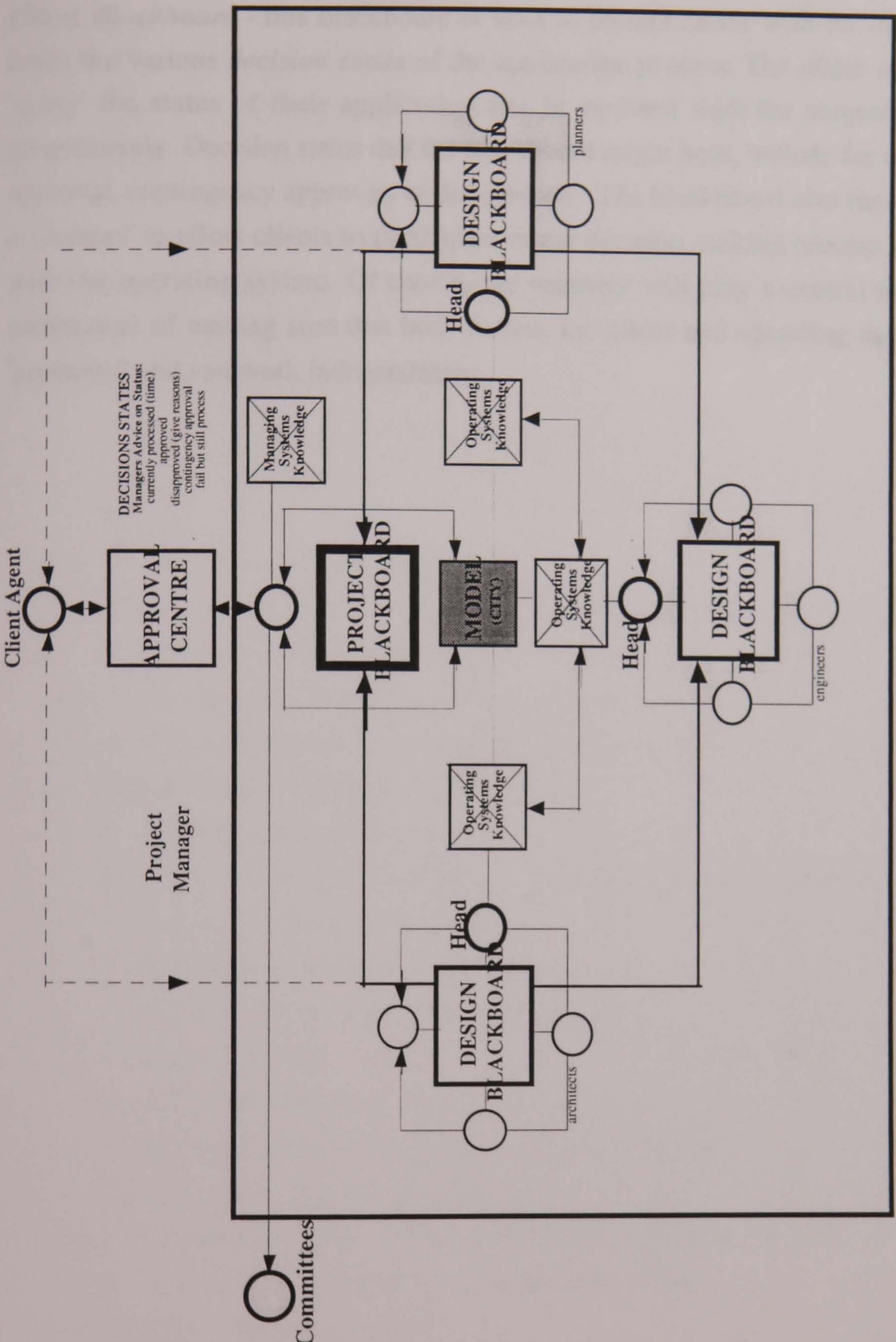


Figure 6-5 Proposed Hierarchical Blackboard Design consisting of the Client Blackboard, Project Blackboard, and Design Blackboad

allowing them to work independently but coherently. Design Blackboards are also utilsed as a 'private space' to solve disagreement and conflicts that might exist during the act of cooperation. This is to ensure that disagreement is not broadcast to team members. Any conflict is to be resolved by the project manager in special 'conflict spaces' in the private blackboard.

Client Blackboard - this blackboard is used to communicate with the client and holds the various *decision states* of the application process. The client agent can 'query' the status of their application and be updated with the project's status progressively. Decision states that the blackboard might hold, include for example, approval, contingency approval, or disapproval. The blackboard also functions as a 'channel' to allow clients to participate in the decision making process together with the operating system. Of course, the manager will play a central third role (arbitrator) of making sure that both parties, i.e. client and operating agents, are 'protected' and can work independently.

Chapter 8
The Prototype of a Management System for Development Control based on the Contract Model

Chapter 8

The Prototype of a Management System for Development Control based on the Contract Model

8.0 General Working of the Prototype

8.0.1 Message Broadcast

We propose a two-phase protocol.

a. The first phase establishes the potential project team agents that will participate, and the ground rules which must be adhered to. This phase is similar to the *task announcement* phase of the contract-net protocol (Smith and Davis, 1981) described in Chapter 6, in which focussed addressing is used to limit the extend of the broadcast to a subset of the entire community. The overall objectives of the project are also made known to the potential agents.

b. The second phase of the protocol specifies who will perform each activity and at what time, this being achieved from the design and analysis of the network model of the team agent's *plan*.

The idea of two-phase broadcasting is similar to current practices in the construction industry, whereby in the first-phase the project manager will broadcast the existence of *projects* (tasks), to be contracted out. Since the cost of this *general* broadcasting is high, only minimal information about the project is made known. In the second phase, selected parties who have made known their intentions to participate, will be provided with the full details of the project. This type of *focussed* addressing, reduces message processing overhead by allowing non-addressed parties to ignore tasks announcements.

Moreover, the two phase strategy is needed because of the complexities of the applications of the parties involved. As the project manager does not have a complete picture of all the activities within the project team (community), it is not aware of the existing commitments and desires of all its potential team agents. Hence, the exact and final timing must be reached through *mutual agreement*, rather than being dictated by the project manager.

8.0.2 Elements of the Prototype

The prototype is developed using Hypercard, Micro Planner and File Maker Pro. The major elements used in the prototype, can be categorised as follows (Figure 8-1).

8.0.2.1 Blackboards and Communications

The project team uses the blackboard to communicate as described in the last chapter. There are three types of blackboard, namely the project blackboard controlled by the project manager, the design blackboard utilised by the individual and specialised operating agents, and the client blackboard which act as a communication channel for the client agent to query and participate in the decision making process.

8.0.2.1 Forms

The broadcasting of messages can be done using *forms*. There are three categories of forms namely, *cooperation* forms, *project* forms and *contract* forms. Cooperation forms are used for communication and theses include *response* forms, *establishing-team* form, and *application for extension of time* form. Project forms hold information relating to the project, and includes the project detail such as databases, drawings, etc. Contract forms contain information relating to the contract such as agreements, conditions, Appendix, and the penalty for breaching the contract.

8.0.2.2 Tools

The project team is aided by a series of *tools* which allow them to work on a particular aspect of the project. These are

i. *Communication Tools* - allow agents to broadcast (SEND button) to the blackboard and extract (READ button) information from it.

ii. *Contract Tools* - allow agents to work on the project. Clicking on the Establish-Team, Assessment, and Plan-Synthesis buttons will call-up specific *form*. The Develop Plans, and the Assessment buttons, will link the user to a background project management software, i.e. MicroPlanner. The Signing & Execute, Update, and Plan Synthesis buttons will link the user to a database software, i.e. FileMaker Pro. The overall concept of the background software, is illustrated in Figure 8-2.

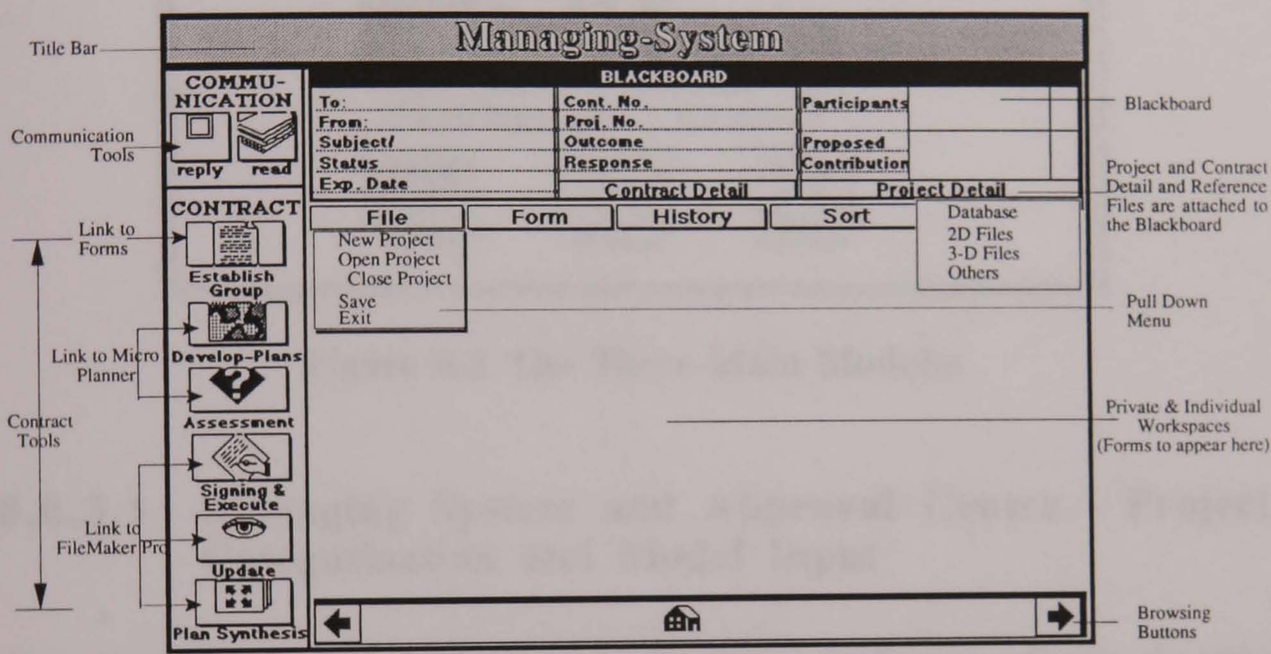


Figure 8-1 Overall Systems Interface

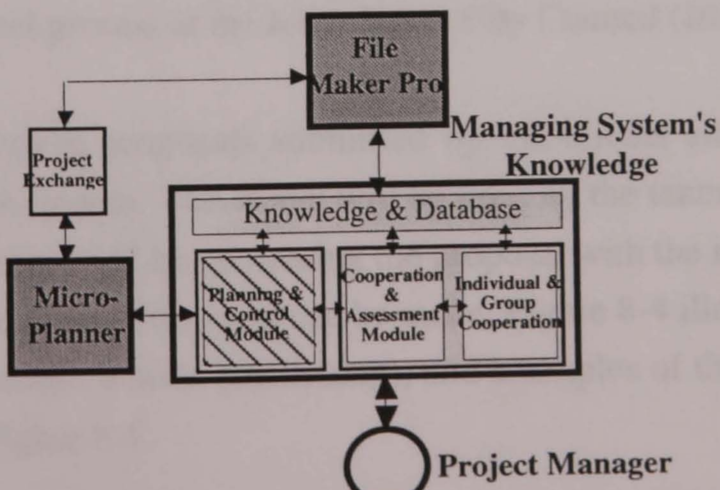


Figure 8-2 Background Software used in the Prototype

8.0.3 The Three Main Modules

The Management System illustrated in Figure 8-3, can be divided into three main modules, namely the managing system utilised by the project manager, the operating systems, utilised by the project team agents, and the client system, utilised by the client agents.

Figure 8-3 The Three Main Modules

8.0.3.1 Managing System and Approval Centre - Project Categorisation and Model Input

Once the client agent has submitted an application to the Approval Centre, the tasks of the project manager include project categorisation, and inputing the project information into the overall system's Model (a continuous updating process). As described in chapter 2, the Model functions as the 'technical heart' for the development control process at the Johor Bahru City Council (JBCC).

Here the development proposals submitted by the clients are considered as a 'disturbance' to the system. The model will be used by the team agent to simulate the proposal (changes) and by comparing the proposal with the intended plans (eg. local and structure plan), a decision can be made. Figure 8-4 illustrates the overall concept of the manager's tasks (modelling), and examples of the project database are illustrated in Figure 8-5.

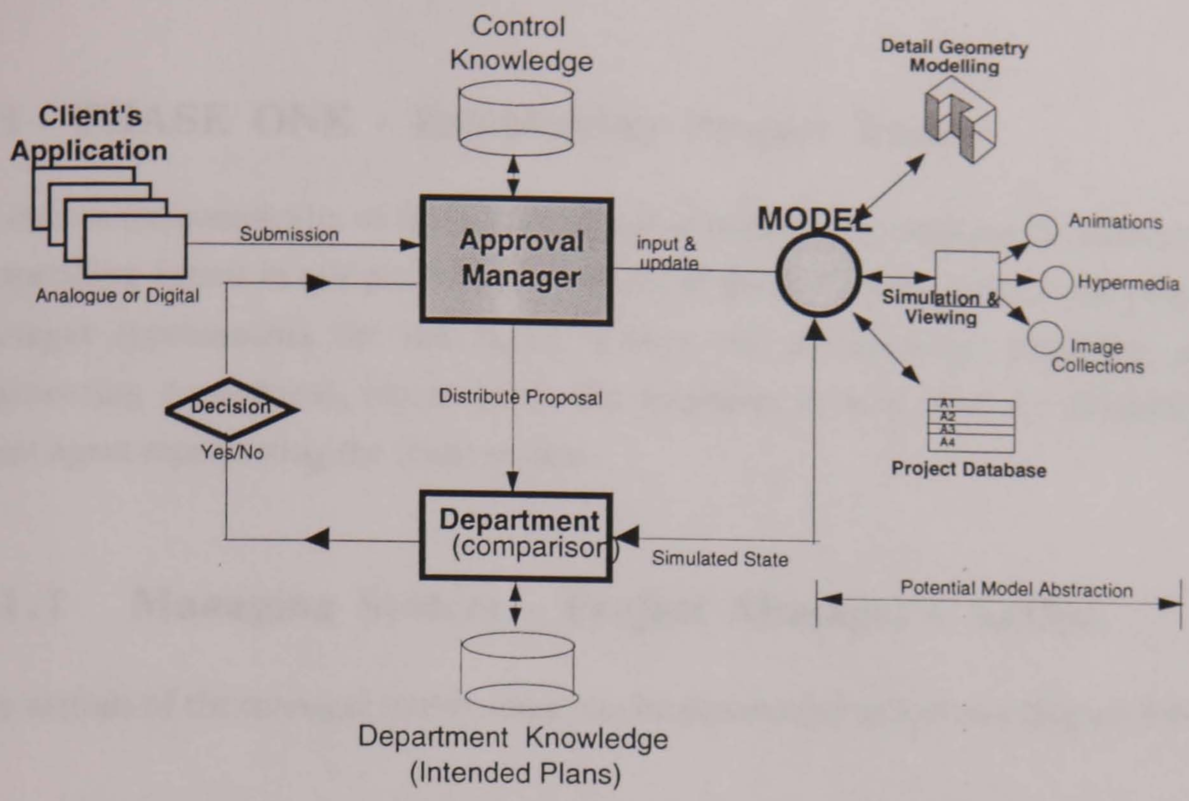


Figure 8-4 Concept of Control, Model Input and Abstraction
(after McLoughlin, 1982)

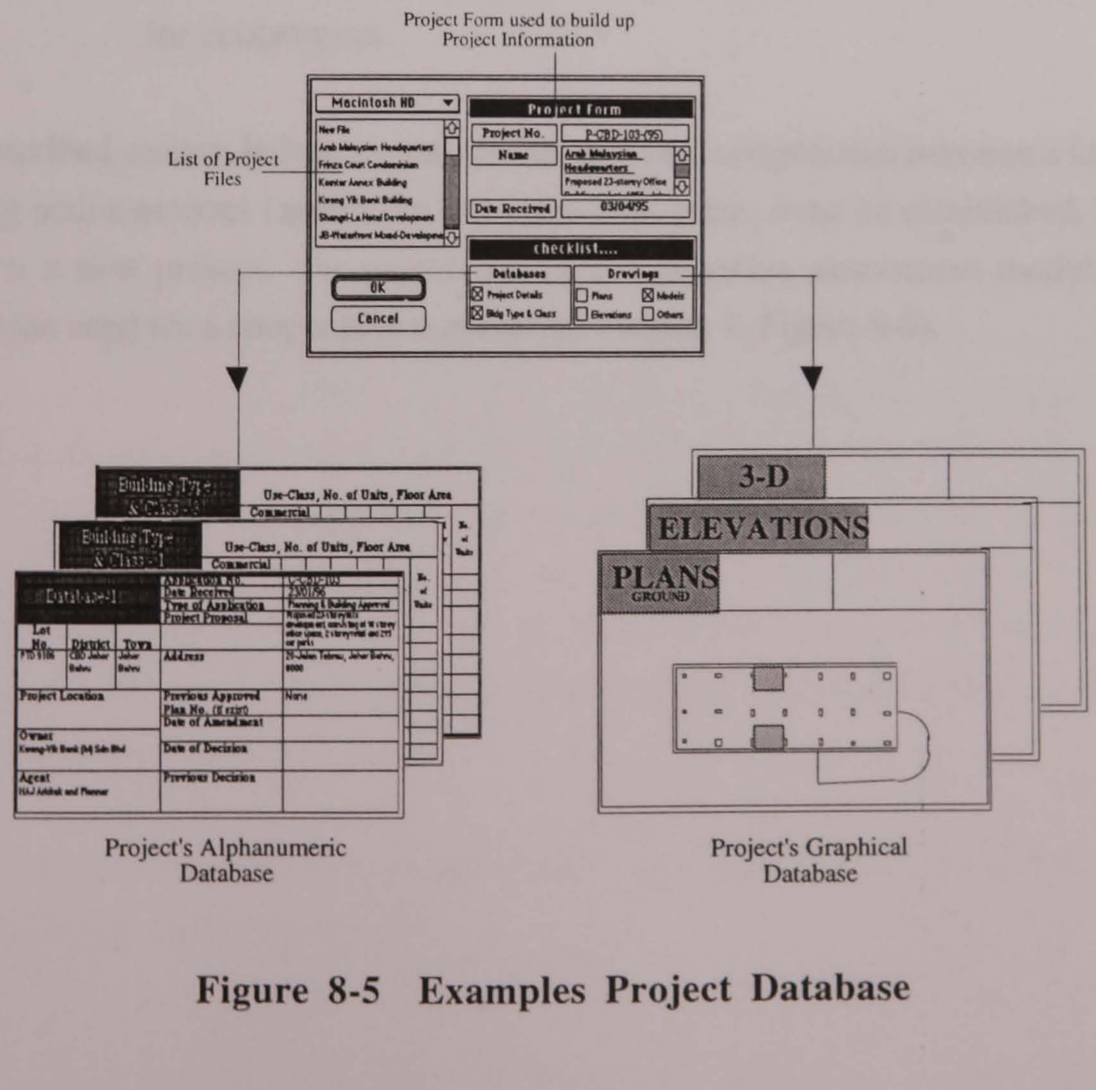


Figure 8-5 Examples Project Database

8.1 PHASE ONE - Establishing Project Team

To reduce the complexity of the interactions involved, we are limiting the number of cooperating agents in our prototype to consist of the following, namely the project manager representing the managing system, the architecture, planning, and engineering department, representing the operating system, and the submitting client agent representing the client system.

8.1.1 Managing System - Project Manager's Action

The actions of the manager in this stage can be summarise as follows (Figure 8-6).

> Manager receives new application and detects need for joint-action to
> solve project's goal ***G***
> AND determines that plan ***P*** is the best means of attaining it
> Manager contacts all potential team agents capable of contributing to
> ***P*** to determine
> IF they will participate in the joint-action using the Contract Model
> for cooperation.

As described earlier, before a contract can proceed, cooperation between a team of willing acquaintences (agents) to form a project team, must be established. When there is a new project, the project manager's situation assessment module will detect the need for a cooperative team action (action 1, Figure 8-6).

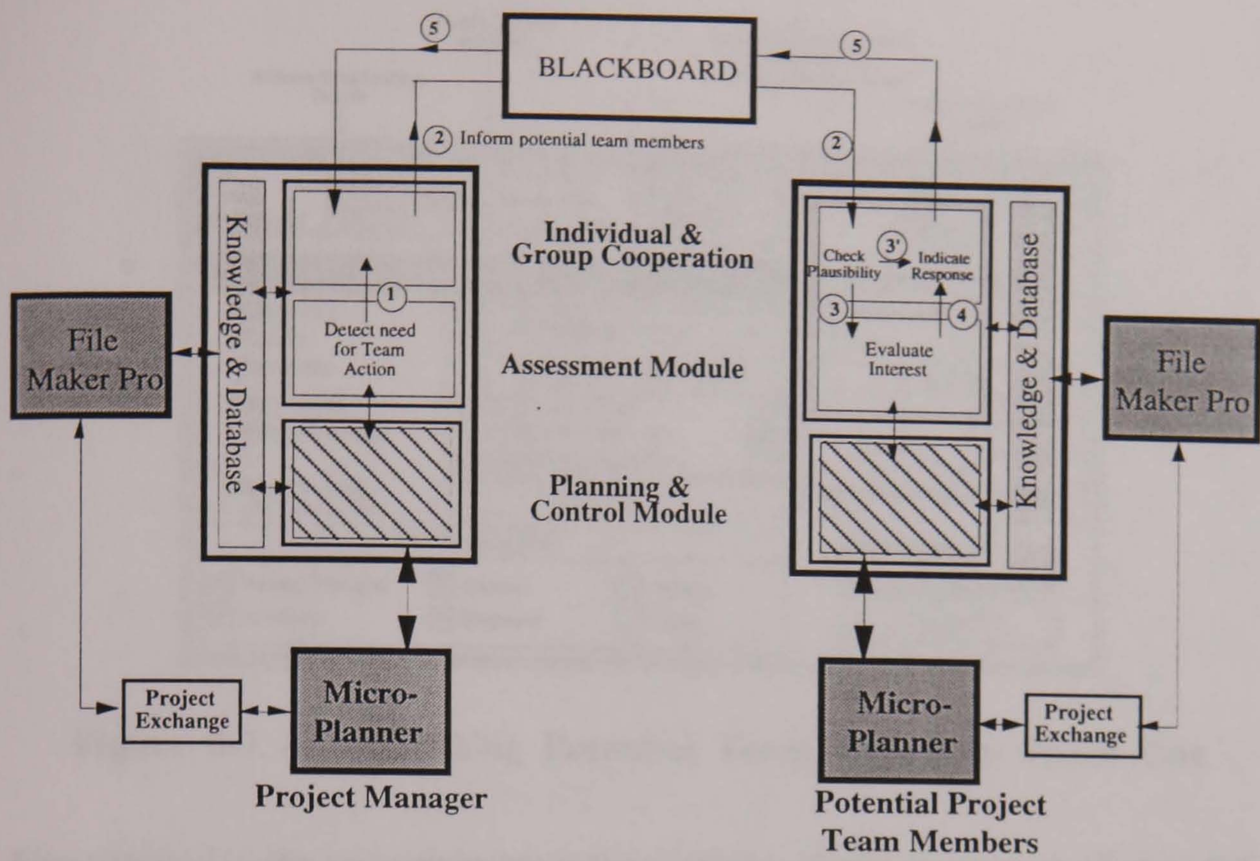


Figure 8-6 Establishing a Project Team

The project manager will use the *cooperation* form for broadcasting to potential team agents. This form has five main slots namely the status, outcome, participants, proposed contribution, and expiry date slot (Figure 8-7).

The *status slot* refers to the current phase of the planning protocol and has the value *establishing-team*. The *outcome slot* enumerates the expected results of performing the cooperation, and has the value *agreeing to participate*. The *participants* slot indicates the proposed team agents to execute the project. The *proposed contribution* slot records those agents which are adjudged by the project manager, to be capable of contributing to the solution and it also specifies whether they have agreed to make the contribution. Since we are in Phase-One, none of the potential agents has agreed to make a contribution. In a way, this slot is used to further restrict the possible respondents from submitting a 'bid' as only those who feel able to make the required contribution will respond. Finally, the *expiry date* slot records the deadline for receiving a response.

Since time is critical in the negotiation process, we assume global synchonisation among the potential team agents.

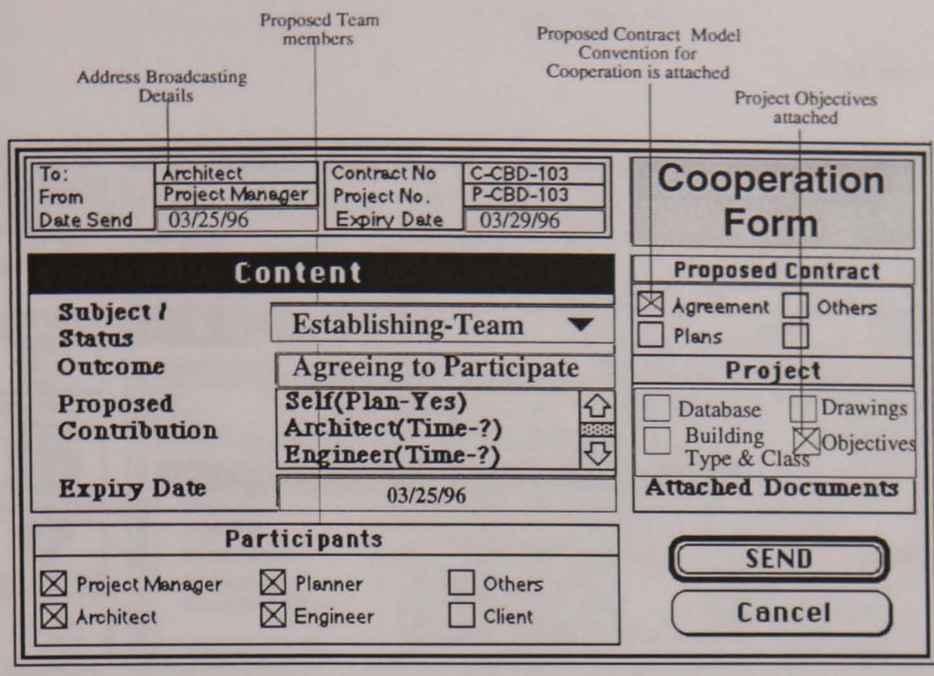


Figure 8-7 - Establishing Potential Team Agents in Phase One

Also attached in the announcement is the *Contract Model* convention (Figure 8-8). Among others, the convention outlines the roles and responsibilities of the project team, and the procedures for cooperation. It is assumed that these conventions and rules will become familiar to all project team agents as more projects are executed. A full detail of the Contract Model convention can be found in Appendix 4-A. Finally, the objectives of the project is also attached for broadcasting.

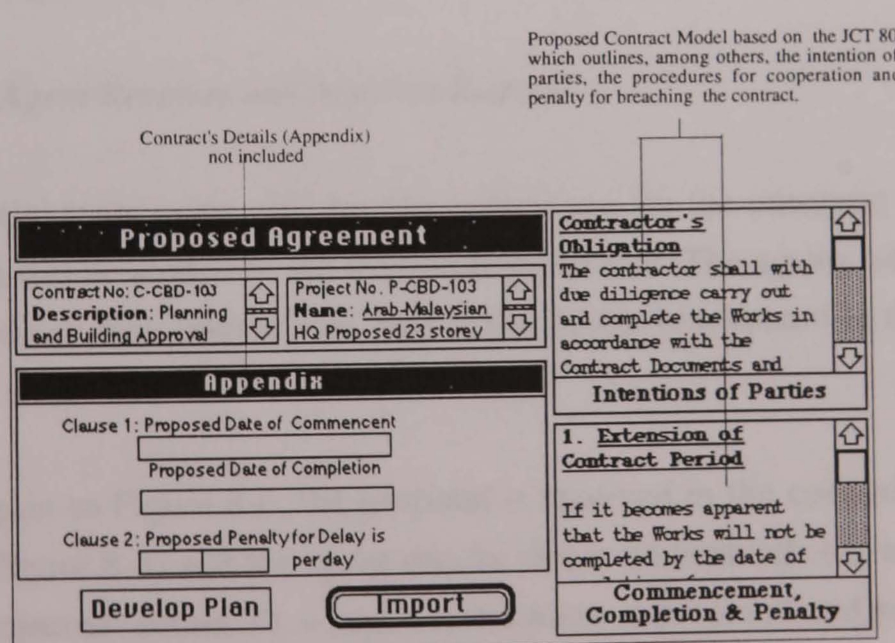


Figure 8-8 - Proposed Agreement outlining the Contracts Conventions, and Rules for Cooperation

Refering again to Figure 8-6, the completed form, is then SEND to the blackboard, as illustrated in Figure 8-9, to all potential team agents (action 2, Figure 8-6).

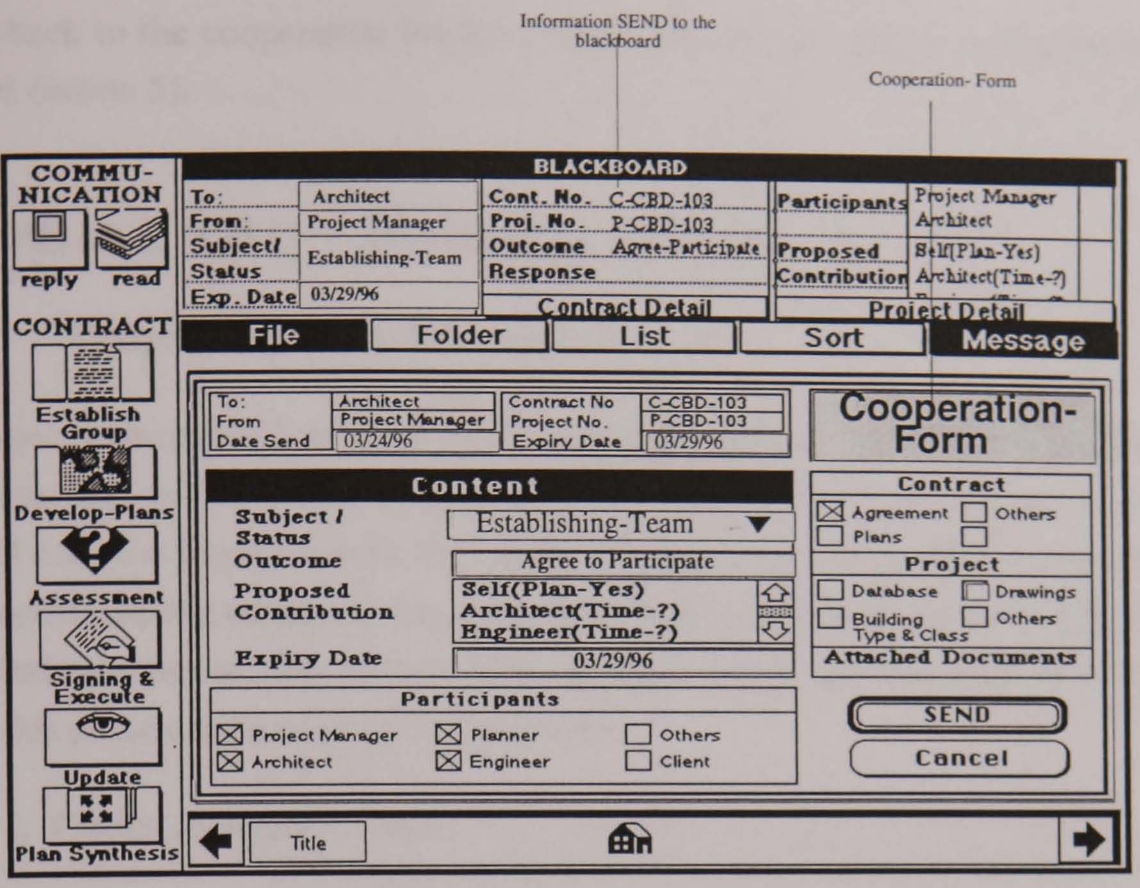


Figure 8-9 - Message SEND to the Blackboard

8.1.2 Operating Systems - Potential Project Team Agent's Actions

i. *Potential Agent Receives and Assesses Request*

Each potential team agent will receive a message (in the common space of the blackboard) and be alerted of the need to respond to it. The agents will READ the message and use their own private area in the design blackboard as their working space.

Refering again to Figure 8-6, the proposal is received in the cooperation module (action 3, Figure 8-6) and the agent checks that it understands the request. If the request is rejected (action 3'), a negative response is prepared and passed back to the manager. Assuming that the request is accepted at the cooperation module, it is then passed to the situation assessment module (action 4) to see whether it has sufficient resources to tackle the problem. This involves analysing existing commitments database (in Micro Planner, and FileMaker Pro), to ensure that the proposal made is consistent with existing ones, and that it can be accomodated successfully. We will see the use of MicroPlanner and File Maker Pro for this type of assessment later in the chapter. The result of this evaluation, either yes or no, is passed back to the cooperation module, which returns the answer to the project manager (action 5).

8.2 PHASE TWO - Developing Solution

8.2.1 Project Manager's Action

The project manager will compile all the responses from Phase-One, and identify the agents who will form a team to execute the project. The second-phase of the protocol can now begin whereby the project manager needs to develop a *plan* that will specifies among others, the exact detail of the activities to be performed by the individual team agents. The actions of the project manager and the team members during this phase can be summarise as follows:

i. *Project Manager's Action*

Let Ω = set of willing project team agents
Project Manager design Plan ***P***

For all actions in Plan ***P***
  select team agent **A** $\in \Omega$ to carry out activities in plan ***P***
  calculate time (*t*) to be performed by A (obtained from PERT analysis)
  send (*t*) proposal to ***A***

ii. *Individual Team Agent's Action*

A evaluates proposal against existing commitment (*C*)
  IF no-conflict, THEN create commitment C_1
  IF conflicts
    THEN find free time, note commitment, and propose updated time to manager
  Return acceptance or modified time to project manager
IF time proposal is modified THEN update remaining action times

END FOR ALL

Note: the symbol $\in$ denotes the operator 'is a member of'

8.2.1.1 Development of Project Team Agents Plan and Interdependencies

As described in chapter 3, one of the main aim of utilising project management techniques to manage development control, is to achieve integration. Project integration consists of ensuring that the various 'pieces' of the project, come together as a 'whole' at the right time, and according to plan (Struckenbruck, 1974). In the development control process, two types of integrating tasks are demanded. Firstly, the integration of the different specialised project team agents, and secondly, the need for integration between the output of the tasks, such as individual proposals, opinions, and viewpoints. Integration in both cases is paramount because of the existence of firstly, *sequential interdependency* and secondly, *reciprocal interdependency*. As described in Chapter 3.2.1, sequential interdependency is best integrated using *plans* and *schedules*. Reciprocal interdependency on the other hand, is best integrated by *negotiation* and *mutual adjustment* between the parties involved.

We will first look at sequential interdependency and the use of plans and schedules.

8.2.1.1.1 Development of Plans

We have concluded in the last chapter that the development of a final plan can only be achieved through negotiation. Prior to negotiating, much of the information needed for developing a plan, namely, activities and its relationships, available resources that can be allocated for the different activities, and the time required to complete each activity, may be uncertain, incomplete, or unavailable. We proposed that the development of a *skeleton-plan*, where information is incomplete, is done by using assumptions and/or facts. Assumptions are a necessary part of *concurrent* development of plans. Furthermore, the use of assumptions reduces the need for frequent interaction which causes delays and increases communication cost. These assumptions however need to be confirmed before a final concrete plan emerges.

In addition to these assumptions and facts, the manager uses his experience and knowledge, and/or PERT techiniques, to arrive at propositions regarding the completion of various activities. Refering to the example in Figure 8-8, based on the resources available (fact), and activity knowledge (fact), and resource allocation (assumption), the project manager can arrive at a proposition to complete the *consultation* activity in 30 working days.

Another special feature of our plan development, is the time limit or *deadline* within which the project must be completed. In many ways, this again makes the modelling of the plan unique compared with conventional projects. Where we usually utilise PERT techniques to analyse and show us the possible beginning and completion time of the project, this information is already known in our model, and therefore can be *allocated*. Every project starts on the day the client agent submits to the Approval Centre, and as a legislative requirement described in Chapter 4, must end 3 months afterwards. The analysis that needs to be done now, is to determine how much resources that must to be allocated, the interdependencies of the cooperation activities, and at what time, without over running the project's deadline.

8.2.1.1.2 The Planning Process

In developing the individual team agent's plan, we assumed that agents have already been informed and understand the overall objectives of the project in phase one of the protocol. The distribution of the workload may not pose special problems if the workload is so distributed that it matches the *expertise* of each team agents. In our example, we assume that the workload is distributed along the departmental lines and that each department is aware of its goals in meeting the overall objectives. Since they function as a team, they also have the knowledge of the interactions they may have with other team agents.

Depending on the nature of the project (size and complexity), each team agent may have complete or incomplete knowledge of all the activities it has to perform. Whatever the actual case, we assume that at the very least, each agent knows the *major activities* it has to perform to accomplish its goals. Thus each agent should be able to list the major activities (without pre-specifying any sequence) it needs to perform, along with the possible interactions it may have with other agents. Apart from the project manager, Figure 8-10 illustrates the major specialised tasks that will be performed by the different agents during the *assessment and consulatation stage*.

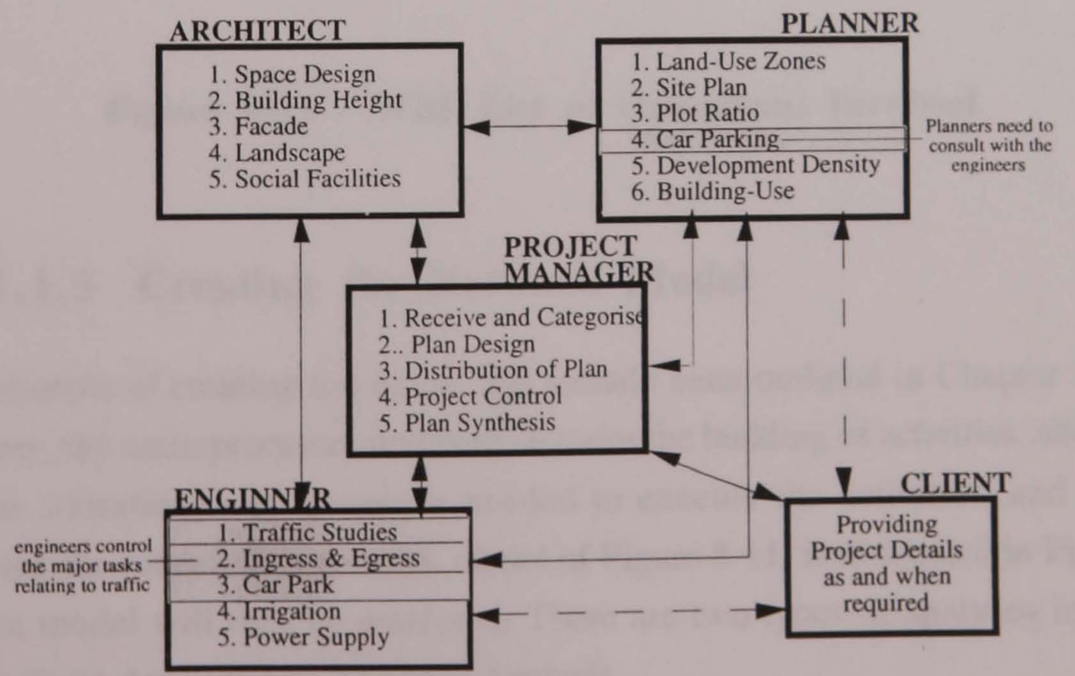


Figure 8-10 - Individual Team Agents Major Tasks during Assessment and Consultation Stage

As illustrated in the above diagram, the planning department for example, knows from its *belief* database, that before it can approve the car parking proposal for a development, it needs to consult and get an agreement from the engineering department as well.

The project manager will first draw up Work Breakdown Structure (WBS) diagram, i.e. a list of the major operation involved in the project, and the estimated time (duration) to complete each activity, the resources needed, and the person responsible for the execution of each activity. If needed, these will be broken down further, into sub-activities as depicted in Figure 8-11.

Operation	Estimated no. of working days
1. Initial Stage	
a. Receive and Categorise	4
b. Broadcast Task (Phase-One)	1
c. Receive Feedback (Phase-One)	4
b. Design of Plans	5
2. Distribution Stage	1
3. Consultation Stage	30
4. Coordination Stage	
a. Coordination of Consulation	5
b. Foward to Planning Committee	5
5 Planning Committee Decisions	5
TOTAL	**60**

Figure 8-11 - WBS List of Operations Involved

8.2.1.1.3 Creating the Network Model

The concepts of creating the model has already been outlined in Chapter 3. As a summary, the main processes involved includes the building of activities, allocating its time (duration) and resources needed to execute the activities, and finally analysing the model. The network model of Figure 8-11, is illustrated in Figure 8-12. The model will then be *analysed*. There are two types of analyses involved namely Time Analysis and Resource Analysis.

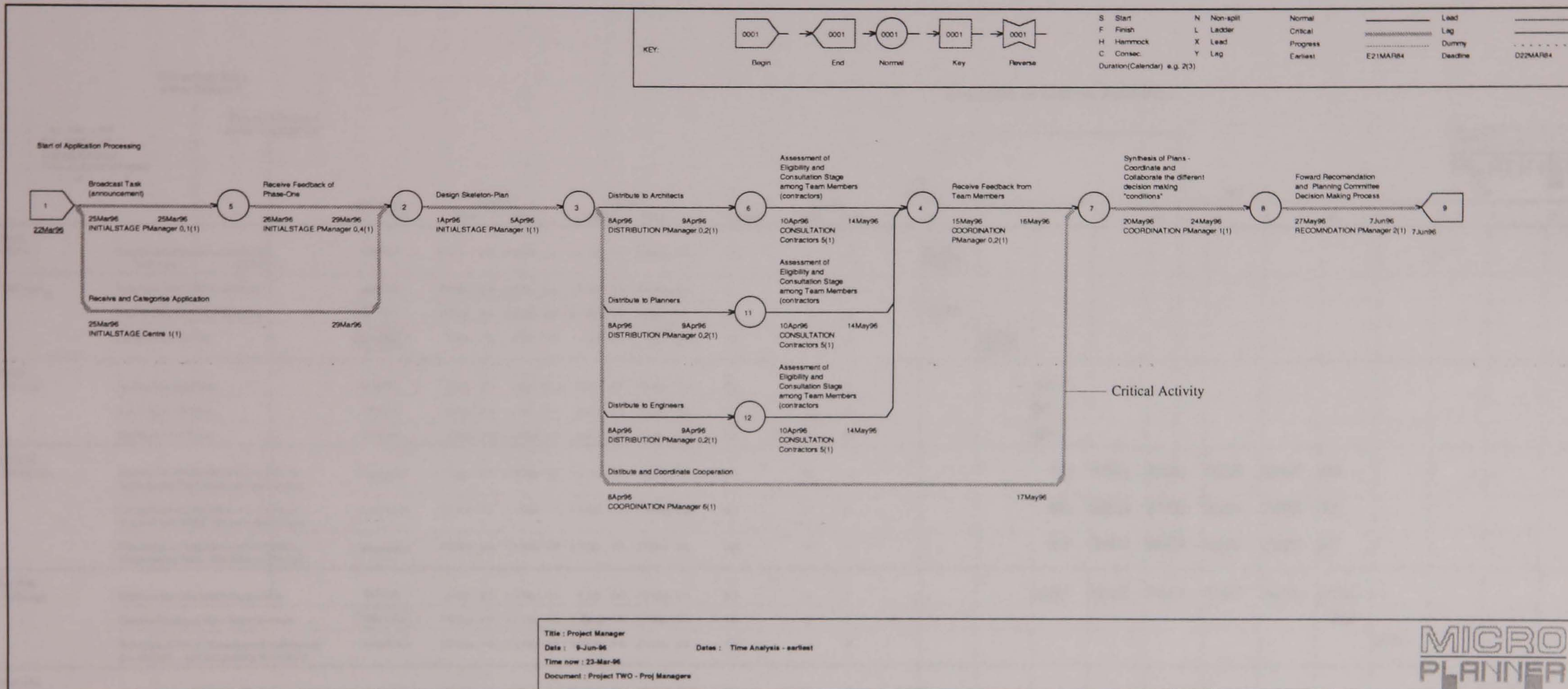


Figure 12 - Project Manager's Network Diagram for Phase-One and Phase-Two

This activity has a status 'Believed'

This activity has a status 'Assumption'

Date : 9 - JUN - 96
Time Now : 23 - MAR - 96
Project : **Project Manager**
Output : **Time analysis schedule**
Sheet : 1 of 1

			STATUS	EARLY Start	EARLY Finish	LATE Start	LATE Finish	Duration	Events Prec	Events Succ
INITIALSTAGE	Centre	Receive and Categorise Application Technician 2.00	Believed	25 Mar 96	29 Mar 96	25 Mar 96	29 Mar 96	1,0	1	2
	PManager	Broadcast Task (announcement)	Believed	25 Mar 96	25 Mar 96	25 Mar 96	25 Mar 96	0,1	1	5
		Receive Feedback of Phase-One	Believed	26 Mar 96	29 Mar 96	26 Mar 96	29 Mar 96	0,4	5	2
		Design Skeleton-Plan	Believed	1 Apr 96	5 Apr 96	1 Apr 96	5 Apr 96	1,0	2	3
DISTRIBUTION	PManager	Distribute to Architects	Believed	8 Apr 96	9 Apr 96	9 Apr 96	10 Apr 96	0,2	3	6
		Distribute to Planners	Believed	8 Apr 96	9 Apr 96	9 Apr 96	10 Apr 96	0,2	3	11
		Distribute to Engineers	Believed	8 Apr 96	9 Apr 96	9 Apr 96	10 Apr 96	0,2	3	12
CONSULTATION	Contractors	Assessment of Eligibility and Consultation Stage among TeamMembers (contractors)	Assumption	10 Apr 96	14 May 96	11 Apr 96	15 May 96	5,0	6	4
		Assessment of Eligibility and Consultation Stage among Team Members (contractors)	Assumption	10 Apr 96	14 May 96	11 Apr 96	15 May 96	5,0	11	4
		Assessment of Eligibility and Consultation Stage among Team Members (contractors)	Assumption	10 Apr 96	14 May 96	11 Apr 96	15 May 96	5,0	12	4
COORDINATION	PManager	Distibute and Coordinate Cooperation	Believed	8 Apr 96	17 May 96	8 Apr 96	17 May 96	6,0	3	7
		Receive Feedback from Team Members	Assumption	15 May 96	16 May 96	16 May 96	17 May 96	0,2	4	7
		Synthesis of Plans - Coordinate & Collaborate the different decision making "conditions"	Assumption	20 May 96	24 May 96	20 May 96	24 May 96	1,0	7	8
RECOMNDATION	PManager	Foward Recomendation and Planning Committee Decision Making Process	Assumption	27 May 96	7 Jun 96	27 May 96	7 Jun 96	2,0	8	9

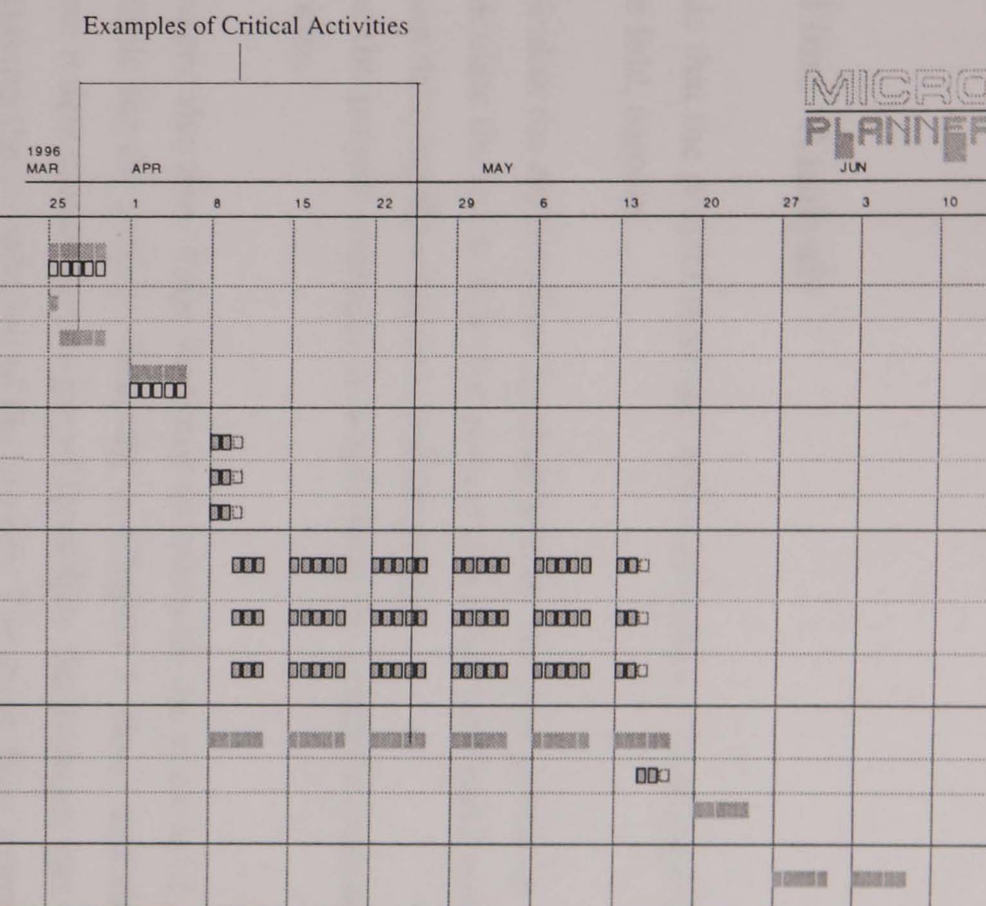


Figure 13 - The Project Manager Records an Activity's Status on the Time Analysis Barchart Diagram

8.2.1.1.4 Time Analysis

The first analysis that the project manager will undertake is Time Analysis. The objective is three fold, namely,

i. to calculate the *earliest date* that each activity can *start* and *finish*
ii. to calculate the *latest date* that each activity can *start* and *finish* without delaying the completion of the project
iii. to aid the project manager in identifying the project's *critical* activities.

The project manager also uses Time Analysis to calculate the amount of *float* or *slack* time available for the project. Refering to Chapter 3, floats and slacks are important because it determines the margin of flexibility the manager has with the dates without delaying the completion of the project. The more float a project has, the more flexibility it gives the manager.

Refering again to Figure 8-12, the critical dates that need attention, is the *interface* of the *consultation and assessment stage* of the various team agents. As illustrated in Figure 8-11, the project manager has allocated a total of 30 working days (equivalent to 6 weeks based on a 5 day week) for the completion of this stage without delaying the project.

8.2.1.1.5 The Time Analysis Bar Chart

The final dates need to be negotiated and confirmed with the various team agents. The project manager uses the Time Analysis Schedule Bar Chart, illustrated in Figure 8-13, to record the *status* of each activity. The status has the value *assumed* or *believed* depending on the knowledge the project manager has about the activity. For example, the project manager knows, i.e. *a fact*, that the activity 'Design Skeleton-Plan' (which the manager is responsible for) will take five working days and can start in week 2. However, since the activity 'Receive Feedback From Team Agents' depends on a number of preceeding activities, he can only *Assumed* that it will be completed in week 8. When an 'assumed' activity has been confirmed (eg. through negotiation), its status will changed to ***Believed***. The Time Analysis Schedule barchart, also display vital activities information, including its *earliest* and *latest* start and finish dates, as well as the *duration* of each activity.

8.2.1.1.6 Project Exchange and Import

Once the network model has been analysed, the project manager's task is to broadcast the proposed dates to the individual team agents. In our prototype, specific activity dates can be extracted by the project manager automatically for broadcasting. In MicroPlanner, this can be done through a utility program called Project Exchange. Project Exchange allows the project manager *to transfer* a specific part of the network (eg. an activity) to, or *receive* a data *from* another application such as a database or a spreadsheet program. In our prototype, statistical information and records about resource usage, activity durations, or critical activities are being kept in the FileMaker Pro database program. The concept of Project Exchange is illustrated in Figure 8-14. The technical details for exporting and importing data using this utility is attached in Appendix 4-C.

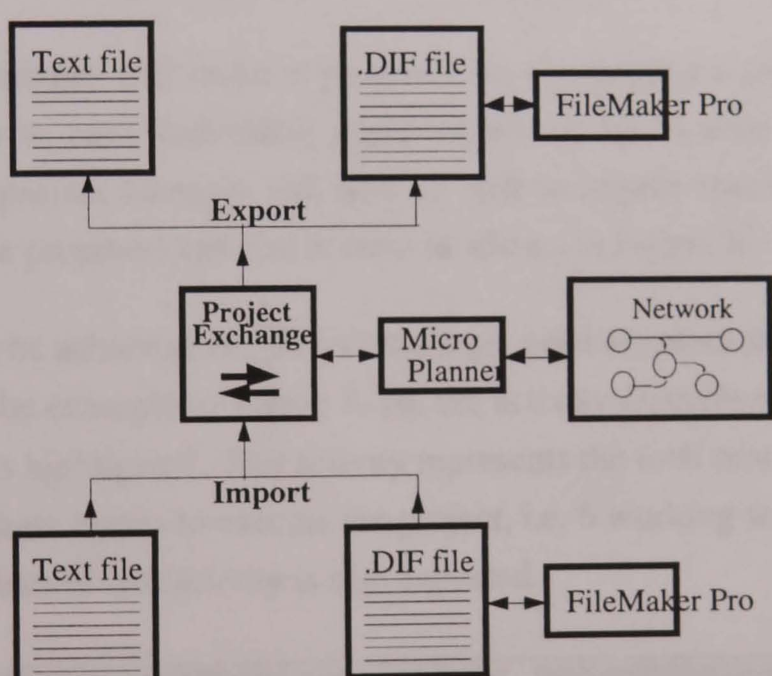


Figure 8-14 - Concept of Network Import and Export
(after Micro Planner)

8.2.1.2 Broadcasting of Plans

Using the *cooperation form* (Figure 8-15) once again, the project manager now updates the *status* slot to *developing-solution* and modifies the *participants* slot to reflect the fact that the team is now in the solution planning phase, and updates the *outcome* slot to *validated-assumptions*. As mentioned earlier, the numbers of potential agents from the operating system, has been limited to the architects, planners, and engineers.

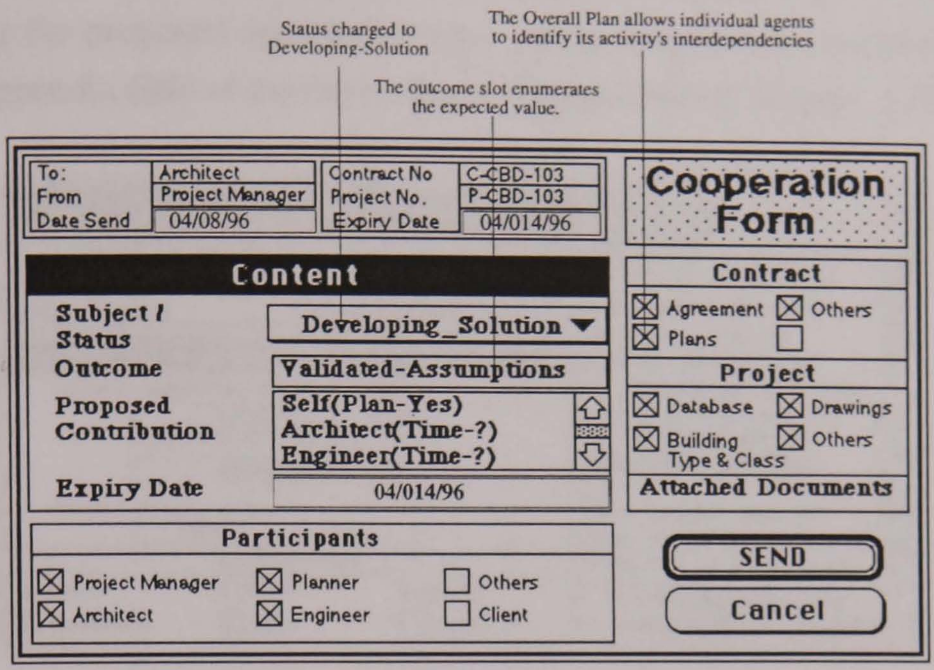


Figure 8-15 - Developing-Solution

The project manager will make a proposal for the project's *starting dates* and *finishing dates* to each individual agent based on his analysis. Using Project Exchange, the project manager will now be able to import specific dates into the Appendix of the proposed agreement form as shown in Figure 8-17.

Before this can be achieved, the project manager need to select the specific activity for export. In the example in Figure 8-16, the activity *Distribute and Coordinate Cooperation* is highlighted. This activity represents the total amount of time given to the various team agents to execute the project, i.e. 6 working weeks. The starting and finishing dates of this activity is also exported.

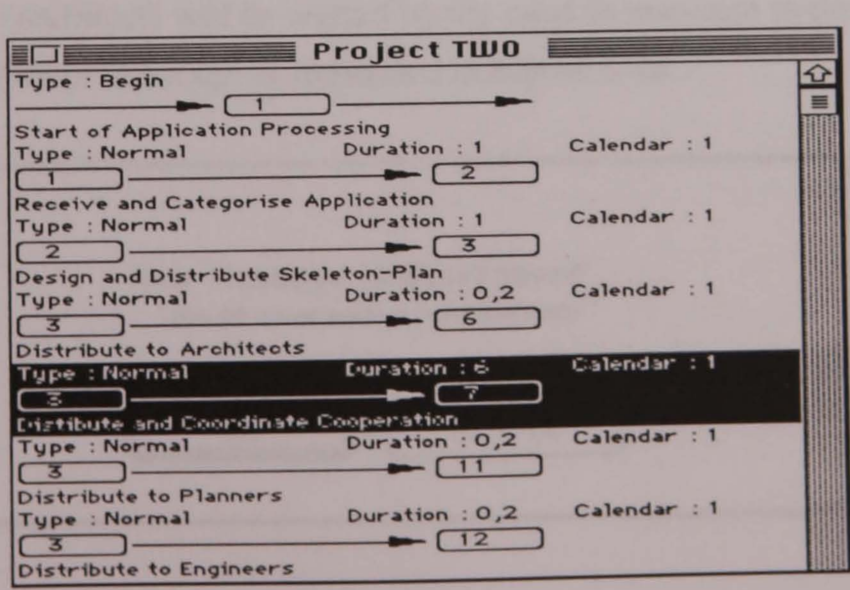


Figure 16 - Activity (3)→(7) is selected for Export

Refering to the network diagram of Figure 8-12, the proposed commencement date for this activity is *8-April-1996,* and the proposed completion date to be *18-May-1996.* Using the proposed agreement form, these dates will be extracted into the allocated Appendix field of the form using the Import button (Figure 8-17).

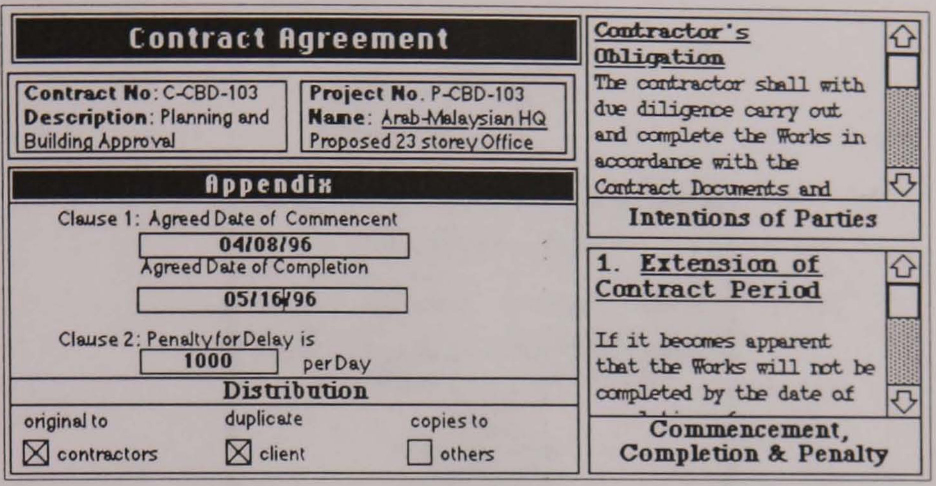


Figure 8-17 - Proposed Agreement together with the Contract and the Project Details

The proposed date is then SEND to the individual agents (in this example, the architect), together with the overall network plan. The attachment of the overall network plan is important to allow each team agents firstly, to identify the details of the activity that has been allocated to it, and secondly, identify the agent's inter-dependencies activities in relationship with the other project team agents.

8.2.2 Contractor's Actions - The Architecture Department as an Example

The contractor (architect) will be alerted by the need to response to the proposal by the manager, with the message as illustrated in Figure 8-18.

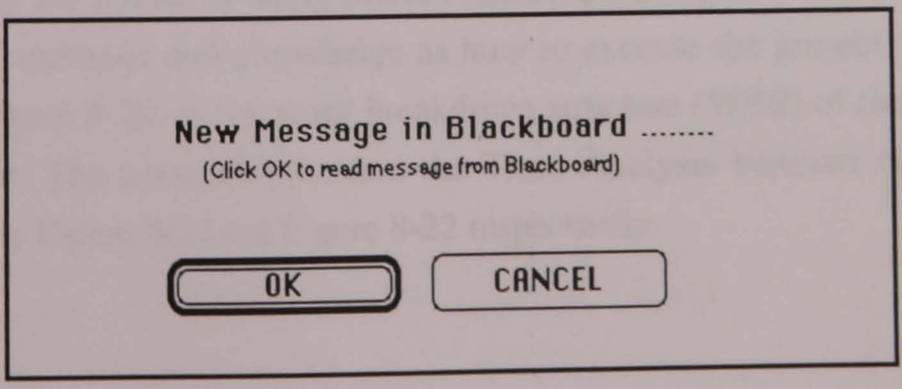


Figure 8-18 - New Message

Upon receipt of the proposal (after it READs from the blackboard), the architect will need to evaluate as to whether the proposed dates is acceptable. To aid him with the task, the architect utilises the Assessement Tools. This is a 'link' button to his department's commitment database, modelled in MicroPlanner. All of the tasks will be done in their private area of the Design Blackboard illustrated in Figure 8-19.

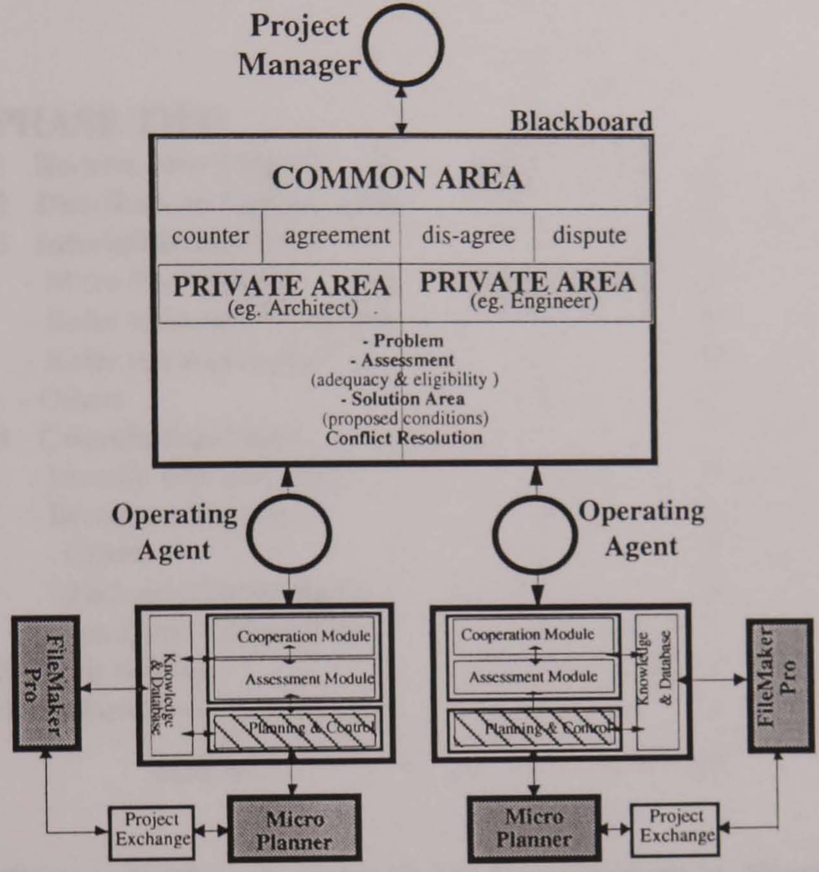


Figure 8-19 Operating Agents's Design Blackboard

8.2.2.1 Development of Individual Agent's Plan

Just like the project manager, every team agent has it own commitment database. Again, these are modelled using Micro Planner. Every agent will also have its own specialised methods and knowledge as how to execute the project. The example given in Figure 8-20, is the work breakdown structure (WBS) of the Architecture Department. The network plan and the Time Analysis barchart of the WBS is illustrated in Figure 8-21and Figure 8-22 respectively.

Operation	Estimated no. of working days
PHASE ONE	
1 **Receive Request**	1
2 **Evaluate & Assess Request**	
- Check against other commitment	2
3 **Inform Requestor**	1
4 **Monitor Request**	5
TOTAL	**9**

PHASE TWO	
1 **Receive New Project**	1
2 **Distribute to Caseworkers**	2
3 **Internal Evaluation**	
- Make Site Visit	7
- Refer to Standard Checklist	8
- Refer to Past Records	8
- Others	7
4 **Consultation Stage**	
- Identify who and what	2
- Broadcast Request	2
- Client	5
- Technical Departments	5
- Coordinate Consultation	3
5 **Crit Session**	5
6 **Inform Project Manager**	2
TOTAL	**57**

Figure 8-20 - Architecture Department's Work Breakdown Structure

Apart from this, the architect has to assess and determine, for example, whether these activities should be completed locally or whether assistance should be sought from other project team agents. This decision is based upon the number of plan components which the architect wants its acquaintance (project team agents) to cooperatively undertake. There are three potential outcomes of this analysis:

i. the action can be solved entirely locally

ii. need full external input (eg. from other team agents) i.e. need full joint-consultation

iii. some assistance is needed but not sufficient to warrant a full joint-consultation (i.e. only require partial input).

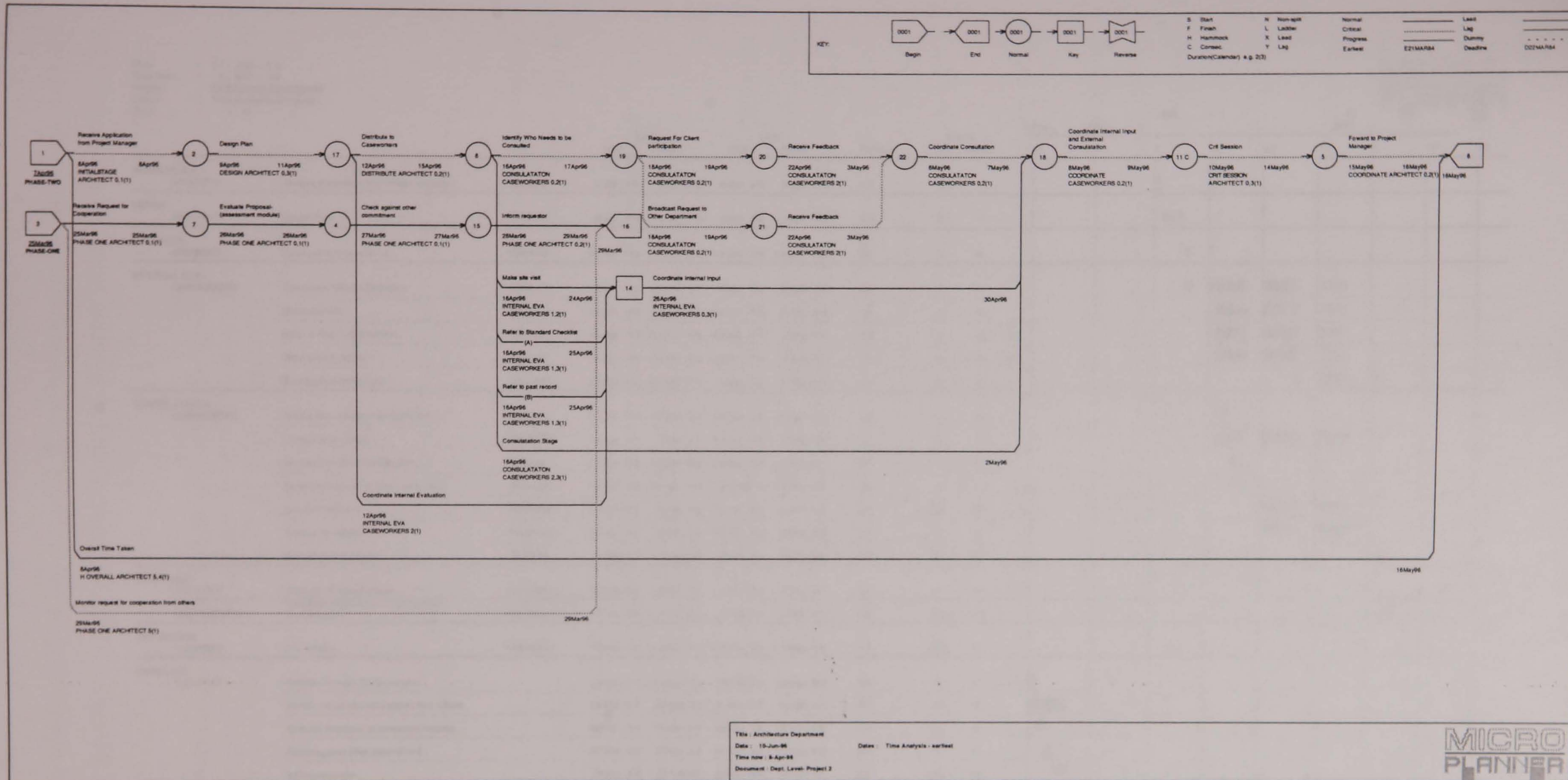


Figure 21 - Architecture Department's Network Diagram

Date : 11 - JUN - 96
Time Now : 8 - APR - 96
Project : Architecture Department
Output : Time analysis schedule
Sheet : 1 of 1

			EARLY Start	EARLY Finish	LATE Start	LATE Finish	Duration	Events Prec	Events Succ	
INITIALSTAGE										
ARCHITECT	Receive Application from Project Manager	Believed	8 Apr 96	8 Apr 96	8 Apr 96	8 Apr 96	0,1	1	2	
DESIGN										
ARCHITECT	Design Plan	Believed	9 Apr 96	11 Apr 96	9 Apr 96	11 Apr 96	0,3	2	17	
DISTRIBUTE										
ARCHITECT	Distribute to Caseworkers	Believed	12 Apr 96	15 Apr 96	12 Apr 96	15 Apr 96	0,2	17	8	
INTERNAL EVA										
CASEWORKERS	Coordinate Internal Evaluation	Believed	12 Apr 96	25 Apr 96	19 Apr 96	2 May 96	2,0	17	14	
	Make site visit	Believed	16 Apr 96	24 Apr 96	24 Apr 96	2 May 96	1,2	8	14	
	Refer to Standard Checklist	Believed	16 Apr 96	25 Apr 96	23 Apr 96	2 May 96	1,3	8	14	A
	Refer to past record	Believed	16 Apr 96	25 Apr 96	23 Apr 96	2 May 96	1,3	8	14	B
	Coordinate Internal Input	Believed	26 Apr 96	30 Apr 96	3 May 96	7 May 96	0,3	14	18	
CONSULATATON										
CASEWORKERS	Identify Who Needs to be Consulteo	Believed	16 Apr 96	17 Apr 96	16 Apr 96	17 Apr 96	0,2	8	19	
	Consulatation Stage	Assumption	16 Apr 96	2 May 96	19 Apr 96	7 May 96	2,3	8	18	
	Request For Client participation	Believed	18 Apr 96	19 Apr 96	18 Apr 96	19 Apr 96	0,2	19	20	
	Broadcast Request to Other Department	Believed	18 Apr 96	19 Apr 96	18 Apr 96	19 Apr 96	0,2	19	21	
	Receive Feedback	Assumption	22 Apr 96	3 May 96	22 Apr 96	3 May 96	2,0	20	22	
	Receive Feedback	Assumption	22 Apr 96	3 May 96	22 Apr 96	3 May 96	2,0	21	22	
	Coordinate Consultation	Believed	6 May 96	7 May 96	6 May 96	7 May 96	0,2	22	18	
COORDINATE										
ARCHITECT	Foward to Project Manager	Assumption	15 May 96	16 May 96	15 May 96	16 May 96	0,2	5	6	
CASEWORKERS	Coordinate Internal Input and External Consulatation	Assumption	8 May 96	9 May 96	8 May 96	9 May 96	0,2	18	11 C	
CRIT SESSION										
ARCHITECT	Crit Session	Assumption	10 May 96	14 May 96	10 May 96	14 May 96	0,3	11 C	5	
PHASE ONE										
ARCHITECT	Receive Request for Cooperation		25 Mar 96	25 Mar 96	25 Mar 96	25 Mar 96	0,1	3	7	
	Monitor request for cooperation from others		25 Mar 96	29 Mar 96	25 Mar 96	29 Mar 96	0,1	3	16	
	Evaluate Proposal- (assessment module)		26Mar 96	26 Mar 96	26 Mar 96	26 Mar 96	0,1	7	4	
	Check against other commitment		27 Mar 96	27 Mar 96	27 Mar 96	27 Mar 96	0,1	4	15	
	Inform requestor		28 Mar 96	29 Mar 96	28 Mar 96	29 Mar 96	0,2	15	16	
OVERALL										
ARCHITECT	Overall Time Taken	Believed	8 Apr 96	16 May 96	8 Apr 96	16 May 96	5,4	1	6	

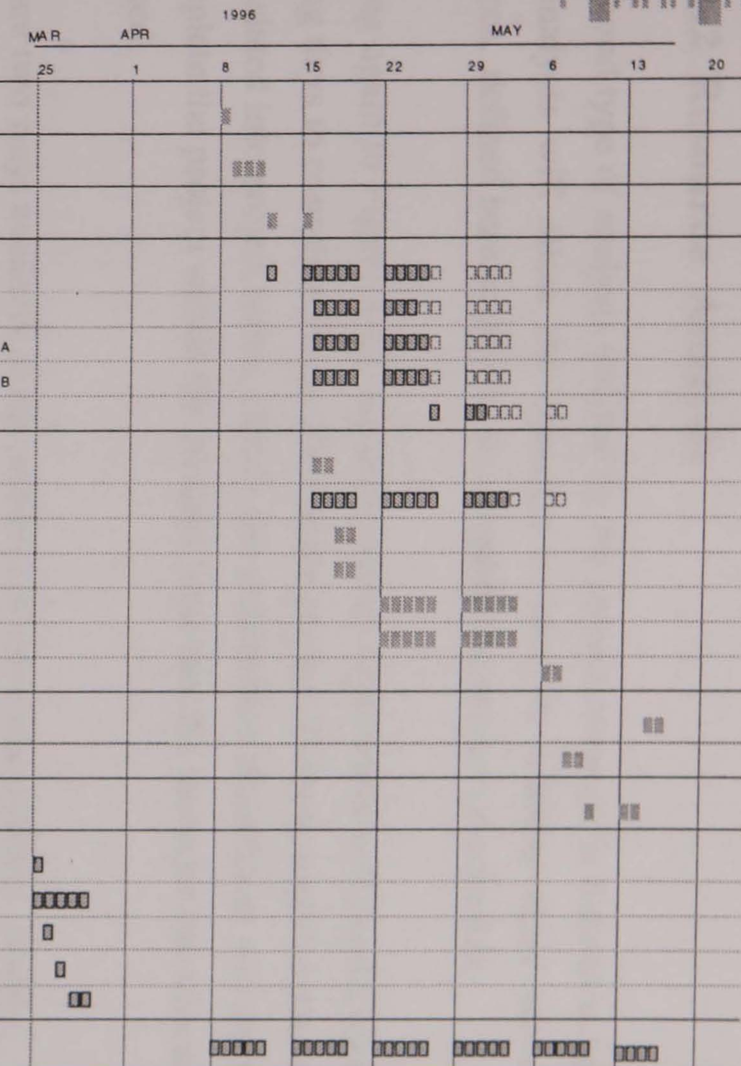


Figure 22 - Architecture Department Time Analysis Bar Chart

8.2.2.2 Resource Analysis

The second type of analysis utilised by the project manager is Resource Analysis. This analysis will allow the manager to identify whether there are enough resources, defined here as people, to complete the project on schedule.

Refering again to Figure 8-20, the architecture department will need a total of 57 working days to complete Phase-Two of the project. If these requirements were to be translated into project terms, clearly the architecture department will not be able to complete the project within the 30 days limit that the manager has allocated and proposed.

There are two ways available to the architect to solve this problem, namely,

i. *Resource Levelling* - this process figures out when each operation *should* start and finish while making best use of the available resources. It uses spare time to alleviate any conflicting demands by delaying non-critical activities within their float period so that the resources are made available to more urgent operations. However, if there are insufficient resources available to schedule all the activities according to the theoretical Time Analysis deadlines, then a decision is required.

> *Does the architect overload the resources so that the project finishes in the minimum time, or stretch the schedule to accomodate their resource constraints ?*

ii. *Time and Resource Trade-off* - here the architect is offered two types of Resource Analysis, namely

a. *Time Critical Resource Analysis* - which identifies what additional resources the architect needs to finish the project as quickly as possible. If the architect chooses this analysis, it means that he wants to *make the project finish by the Time Analysis deadline date, overloading the reources if necessary*

b. *Resource Critical Resource Analysis* - which shows when the project can be expected to finish given the resources available. If the architect chooses this analysis, it means *do not overload the available resources and delay activities until those resources become available.*

Refering to our example, because the committed deadline is 3 months, the *Time Critical Resource Analysis* is usually chosen by the project agents and project manager for these tasks. However, it must be stressed that both the project manager and the project agents, must continuously use his knowledge and skill, to balance (trade-off) between the amount of resources (manpower) needed and is available, against the time required to complete the project.

The proposed dates by the project manager i.e. E8-Apr-96 and L 18-May-96 is fed into the architects network diagram for analysis. Refering to the network diagram of Figure 8-21, the proposed dates *are within* the capability of the architect to complete it successfully. Infact, the architecture department can complete it by the 16-May-1996, one day ahead of schedule.

The architect then return his reply, i.e. *agree*, and broadcast it to the project manager. Like the project manager, the architect will also attached his proposed network plan so that the others in the team can have an overall view and understand the basis for his analysis. The architect will also attach the '*conditions for agreement*' in his broadcast.

8.2.2.3 Conditons for Agreement

Another feature of our management system is the existence of 'conditions of agreement' during negotiation. Similar to the concept of assumptions used in project modelling described earlier, the main objective of using the 'conditions of agreement' during project execution, is to reduce the amount and therefore cost of communication (consultation) among project team agents. We propose two types of conditions, namely:

i. conditional agreement
ii. consensual agreement

i. *Conditional agreement*

Refering to the network diagram of Figure 8-21, the architect can state that, for example, the acceptance of the dates proposed by the manager is conditional on the planners agreeing to :

i. participate in the consultation
ii. complete the consultation stage within two weeks

iii. start this stage on the 18-Apr-96 (provided of course the architect himself will provide the necessary details by the 18-May-96).

ii. *Consensual agreement*

The architecture department for example, can state that it does not object to the proposed dates, provided that every project team agent do not object to it. We will highlight these two conditions with further examples, in section 8.3.3.

8.2.3 Interaction and Negotiation Process

If however, the suggested time is *unacceptable*, the architect will propose a new time at which the action can be fitted in with its existing commitments, makes a counter-proposal for this time, the reasons for the conter-proposal, and returns the suggestion to the project manager. The overall negotiation and interaction process between the project manager and the project team agents is illustrated in Figure 8-23.

If the modified time is *acceptable* to the project manager, it will make appropriate adjustments to its plans (skeleton) and proceeds with the next action. If the architect totally *disagree* with the proposal, it must inform the project manager the reason for the disagreement. The project manager and the architect will now be in a dispute mode and both of them will try to reach an agreement as how best to proceed with the project. This usually happens in the *private space* (conflict resolution is not open) between the two parties.

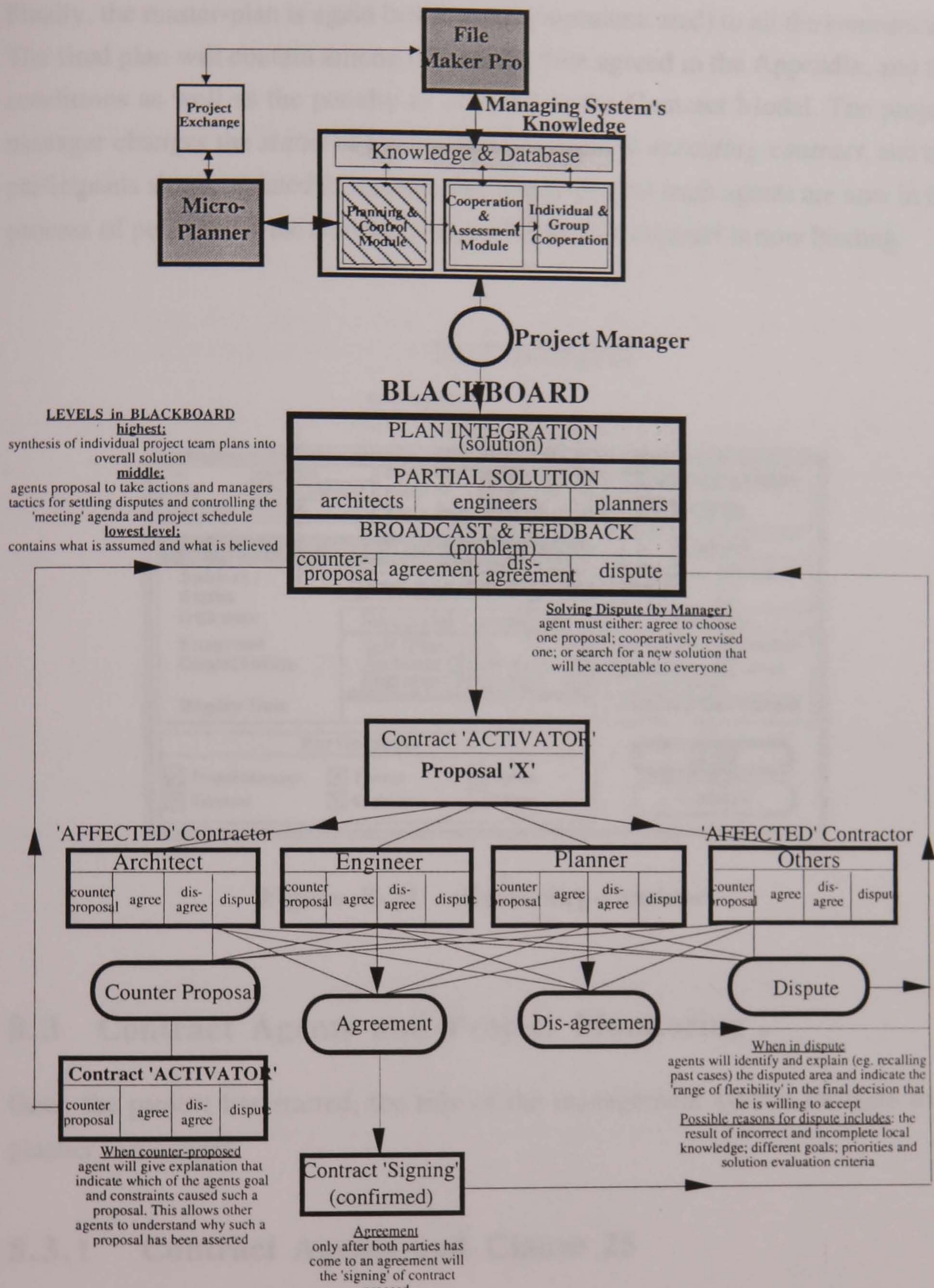


Figure 8-23 - The Interaction and Negotiation Process

8.2.3.1 Agreement and Contract Binding

The process of the agreement from every team agent continues until a final concrete plan emerges. This plan will now have a status of a *master-plan* and will be utilised by the project manager to manage and control the project.

Finally, the master-plan is again broadcasted (communicated) to all the *contractors*. The final plan will contain among others, the time agreed in the Appendix, and the conditions as well as the penalty as outlined in the Contract Model. The project manager changes the *status* of the cooperation form to *executing-contract*, and the participants slot is updated to indicate that all the project team agents are now in the process of performing the contract (Figure 8-24). The contract is now binding.

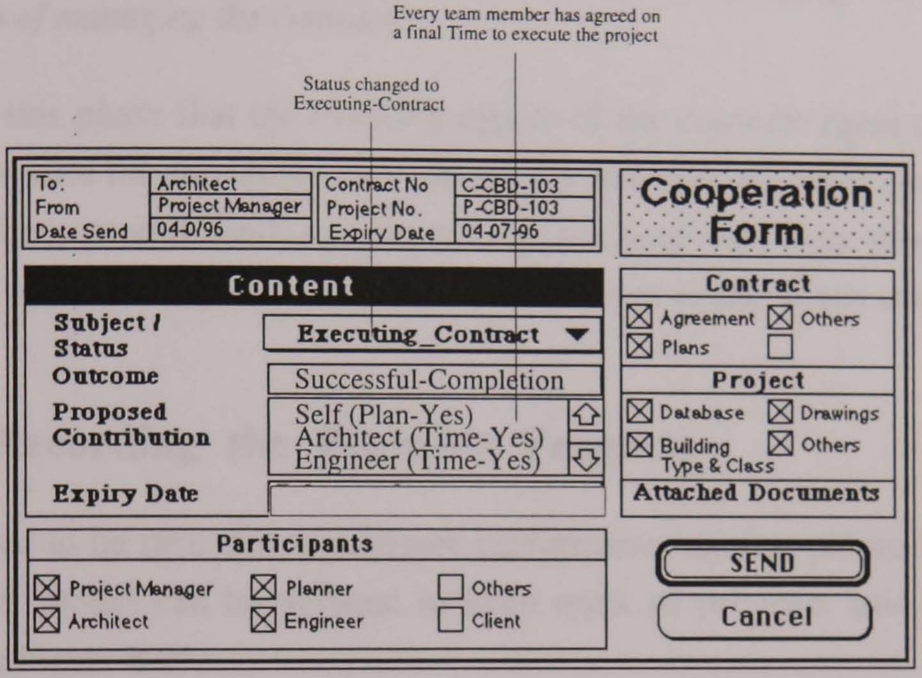


Figure 8-24 - Executing-Contract

8.3 Contract Agents and Project Monitoring

Once the project has started, the role of the management system changes from planner to manager.

8.3.1 Contract Agents and Clause 25

As described earlier, the contract provides a convention which among others, clearly distinguishes between the situations in which commitments to the contract need to be re-examined and the action that should be taken in such circumstances. We will now examine the operation of the contract clause relating to the *extension of time*. In the JCT 80, this is handle by Clause 25. Infact, Clause 25.2.3 states that once a contract is in progress, a '*continuous dialogue*' must be established between the contractor and project manager. This is because the project manager has to '*form an opinion*' as to the award of *an extension of time* based on the evidence of the contractor and the project manager's own observation. Appendix 4-B outlines this clause in detail.

Therefore once a contract has been established, the project manager must *continuously monitor* and *keep track* of its execution. In our model, the project manager's task is being performed by a *contract agent*. Refering to the definitions of computer agents in Chapter 6.0.2, here a contract agent can be defined as a :

> *software that functions to assist the manager in carrying out the tasks of managing the contract.*

It is during this phase that the *tracking* aspect of the contract agent comes into action. It specifies the *conditions* under which the manager and team agents should reconsider their commitments, and describing (advising) how they should behave both locally and with respect to its fellow project team agents if any such problem arise.

8.3.1.1 Recording the Project's Progress

Progress need to be recorded to compare performance against planned schedule. The network model can be updated to keep track of progress using the form illustrated in Figure 8-25.

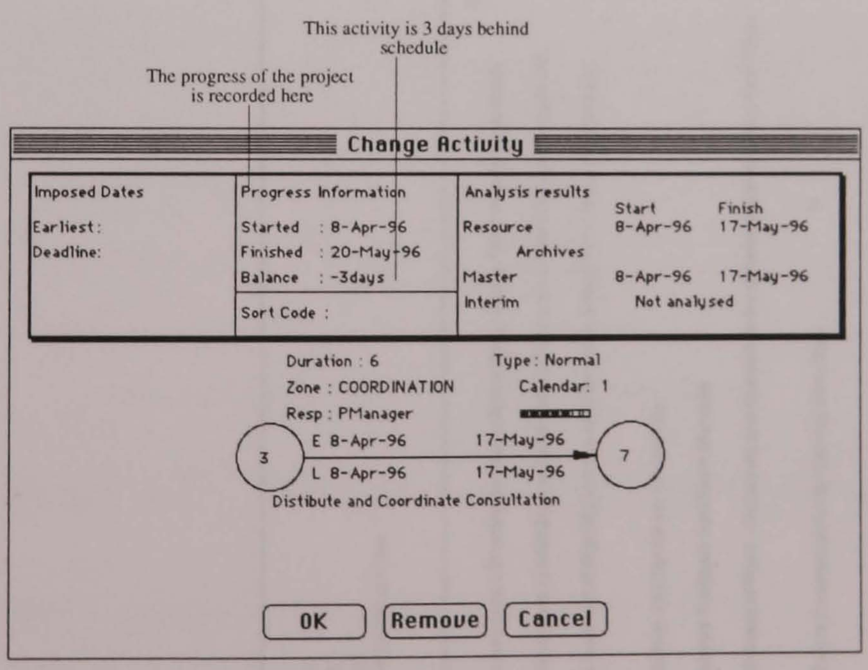


Figure 8-25 - Recording Project's Progress

In this example, the activity *Distribute and Coordinate Consultation*, is 3 days behind schedule, and the project manager needs to take action to rectify it, eg. increase the resources to complete the activity. The manager can then do a 'Progress Analysis' to give him a complete overall picture as illustrated in Figure 8-26.

This activity is 3 days behind schedule

Date : 4 - JUN - 96
Time Now : 10 - JUN - 96
Project : **Project Manager**
Output : **Time analysis & master archive**

Page 1 of 1

MICRO PLANNER

			SCHEDULED Start	SCHEDULED Finish	CURRENT Start	CURRENT Finish	LATEST Finish	Ahead or Behind	Remaining Float
CONSULTATION									
	Contractors	Assessment of Eligibility and Consultation Stage among Team Members (architect)	10 Apr 96	14 May 96	9 Apr 96	16 May 96	13 May 96	-0,3	0,0
		Assessment of Eligibility and Consultation Stage among Team Members (engineers)	10 Apr 96	14 May 96	10 Apr 96	14 May 96	14 May 96	0,0	0,0
		Assessment of Eligibility and Consultation Stage among Team Members (planners)	10 Apr 96	14 May 96	12 Apr 96	10 May 96	10 May 96	+0,2	0,0
COORDINATION									
	PManager	Distibute and Coordinate Cooperation	8 Apr 96	17 May 96	2 Apr 96	16 May 96	16 May 96	-0,3	0,0
		Receive Feedback from Team Members	15 May 96	16 May 96	16 May 96	17 May 96	17 May 96	-0,1	0,0
		Synthesis of Plans - Coordinate and Collaborate the different decision making "conditions"	20 May 96	24 May 96	18 May 96	24 May 96	24 May 96	-0,1	0,0
RECOMNDATION									
	PManager	Foward Recomendation to Planning Committee	27 May 96	7 Jun 96	27 May 96	7 Jun 96	7 Jun 96	0,0	0,0

Figure 26 - Progress Analysis Diagram

8.3.1.2 Contract Agent's Action

The contract agent is continuously monitoring events which occur within the project team. As illustrated in the monitoring *schemata* diagram of Figure 8-27, these events may originate from the domain level system of a team agent (eg. goal completed, need more information), or they may come within the project team agents (eg. request for information, return of requested information). In the majority of cases, these events will have no effect on the contract. However, in some instances, they will impinge upon it and cause the project agent to reconsider its commitments (eg. the conditions in the contract is violated).

Using the Contract Model, we can identify precisely those conditions in which a project team agent can drop its commitment to the contract's goal (eg. goal has been attained, or goal will never be attained), and those conditions in which a project agent can drop its commitment to the project plan (i.e. plan invalid, plan untenable, and plan violated).

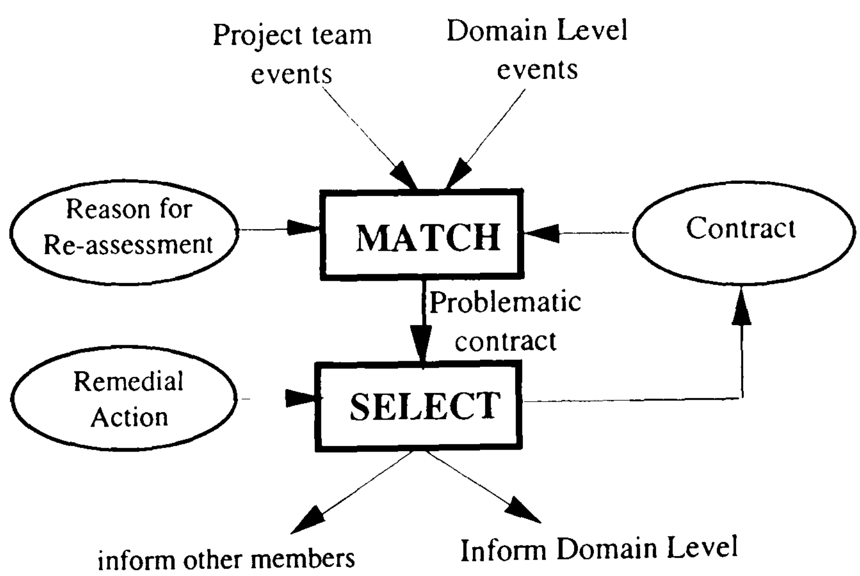


Figure 8-27 - Schemata for Monitoring Contract

We proposed that the agent is built using rules presented in the

IF <condition> **THEN** <action>

format. All the rules can be represented in the '*reasons for re-assessment*' components. It is the task of the '*match*' process to identify when one of the situations in the reasons for re-assessment store (rules/database) becomes true. Thus for example, all those events which have the potential to cause the contract to become invalid must first be recognised.

Such circumstances may arise as a result of local problem solving (contractor)

PHASE ONE
Rule 1match
IF a local plan is executed and
it has produces the desired outcome
THEN the Contract (C) is SATISFIED

or as a consequence of events occuring elsewhere in the project team (community)

Rule 2match
IF social task T1 component has been delayed and
delayed component is related (interdependent) to local task T2
AND there is no request for extension of time for T1
THEN contract (C) is VIOLATED

These rules take events which have occured locally or elsewhere in the project team and determine whether the cooperative action (contract) has become unsustainable in its present form. Once identified, the contract agent must decide upon the appropriate course of action. This decision is achieved, in the situation assessment module, by matching the reasons for failure against the possible courses of action and selecting the most appropriate remedy.

PHASE TWO
Rule 1select
IF Contract (C) has been SATISFIED
THEN Inform Cooperation Module that
Contract (C) has successfully FINISHED
Abandon all associated activities

Rule 2select
IF Contract (C) is VIOLATED
AND (C) can be successfully re-schedule
THEN reset new time (t_2) for (C)
inform cooperation module that (C) has been VIOLATED
propose new timing

As well as taking actions locally, such as suspending or rescheduling tasks, the Contract Model stipulates that the other project team agents must be informed when a contractor's individual commitment is compromised. This aspect of the model is realised by the cooperation module, based on information provided by the situation assessment module. In the above examples, the assessment module indicates that the contract's goal has been satisfied, or that it has been violated. It is then up to the cooperation module to ensure that the other team agents are informed.

PHASE THREE
Rule 1inform
IF Contract (C) has successfully FINISHED
THEN Inform all project team agents

Rule 2inform
IF Contract (C) has VIOLATED
AND New proposal for timing (t2) exist
THEN inform other team agents of violation and
inform new time (t2)

8.3.1.3 Application for Extension of Time.

When a contract has been agreed, the contract agent will track the development of the contract execution, advising contractors for example, if the contract needs to be *abandoned*, *suspended*, or *rescheduled*. In our prototype, if action has not been taken after a contract has been 'signed', a message reminding the contractor to response will appear, 5 days *before* the contract expires. The message will also *advise* the contractor the actions that need to be taken, to avoid the violation of the contract (Figure 8-28).

Figre 28 - Message Advising Contractors

The contractor can either response or ignore this message. If the contractor feels that a response requesting for an extension of time is required, it will click on the OK button, and a new form "Application for Extension of Time" will appear as illustrated in Figure 8-29.

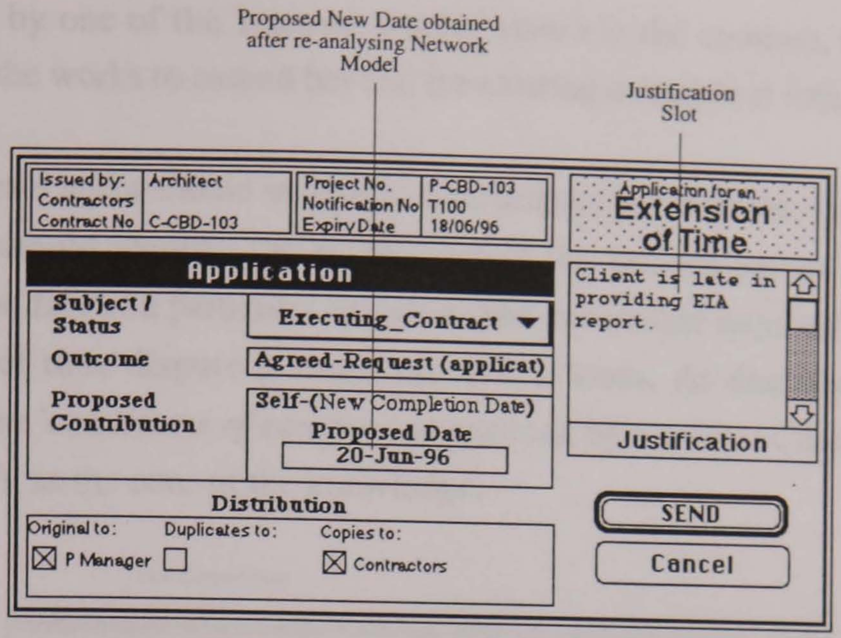


Figure 8-29 - Application for Extension of Time Form

In requesting for an extension of time, the contractor needs to give a '*justification*' for the request as illustrated above. The contractor then need to propose a *new date* as to when the project can be completed. This new date can be obtained by doing an analysis of the contractor's network diagram once again.

8.3.1.4 Evaluating Request for Extension of Time

When the project manager receives a request for an extension of time, the message below will appear on the project manager's screen. The project manager's task is to assess (evaluate) if the application is valid.

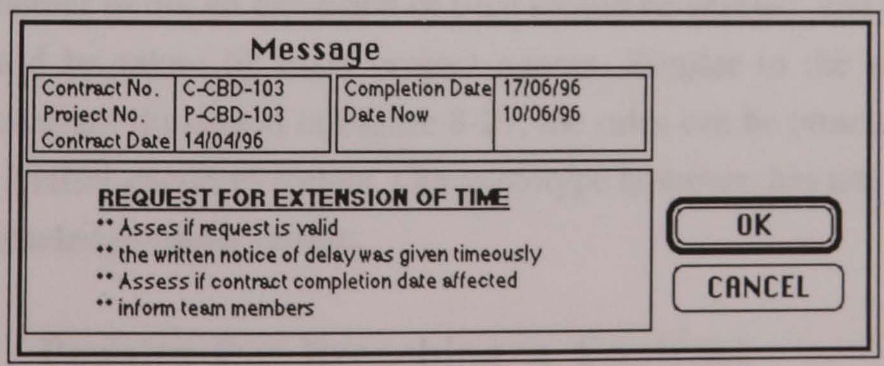


Figure 8-30 - Message Advising Project Manager

The granting of an extension of time by the manager under the JCT 80, is only valid when a specified event is likely to affect the contract completion date. If deemed necessary, an extension of time '*certificate*' will be issued, which is a means by which the project manager can defer the date when the *contractor* becomes liable for '*damages*'. For such certificate to be valid, the progress of the works must have been delayed by one of the 'relevant events' stated in the contract, in such a way that it causes the works to extend beyond the existing completion date.

Here the contract agent should be able to discriminate between the various bases for '*claims*' and should identify the entitlement of the various agents in the project team, given the fact of a particular situation. The knowledge required for resolution of extension of time dispute is based on several areas. As described earlier, we proposed to use '*conditions of contract*' as outlined by the Joint Contract Tribunal, 1980 (JCT 80), as the core of the knowledge.

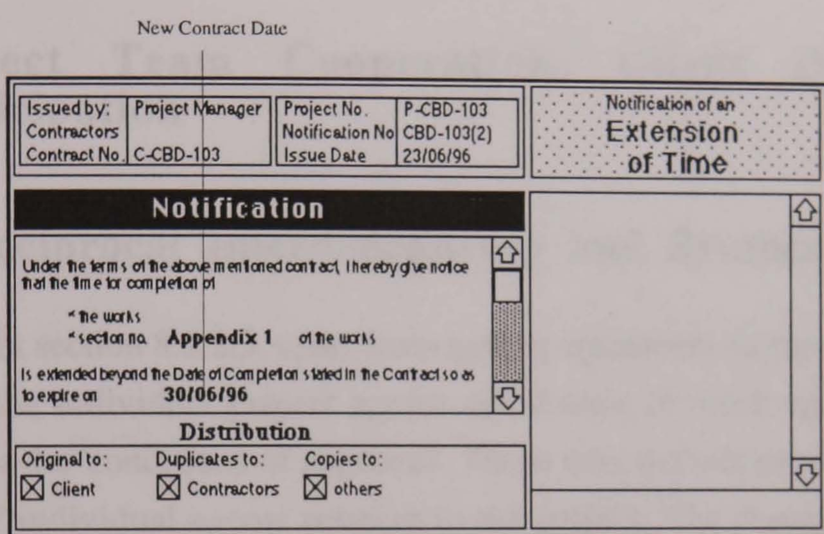


Figure 8-31 - Notification of Extension of Time need to be Brodcasted to all Team Agents

What is needed is a *knowledge based system* to assess claims. The goal of the system is firstly, to detect the *violation* of contract regarding the extension of time, secondly, whether or not an extension of time should be granted, and thirdly, what actions should be taken by each project agents. Similar to the schemata for monitoring contract illustrated in Figure 8-27, the rules can be presented in the IF <condition> THEN <action> format. Our prototype however, has not attempted to model the knowledge-based system.

8.3.1.5 Penalty for Breaching a Contract

If after a final extension of time is granted and an agent has still not fulfilled his duties, then a penalty will be imposed. One of the reason for including a penalty clause in a contract, is to act as a deterrent for agents to abide by their contractual agreements and to compensate the client. There are two type of penalty that the manager can utilise, firstly monetary, and secondly, shame.

Monetary penalty is self-explantory and the amount is included in the Appendix. *Shame* however, is unique to our model and is to be used only as the *last-resort*. As outlined in Chapter 6.2.3.3.2, this principle is being used as a 'deterrent' for agents to abide by their contractual commitments during cooperation. In a culture where *face-saving* is paramount, the idea of using shame to ensure that commitments are being met can be very effective. If an agent has not fullfilled his obligation to the group, i.e the agent has not behaved in a team spirit, then his name and his actions will be broadcasted to every member of the team, i.e the agent will be shamed.

8.4 Project Team Cooperation, Client Query and Participation

8.4.1 Reciprocal Interdependency and Synthesis

As described in section 8.2.2.3, apart from getting agreement on the time to execute the project, the individual project agents collaborate to reach agreement on the fomulation for the 'conditions of approval'. These may include expert opinions and viewpoints of individual agents relating to the project. The manager's tasks is to *integrate* and *synthesize* these opinions and viewpoints, to form a single overall solution. The synthesis is important for two reasons; firstly, it is the manager's responsibility to foward them for deliberation by the Planning Committee, who is the highest decision making body at the Johor Bahru City Council (JBCC); and secondly, to respond to queries from the client agent.

8.4.1.1 Project Team Cooperative Action

The project agent's (contractor) response to an application for development can be one of the following recomendations, i.e

i. *Approval* - the contractor totally accept the development proposal put foward by the client agent.

ii. *Dis-Approval* - opposite to the above. For example, proposed development is unsuitable for the site.

iii. *Conditional-Approval* - the proposal will only be approved after some new conditions are met, for example, after the client has increased the number of car parking spaces. This is the most common form of approval.

iv. *Consensus-Approval* - used primarily to speed up cooperation among project team agents. For example, a contractor will not object to the client's proposal, provided the other project team agents do not object as well.

a. *Example of Conditional-Approval*

Refering to this example illustrated in Figure 8-32, the development proposal will be approved only if the client 'surrender a part of the ground floor to create a 'public-space'.

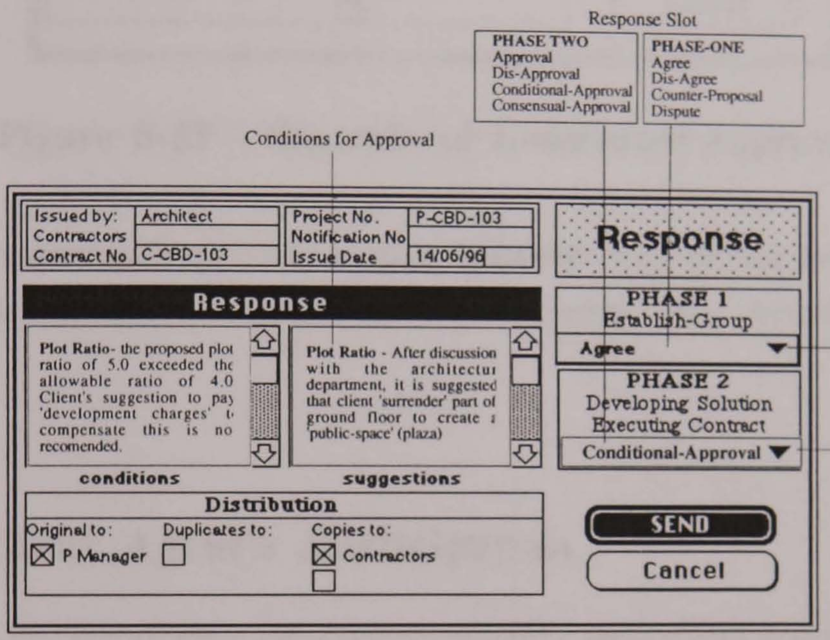


Figure 8-32 - Architect's Response

b. *Example of Consensual-Approval*

As decribed in section 8.2.2.3, this condition is used primariy to speed up cooperation among project team agents. In the example illustrated in Figure 8-33, the architecture department concluded that based on the department's checklist, the development need to provide an additional 21 numbers of car parking spaces before it could be approved. After discussing with the client (through the project manager), it was found that this will be too costly for the development proceed. The client however, is willing to pay 'development charges' to compensate for the shortfall. The suggestion from the architecture department is that it does not object to this payment, provided the engineering department has no objection to the conditions as well.

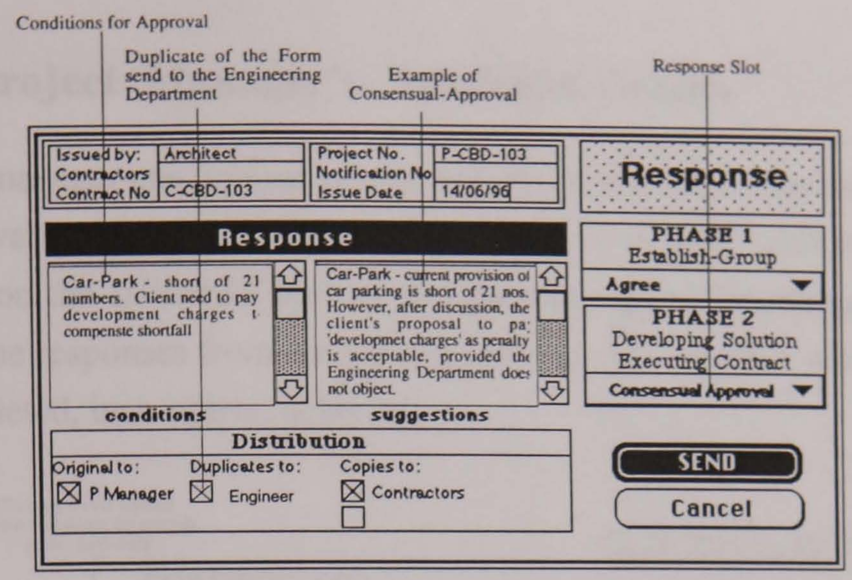


Figure 8-33 - Example of Consensual-Approval

The use of consensual-approval in this example, will reduce the need for the engineering department to communicate with the architecture department regarding this issue.

8.4.1.2 Client Agent's Participation

One of the major roles of the project manager is to ensure that the client agents can participate and are consulted progressively during the decision making process. This is done by establishing formal communication channels through the client's blackboard. Allowing client agents to participate will overcome the problem of 'uncertainty' in the decision making process, and solve the problem of client having to appoint 'file-chasers'. Since all 'discussion' should be made 'through' the project manager, it will protect the project team agents from outside 'interference' in executing their tasks.

At any stage of the decision making process, the project team agents or the client can request for a 'meeting session' to take place. The project manager will be the formal point of contact for such request. This meeting session will be '*chaired*' by the project manager. Once the session starts and a channel has been established between the client agent and a particular project agent (eg. the architecture department), both of them can communicate '*directly*' with each other with the project manager playing a passive role. However, if there is a conflict between the two parties, the project manager will be in an active mode, and play the role of an arbitrator.

8.4.1.3 Project Manager's Synthesis Action

The project manager can 'update' all the records of the conditions and suggestions send by the various contractors into a database format, illustrated in Figure 8-34. By clicking on the *UPDATE* button, this database gives the manager an overall view of all the responses from the various team agents, together with the project's status (completed, incomplete, delay, etc.).

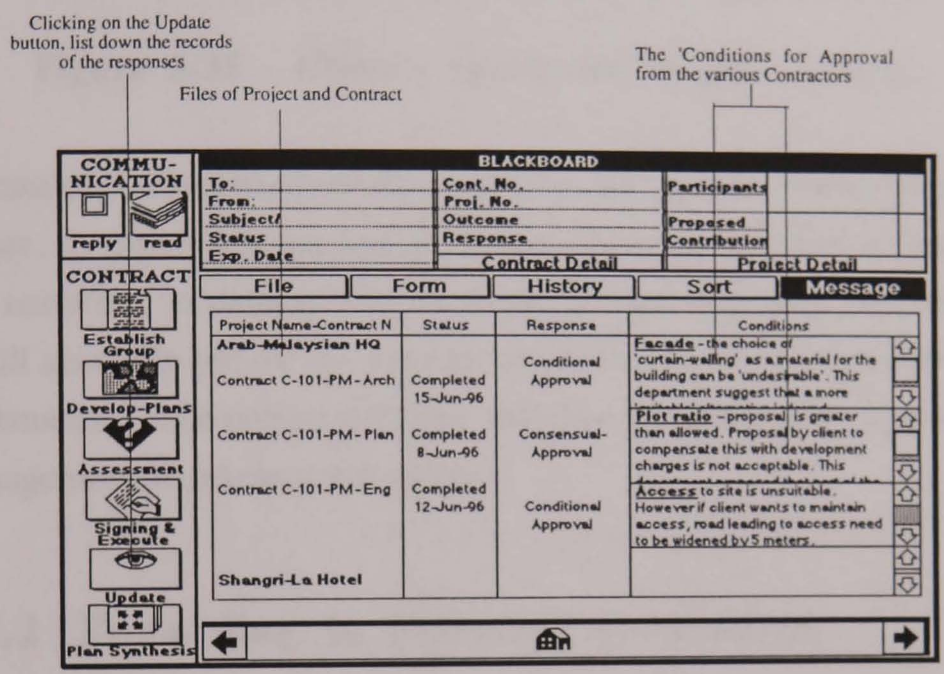


Figure 8-34 - Database of the Project's various Decision-States

8.4.1.3.1 Responding to Client's Query

At any stage of the project, the project manager will be able to respond to any query from the submitting client regarding the status of the project. It also allows the client to keep track of the development of the application *progressively* instead of the current practice of being inform of the outcome at the end of the 3 months period. When, for example, a 'fault' in an application is being detected by one of the project agents, it will immediately inform the project manager, who will contact the client agent. The advise from the project manager for example, can be in the following form (Figure 8-35).

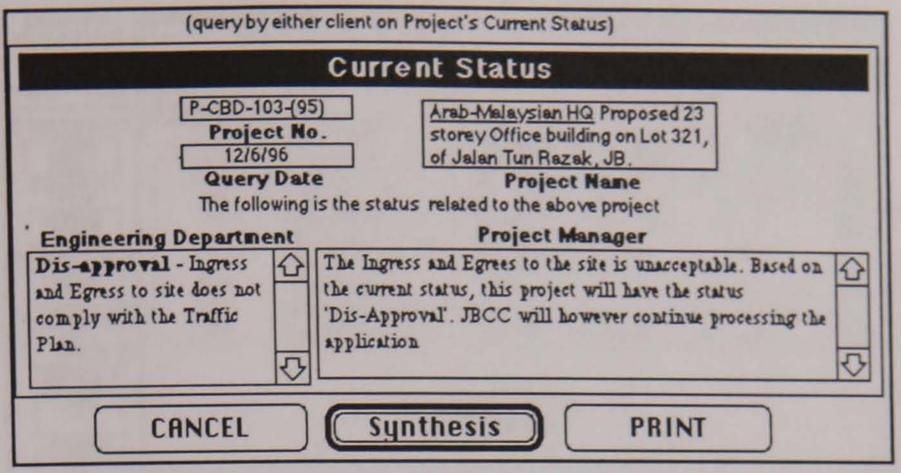


Figure 8-35 - Client's Query on Project's Status

Since the cost of resubmission can be costly, this will give the client the opportunity for example, to make 'ammendments' to the application before a final decision (possibly resulting in disapproval) is made by the Planning Committee. This method will also help reduce the number of projects to be processed by the JBCC from resubmissons. The project manager will thus, be able to play a *pro-active* role in the management of development control.

8.4.1.3.2 Fowarding to Planning Committee.

The project manager can list out the projects by for example, zone, class, or by departments (individual project agents) as illustrated in Figure 8-36.

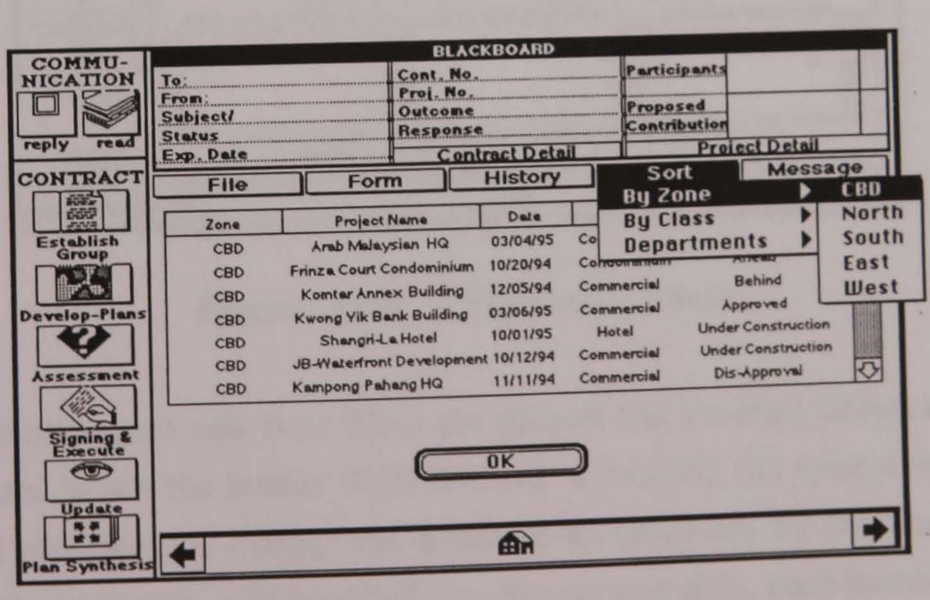


Figure 8-36 - Sorting Project's Database by Zones

Similarly the manager can check on the projects progress history as illustrated in Figure 8-37.

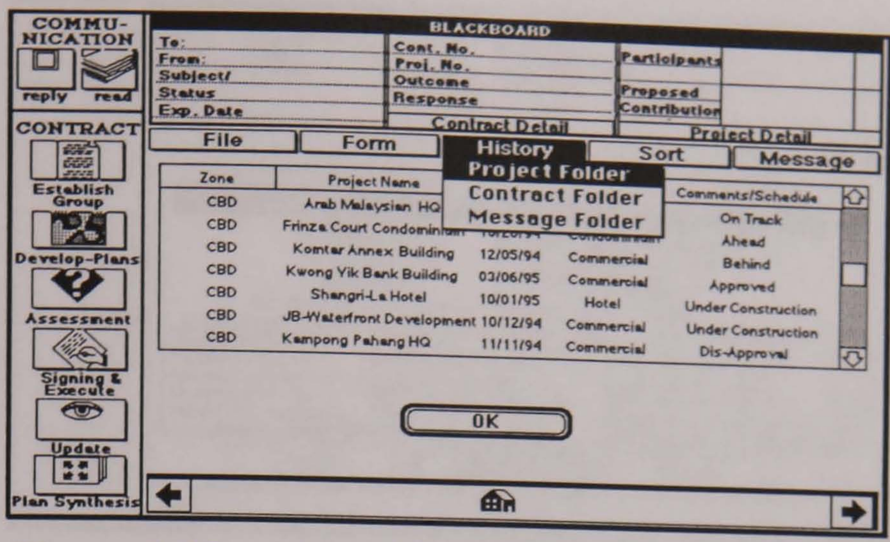


Figure 8-37 - List of Project's Progress History

To prepare the project for fowarding to the Planning Committee, the project manager uses the synthesis form illustrated in Figure 8-38.

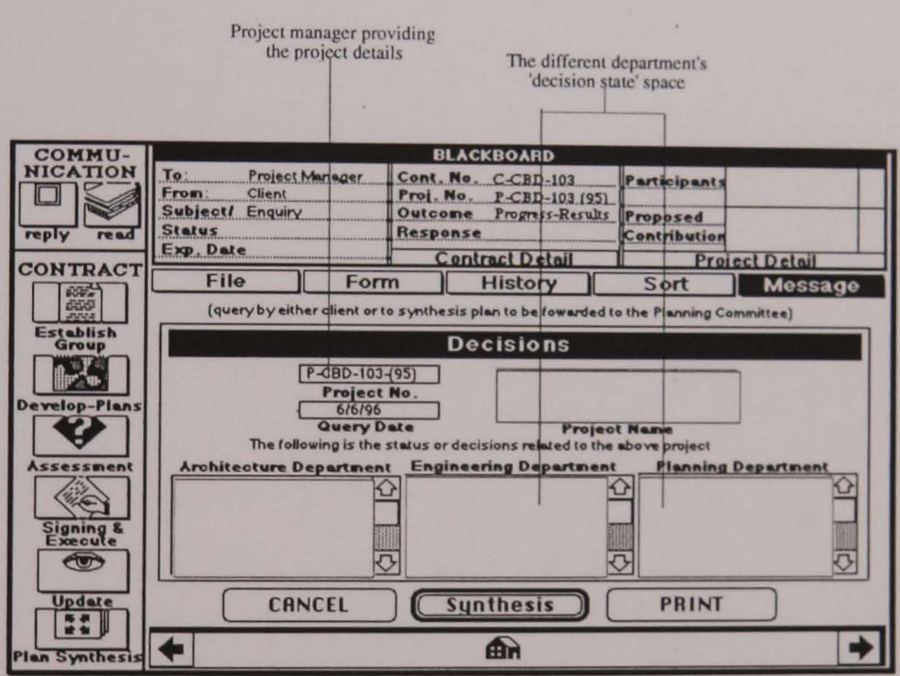


Figure 8-38 - Synthesis Form

The project manager's task is to fill in the project and contract information on the specific slots. When the button SYNTHESIS is pressed, the system will look up the project number and *extract* the database as requested by the manager. The records of the responses will be filled into the various slots, each corresponding to an individual department, eg. architecure, engineering, etc. The outcome of the synthesis is illustrated in Figure 8-39.

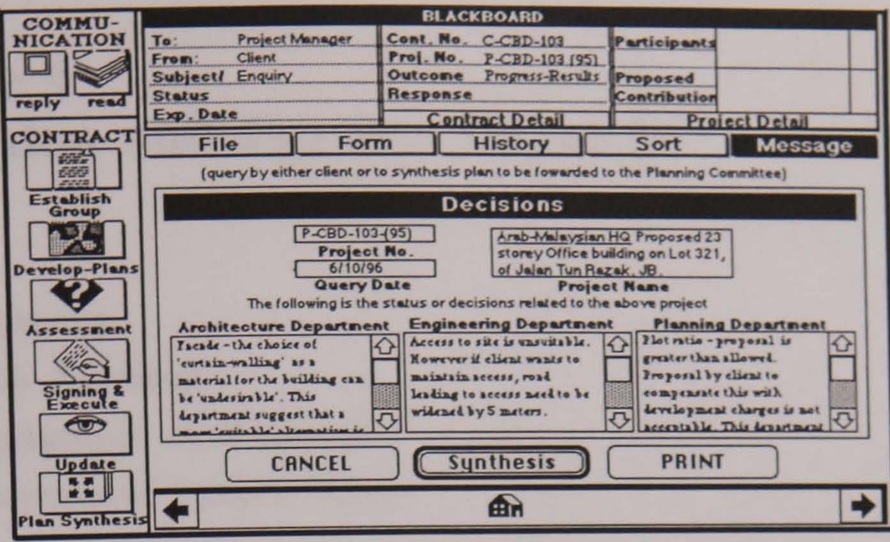


Figure 8-39 - Outcome of Project Synthesis

Chapter 9
Conclusion and Further Research

Chapter 9

Conclusion and Further Research

9.0 Summary

The original motive of this research arose from the recognition of the unsatisfactory nature of decision making process in development control in Johor Bahru. Decisions are not iterative and are at best ad-hoc resulting in delay and uncertainty. This has resulted us to propose the two perspectives of decision making for an environment such as development control; firstly, it is *distributive* and *cooperative*, and secondly, experts operate in a *dynamic* environment and need to behave in a *coherent* manner.

The interdisciplinary nature of the participants has contributed to the first perspective.

a. Expertise and relevant knowledge are assumed to be distributed amongst a wide range of participants. Participants are considered as individual experts

b. Each individual expert needs to cooperate to solve the problem as a whole. Cooperation is necessary because of the *limitation* of rationality, the neccessity to meet *constraints*, and existence of *interdependencies*. Moreover, the final solution will only be achieved through the process of *negotiation* and *mutual adjustment*.

The second perspective is that individual expert operates in a dynamic environment and need to function as a whole.

b. This has resulted in the need for frequent interaction since the decision making process is almost certainly based on *uncertain* and *incomplete* information.

a. Individualism increases the need for the experts to behave in a *coherent* manner to function as a whole.

The features described above have led us to enquire into the requirements for generic computing systems that can be supportive of, and enhance the process of cooperative problem solving activity among distributed individual expert called agents, in a coherent manner.

9.1 Main Findings

a. A Management System and Coordination Centre

The above objectives can be advanced through the development of *Coordination Centre*. The main function of the Centre is to reduce the uncertain and unpredictable nature of problem solving such as design and development control. This can be achieved through the design of a *computer-based management system for cooperative decision making*. The centre will be managed by a *project manager* and the manager uses project management techniques, such as PERT to identify and decompose the major tasks to be executed by individual agents, representing the various sub-systems. It has two other major roles :

i. The manager has to correctly *synchronise* the agents interdependent actions. This can be achived through the design of a *multi-agent plan*. Agents are classified as individuals and function as a project team. The manager is also responsible to *distribute*, *monitor*, and *integrate* (synthesis) the output of the cooperative act into a complete whole.

ii. The manager has to outline the *rights*, *roles*, and *responsibilities* of individual agent involved in the cooperative act and to ensure coherent behaviour. This can be advanced by using the Contract Model.

i. Project Management and Multi-agent Planning

The manager is responsible for designing a multi-agent plan to synchonise individual agents' interdependent actions. However, the process of designing of plans is often fraught with delays because of for example, interdependencies, and the uncertainty of the environment upon which agents operate. We therefore proposed a model for the design of multi-agent plans using '*assumptions*'. We showed how an 'assumption model' can be effectively combined with existing planning and schedulling tools to allow for incomplete plans and for effective updating and control as more knowledge becomes available. The proposed model is particularly well suited for supporting the extensive *collaborative* process among individual agents that characterizes activities such as design, project management, and development control. Our model allows us to introduce *parallelism* in developing interdependent individual *skeleton-plans*. It also contributes to a cooperative exchange of plan details with a view towards developing an overall *master-plan*. Finally, the model maintains different planning scenarios to support the process of negotiation and mutual adjustment.

Agents are organised as project teams allowing them to function independently but coherently. When the agents have agreed to the project manager's proposal (e.g the timing) as outlined in the plans, they will enter into an *agreement* bound by a contract. A *contract* is thus, an explicit agreement between an agent that generates a task, and an agent that executes the task. Consequently, the project manager is responsible for *coordinating* and *monitoring* the execution of the contract.

ii. Distributed Artificial Intelligence (DAI) and the Contract Model

The role of monitoring contract execution and is undertaken by a *contract agent*. A contract agent is *software* that functions to assist the manager in managing the contract execution, and the project team agents in complying with the *conditions* of the contract. It is during this phase that the *tracking* aspect of the contract agent comes into action. Among others, the contract agent will identify the 'events' that will be deemed as 'breaking' the conditions of the contract and inform the project manager and the project team agents of this fact.

In addition to the development of the contract agent, we feel that our work has two other major contributions to the field of DAI which distinguishes it from previous work on cooperative problem solving. In fact, one of the reason why DAI has been deployed in relatively few real-size applications is that it lacks a clear and implementable model of cooperative problem solving which specifies how agents should operate and interact in a complex, dynamic, and unpredictable environment such as design and development control. We hope that the thesis has made a modest contribution towards providing this missing link. We propose a new principle model for cooperation, called the Contract Model, and it has the notion of a *contract* as its core.

i. *Concept of Roles and Responsibilities to Ensure Group Coherence*

Apart from being used to *cement* the act of cooperation among individual agents working as a team, the contract model also outlines the *roles* and *responsibilities* of agents during cooperation. The Contract Model specifies the *conventions* and *laws* which determines how agents should behave in nominal and exceptional circumstances both with respect to their local activities, and with respect to the fellow project team members. Moreover, the model aid the agents by offering the characterisation of the types of events which can cause problems during cooperative problem solving, and the actions that can be taken to overcome the problems.

This method of approach is also consistent with organisational sciences doctrines, such as those promoted by Galbraith (1973), which state that the best way to tackle problems in the face of task and environment uncertainty is to introduce explicit rules and procedures. If everybody adopts the appropriate behaviour, the resultant aggregate response is a coherent pattern of activity.

By basing the implemented system on a firm footing, such as the Contract Model, it was easier to:

a. predict the range of agents responses, i.e the mental states of agents can be predicted,
b. verify that the agents' commitments had been implemented correctly, and
c. provide a clear boundary on the types of situation in which agents could be expected to successfully operate.

ii. *The Behaviour of Agents in a 'Collectivist' Team or Group.*

Another important characteristics of our models is that it derived from analysing the behaviour of 'collectivist' agents. Our model proposed that agents cooperate not only to achieve their own goals, but to advance the objectives of the group. This can be seen by the activity INFORM described in section 8.3.1.2. For example, when an agent has completed its task, or has detected a 'fault' in the cooperation, and even though the discovery will have *no personal benefit* to the agent's activity, it must endeavour to *inform* the other team members of this fact.

Therefore, when a tasks has been completed successfully, maybe earlier than the schedule, other team agents need to be informed so that they can exploit this fact. As this activity requires computational resources, i.e. time consuming, it is irrational act when viewed from the position of the individual agent. However, in a collectivist team/group, where the goals, objectives, and coherence of the group is more important than that of the individuals, this act is necessary. The act truely model the embodiment of the intuitive notions and spirit of a collectivist values, such as "cooperativeness", "team spirit", and "being a good member". However, it must be stressed that these 'values' are not exclusive to a particular group or individual. The values are universal and should be integrated into a cooperation model regardless of a group's 'background'.

9.2 Limitation of Research

Having described what research tasks have been carried out in the thesis, it is important to acknowledge the limitations of the current study. We can divide the limitations into three main categories namely,

a. Project Management and Multi-Agent Planning, and
b. Distributed Systems based on the Contract Model.
c. Computers, and the Organisation Culture

a. Project Management and Multi-Agent Planning

Our approach using assumptions, provides a convenient mechanism for developing skeleton-plans under uncertain and incomplete information. However we foresee a problem arising from the assumptions made by the individual agents itself. Although we provide a mechanism for the development of a consistent overall plan, the ease with which the plan can be obtained is dependent on the assumptions that agents make. Our system cannot overcome problems created by 'bad' assumptions. As with any other decision aid, the tool is only as good as its users. For example, if the assumptions are not 'reasonable' (i.e., have a high likelihood of being true), they may contribute to the need for frequent revisions of beliefs, leading to significant computational and communication overhead.

b. Distributed Systems based on the Contract Model.

In a distributed system, the question of *efficiency* and *coherence* of the overall systems are likely to be paramount. The criteria upon which the prototype is developed is based on *minimising* the number of team agents. In our propotype, we have limited the number to a small group of four agents. In real life situation, this is usually not the case. This strategy was choosen because the fewer agents there are in a team, the lower will be the communication overhead, since messages need to be send to fewer agents.

Moreover, the number of dependencies will also increase with an increase of participating agents. As a result for example, there will be more likelihood of agents defaulting on their commitments resulting in an increase of conflicts resolution to attend to. The ability of the project manager to control and ensure group coherence, in this case might be compromised. Our objective of allowing project manager more time and opportunity for 'making' decisions rather than spending time 'devising' plans, may not be easily achieved.

c. Computers and Organisational Culture

The third point is more of a general statement on the impact of introducing 'cooperative computing' or described in Chapter 7 as '*groupware*' technology, on a traditional hierarchical organsation such as those practised in the Johor Bahru City Council. It is fair to conclude that in order to harness fully the concepts of groupware, there must be a 'revolution' in the way an organisation works and functions. Our proposal demands a total organisation cultural change. In fact, the proposal to use computers in problem solving itself, is a big decision that need to be taken by any organisation.

For a start, the hierarchical command structure must be eliminated and be replaced by a horizontal 'project' culture. This means requiring everyone to work as a team. However, it also means that all team agents should be treated as 'equals' and can therefore for example, be able to access the same source of information database regardless of their 'position'. In a 'closed' society like Malaysia, where for example, knowledge is often regarded as 'power' and as such should only be allowed limited access, the notion of introducing a computer technolgy that will break down the hierarchical barrier itself might be easier said than done. In its present form, it is fair to conclude that groupware has a long way to go before it can be accepted and adopted in a 'collectivist' organisation. As such more research should be done to tailor the technology to specific groups.

Having said that however, the 'limitations' of the present technology should not be used as an 'excuse' for not adopting the tool in problem solving. Implemented correctly and rigorously, the advantages of the technology are many. It allows for every team member to participate in the decision making process, and therefore encourages ideas to flow freely. For all its criticism, groupware allows every team agent the opportunity to contribute to the team decision making process, giving them a sense of ownership. Prejudice will be broken down because we do not know if the ideas are coming from a Chinese, Indian or a Malay person. Or for that matter if it is being fowarded by the caseworkers or the chief planner. However, with freedom comes responsibility. Groupware should not be used for personal gains and be utilised to 'damage' the coherence of the group. In our context, the ultimate aim of any cooperation is for achieving the team's or organisation's objectives rather than the individual self-interest. Its concept to harness good decision making and to cement the cooperative act in a multi-disciplinary organisation should be adopted.

9.3 Direction of Future Work

a. In terms of the Contract Model, the logical extension is to intensify the 'agentification' process to include all levels of knowledge building. The use of high-level programming language such as Shahom's (1993) 'agent-oriented program paradigm' need to be researched and included.

b. In project management, the process of tracking can to be made visible for all to see. Since formulating dependencies often involves explicit sequencing and tracking process to be sure that an activity can be completed before their result are needed, a *visual computer-based tracking system* will make it easy for every team agent to see the *status* of all the other activities and their dependencies. In this case, *late tasks* could be visible to every team agent throughout the project.

c. Perhaps the most promising avenue for further research and development is to study the impact of cultural behaviour on groupware. Some of the characteristics of a collectivist society such as the preferences of meeting a person *face-to-face* before making a decision, need to be included. In this specific example, we feel that the use of *multi-media* for communication seems to be an obvious extension.

d. The final point is more a general observation on the future direction of groupware. As more and more communication is done across the network such as the Internet, the dominance of 'oral' communication will be replaced by 'words' or 'writings'. The importance of the skills of expressing ourself through 'comprehension' will need to be enhanced. The preference of using 'metaphor' and 'symbolism' for commuication described in Chapter 6, might provide an important clue.

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Appendix 1-A
Malaysia - Facts

KEY FACTS

Area		329,758 sq km
Population	(1994)	19.2 million
Head of State		Yang Di Pertuan Agong
Type of Government		Monarchial Democracy
Currency		Ringgit Malaysia (RM)
Average Currency Rate		US$1-RM2.54 (10/03/96)
National Religion		Islam
National Language		Bahasa Malaysia though English is widely spoken
Capital		Kuala Lumpur

ECONOMIC FACTS

GDP Growth	(1994)	8.6%
	(1995)	9.6%
	(1996)	8.5%
	Average 87-95	8.0%
Construction Growth	(1994)	14.5%
	(1995)	15.3%
	(1996) projected	15.0%

OTHERS

Military Expenditure		3.1% of GDP
Pop. Growth Rate	(1980-93)	2.5%
Adult Literacy rate	(1993)	85%
Tertiary Graduate as % of age group	(1994)	10%
(Target for 2010)		30%
Growth of Urban Population		4.5% per year

JOHOR STATE

Population	(1991)	2.07 million
	(2010)	3.4 million (growth of 2.7%)
Capital		Johor Bahru
Population of JB	(1994)	429,000
	(2010)	750,000
Per Capita GDP	(1991)	RM9,000
	(2010)	RM20,000 (1991 price)

(GDP by Sector of Origin 1991-2010 - some examples)

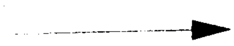
SECTOR	1991	2000	2010
Manufacturing	20.5%	28.2%	33.7%
Construction	7.7%	8.6%	9.4%
Wholesale & Retail	9.7%	10.3%	13.1%
Agriculture	36.8%	24.5%	14.6%
Government Services	13.2%	12%	10.6%

Source: Bank Negara Malaysia Report

Appendix 2-A
Glossary of Project Management Terms

There is a considerable amount of jargon used by project managers today, enhanced by the rapid growth in the use of computers for planning and controlling of projects. The list give some of the more common terms and their usual meaning. Works by Micro Planner (1990) and Young (1994a, b and c) are refered.

Activity
The basic component of a project model which signifies that something is going to happen. It is represented as an arrow where action commences at the tail and ends at the head.



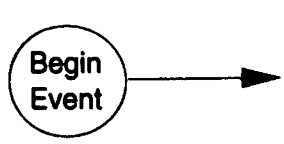
Arrow
The diagramatic representation of an activity or operation on a network

Backward Pass
This is a process when Time Analysis works backwards from the end of a project or from a deadline to calculate all the latest start dates and deadlines for each operation.

Balance
The remainder of an activity's duration after 'Time Now'.

Bar Chart
A graphical representation of the activities of a project derived from the project logic diagram, shown as a time schedule.

Base Date
The earliest possible date in a project's calander

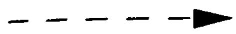


Begin Event
A special event which indicates a point at which logic commences (there are no preceding activity). There can be more than one Begin Event

Calendar
The term used to define the actual days on which activities can work and those days which are non-working. It also refers to the span of dates which can be used on the project - starting from the Base Date

Critical
A critical activity is an operation which cannot be delayed without causing the project or a deadline to be delayed. A path of such activities is called a Critical Path.

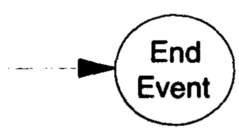
Deadline
A deadline is a date which we can enter to specify the latest permissable completion.



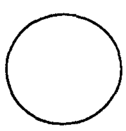
Dummy
A Dummy activity is an activity which does nothing but act as a logic link between two events. Dummy activities do not usually have any duration nor use any resources.

Duration
The length of time that an activity takes to accomplish, expressed usually in weeks and days.

Earliest Date
A date which we can enter to specify the earliest date before which an activity or event must not start.



End Event
A special event which indicates a point at which logic completes (tere is no following activity). There can be more than one End Event.

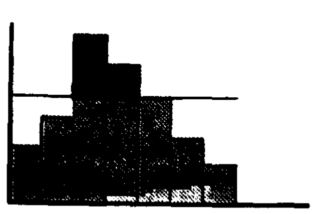


Event
A point in time which acts as a link between activities. Events are shown on a network model as circles.

Flags
These are activities with zero duration which can be used to flag important start and finish dates.

Float
This is project management jargon for 'spare time'. Free float is spare time which is not shared with any other activity as opposed to shared (or total) float.

Foward Pass
This is the process when Time Analysis works foward from the beginning of the project to calculate all the earliest start and finish dates for each operation.



Histogram
A bar graph representation of resource requirements and availability or of costs with dates across the bottom and a quantity (or value) scale up the left side.

Key Event
Sometimes called a 'milestone', this special event can be used to highlight important moments in a project which can be used for summary reporting

Network
All the logic which makes up a project. It is made up of arrows and circles representing the activities and their logical link. A network diagram is a chart showing the logic as arrows and circles linked together - sometimes called a PERT (Project Evaluation and Review Techniques) chart or logic diagram.

Resource
Anything which is required for the completion of an activity - people, money, machines, space, etc.

Resource Analysis
The process which attempts to reconcile the time required with the resources required to complete a project. Resource Analysis works to level resource usage down to the resource availability and re-schedules activity start and completion dates accordingly.

Schedule
A set of start and finish dates for each operation which form the plan of work for a project. Each schedule remains the result of one analysis, either Time or Resource Analysis. Schedules can be used as archives for future comparison.

Slippage
An activity which falls behind or is delayed past an earlier completion date is said to have slippage behind schedule. The amount by which it has slipped can be termed slippage.

Time Analysis
The process during which the computer, figures out all the earliest start and finishes and latest starts and finishes for every activity in the project.

Time Now
This is the date that the computer uses to start all its time calculations. Progress dates will be prior to time now and anything that is not yet complete proceeds after this date.

Work Breakdown Structure
A diagramatic presentation of all the key stages and their associated activities arranged in a hierarchical format, showing every level of planning.

Zone
An optional label which can be applied to any activity (in Micro Planner) as well as labelling, it places that activity in a category used for sorting or report selection.

Appendix 3-A
Surveys and Interviews

The purpose of the surveys and interviews was to identify the issues, processes, knowledge, tasks, and people's relationships, among others, that will give the author a better understanding of the 'elements' that need to be considered in designing *a management system for development control* at JBCC.

1.0 Methods Used

Refering to the concepts used in Chapter 3.4, participants for the survey were representing the following categories ie. from:

i. *Managing System* - the chief planner at JBCC who acts as the *coordinator.*

ii. *Operating System* - the *technical departments*- consisting of two levels in the organisation structure; the technicians who are responsible for making recommendations during the *compliance* and *adequecy assesment*, and secondly, the senior technical assistants who are responsible in making recommendations during the *assesment of eligibility* stage

iii. *Client System* - the *submitting architects* including three architects practising in Johor Bahru each with different 'experiences' of dealing with JBCC and have projects at different 'stages' of application. Two of them have projects in the City Centre area.

During the meeting, participants were requested to select a specific planning application to discuss eg. a specific building type that they are familiar with, especially in the City Centre. The session began by asking the participants to describe his or her background, previous experiences, current position, responsibilities and duties. All questions were asked in an 'open-ended' mannner. Participants were encouraged to cite and recall examples from other previous applications. Sessions were audio taped with the consent of the participants, giving them assurances that the discussion within each session would remain confidential.

The major questions these interviews seek to answer can be categoried as follows:

1. what are the main issues of concern.
2. what are the major and minor tasks to be performed
3. who is responsible for each task
4. how do these tasks interrelate
5. what is the interaction pattern of the partcipating department
6. which tasks and departments are more critical to successful 'completion'
7. what is the nature and location of the uncertainties involved.
8. other related issues

2.0 The Managing System and Operating System

a. General Issues

Questions

What are the most critical issues in development control. How well are you coping. Do you think the present system is effective. What in your opinion, is the one good thing good the present system. What is the one thing you that would like to change.

Answers

1. Time and Resources

The critical issues in development control are time and resources. With the current boom in the construction industry, it is difficult to do an 'effective' control work. Most of the reasons for delay are because submitting architects are not complying with the application procedures. Sometimes, it seems that these architects are doing it on purpose, and want JBCC to pin-point their 'mistakes'. The procedures are fairly easy to follow and usually submitting architects are not doing the submission 'for the first time'. The four main reasons for delays can be pinpointed to the following reasons:

i. delay in receiving feedbacks from other departments.
ii verifications by JBCC on technical requirements.
iii calculations of financial contributions and various charges by JBCC.
iv re-checking of the requirements after plans are returned to JBCC (subsequent stage).

The one good thing about the present system is that it works. Whatever the comments might be, they feel that with the current resources that they have, it is amazing that the system has not 'collapsed'. One thing that they would like to change, is to have more (qualified) staff, so that they can provide, not just a good service, but also effective control. The architect department raised a related issue by suggesting an effective management filing system. With 7000 active files at any one time, this certainly help them to provide a better service. Both the engineering and architecture departments raised the issue of overlapping in application. Checking is done over and over again.

One cited the presence of property speculators as adding to the high demands for development control applications. "We should stop giving any more appovals, until they have made good their previous approvals", was one of the suggestions. They were very receptive to the idea of using a model to give them an overall visual simulation of the city, i.e. simulating existing and proposed projects. With the available resources, they can not afford to do any feedback studies.

b. Specific issues

Questions

1. Identification of Specific Tasks Needs

Is there any counter service(meeting/ discussion) that takes place between applicants and JBCC before a submission. Who attended. Who is responsible for tasks. What are the typical issues raised (eg. did client have any special requirement about the project). Is JBCC able to repond to the client's environment. How frequent is the interface. What are the other points of concern.

Answers

Generally, it is the clients initiative to make appointment to see whoever deem necessary. With the limited resources available, they can only 'entertain' important queries. There is however, no formal 'communication channel' for discussion. Typical issues raised were the time that they will take to process, how long, cost for approval, conditions for approval, and also if their applications will have any problems. However if it is a privatisation project, they have to make arrangement for a formal discussion. There is also a time limit of 3 months to process these applications. This commitment will eventually be extended to all applications, regardless.. A more crucial but somewhat reluctantly discussed, was the issue of political pressure to make decisions.

Questions

2. Requirement Definitions

What are the general requirements for the submission of the applications, in order for it to be successful. Are these requirements made known to applicants. Are there any formal instructions given and by whom. What about other special requirements such as traffic studies, EIA report, etc. Who is responsible for task.

Answers

Instructions and manuals available are for internal (office) use. They are now in the process of drafting and making the requirements available to the public. Usually, they will explain the requirements to applicants (especially first time enquiries) over the counter.

Questions

3. Establishing Time Estimates

Were these issues ever raised. Is JBCC able to respond to the issues (positive or negative). Who is responsible for making the estimates. What are the issues to be considered when giving estimates. Is there a formal method of calculating estimates. Who else (departments/person) involved/consulted in determining estimates.

Answers

Processing of applications need to be done in 'the best time possible'. However, if it is a privatisation job, as mentioned above, they need to process it within 3 months. This is because privatisation jobs are usually State's projects and therefore, there is political pressure to process within the time limit. In any case, most of the projects are huge and need special attention. If applications are from individuals, then estimates will be given by planning department. Clients are expected to follow up - ie. 'chase after their files'. Infact the comment was "they do not expect us to run around to find out if other departments have processed their files". Refer to office manual for job's responsibility.

Questions

4. Managing Application Processing

Who is responsible for managing applications. What are the tasks to be performed after applications are received. Who is responsible for each task. How long does it take to perform each task. Which department is more critical to the successful completion of the task.

Answers

Every department is responsible for managing their own individual applications (as outlined by manuals). The Planning department is suppose to manage the overall system. However, this is only 'successful' if departments are within JBCC. Departments outside JBCC, Power, Telecoms, etc. are beyond their control. There is no effort to publish a standard format of executing things. (Serving client comes last). Infact there are cases where appoval made without consulting outside departments. The Power Department when approached asserted that 'they are in the business of supplying electricity, not approving planning permisssion'.

The head of each department is responsible to prepare a 'workflow chart' based on the resources available, and experience of staff. Most agreed that the staff that thye have are rather 'poorly qualified' eventhough one mentioned that 'experience is more important in some cases'. Clients are usually aware of the responsibilities of officers in the departments (because of the existence of file-chasers).

Questions

5. Negotiation Process

How does the consultation takes place. What tasks are to be performed during consultation. How are the tasks subdivided. How do the task interrelate. What are the interaction pattern of each participating department. Which tasks and departments are more critical to successful 'completion'. Does consultation and negotiation takes the form of any pattern (eg.compromise, common-goal, forced acceptance, etc). What are the proposals based on (reports, acts,visual, etc). What are the the information inputs for each task (eg. documents, plans, pastcases, etc). Are applicants consulted.

Answers

Technical proposals/recomendations are done by technicians. There is a checklist of tasks to be performed (refer to Diagram). Interaction between departments happens only in special circumstances, eg. privatisation work. Consultation is usually done informally (at the canteen, lifts, and on the phone). There is no formal channel or procedure for communication.
There is usually an internal crit session before fowarding recommendation. If departments can agree on a solution (conditions), they will asked the Planning Committee to make the final decision. Applicants are only involved when they themselves approach individual departments. Very rarely have departments within JBCC approach applicants during decision making. Negotiation with clients is usual related to *planning gains* issues.

Questions

6. Models and Feedback Studies

Is there any model (reference) of city constructed. What form does it takes. (Since feedback takes a long time), how do you predict and assess systems performance. Who is responsible for task. Are applicants aware of system model. Who monitors, and controls feedbacks.

Answers

There is no overall model for reference. Infact everbody feels strongly for the need of an overall model. Special Technical studies are usually done by applicants (usually a requirement), such as traffic studies and EIA report. The need to do a 'feedback' analysis study is strongly felt. Everybody agrees with the need for someone to monitor and control feedback. Currently decisions made are as a 'piece meal' and on a ad-hoc basis.

7. Other Issues

a. *JBCC Providing Leadership*

Most ageed that with competition coming from its neighbours, such as Singapore, Batam Island, and the Second Crossing, the pressure for JB to define its role is mounting. There is a need for JBCC to do some foward planning and be more 'intentional' in its approach to developing JB. Currently, JBCC is only 'reacting' to the situations.

b. *Organisation Structure and Ownership*

The present organisation structure is not condusive to suggest 'innovative solutions' to clients. This is because decision are made at the Planning Committee levels and are not delegated. As a result, they do not feel 'ownership' to the decisions made.

c. *Structure Plan Being too Rigid*

"It should never have been gazetted" was one of the reactions. With the current rate of development of JB, they suggested that it was very difficult to plan more than two or three years in advance. Since the recommendations in the structure plan are *statutory*, there was no room for 'creative decision making'. Instead they suggested that the strcture plan should be treated as a Council 'policy guideline'. For example, in the last structure plan of 1985, it was forecasted (and gazetted), that future development will take place in the east-side of Johor Bahru, ie. an area close to the city's port in Pasir Gudang. However this did not materialise, and development had instead focused on the west-side of JB which is in line with the devlopment of the second causeway.

d. *Information Technology (IT) as a Tool to Aid and Enhance Decision Making*

The notion of using IT as a tool to aid decision making, receive a cautious response. A majority felt that decision making is still a 'personal communication' between two parties. Maybe this is a cultural issue. They, however, felt that the current methods used especially during consultation stage, do not allow and encourage them to collaborate and communicate among themselves and especially with the clients.

3.0 The Client System

1. General Issues

Questions

What are the most critical issues in development control. How well are you coping. Do you think the present system is effective. What in your opinion, is the one plus point about the present system. What is the one thing that you would like to change.

Answers

1. Unpredictability

The most critical issue raised was professionalism and efficiency in decision making. The one plus point about the present system is that JBCC is rather 'friendly' in entertaining their queries. They therefore, agree that the present system to some extend is 'working'. However having to 'chase' after their applications, is definately not the way foward. One even highlighted that he has to employ a permanent 'file-chaser' just to ensure that his applications are 'moving'. "Its like playing snake and ladder", was how he sums it up. He cited his experience when after waiting for almost six months after submitting, was told by JBCC that his plans 'was lost'. Sometimes, its faster to built than to get approval. "Infact employing a file-chaser was the best thing that can happen to me and my practice" he asserted.

2. Approval Centre and Transparency

Everyone agreed for the need to develop a system whereby all information pertaining to development control, can be made available. The setting up of an Approval Centre, was overwhelmingly suggested. The architects also suggested that the unavailability of a Local Plan have made it difficult for them to propose a genuine and innovative solution. This has created a lot of 'uncertainty' for a lot of genuine and bona fide developers. As a result, some developers are turning to 'approval agents' who are offering their services to obtain approvals from JBCC such as reduce car parking requirement and an increase in the plot-ratio. In some cases these agents can even guarantee the outcome of a submission.

3. *Progressive Participation*

The architects also highlighted the need to be involved and to participate in the decision making process. This will ensure that the outcomes will be made known to them progressively, rather than at the end of the process, "which can take up to six months". By being able to participate progressively, they can make amendments as required and will save the time and effort of having to resubmit the application all over again (at the end). However, a 'formal procedure' need to be establish for communication and participation. "If we do not, then they (JBCC) can call us any time they wish and maybe to answer some trivial question".

4. *Professional Trust*

Another important issue raised was the overlapping in submission procedure. Because of the one-stop agency procedure, they are required to submit 'the same plan' for the authorities to do the checking at least 'three time'. Related to this is the issue of professional trust. The argument is that if JBCC were to trust the datas and information as stated on their applications at face value, then decision making can be easily speeded up. One commented, "After all the same datas were provided at every stage. They only need to check it before a Certificate of Fitness (CF) is being given. If during this stage the datas do not square up, then do not issue us the CF"

Other Issues Raised

1.*Unsystematic Land-Use Approval Procedures.*

Since land is under the jurisdiction of the State information related to land matters are not 'accessible' to JBCC. The unavailability of these informations make it difficult to propose specific types of development. A rather cynical view was fowarded that in many cases, the State was only interested to know the monetary returns that a development has to offer, eventhough the development proposed is against the guidelines set out by the structure plan. One person has sympathy with JBCC because the power to implement the structure plan is beyond their control.

2. *Structure Plan System being too Vague*

This point was again highlighted by those interviewed. The unavailability of a detail blueprint to guide development, has resulted in an environment of uncertainty, leading to widespread speculation and encouraging malpractice. The lack of data necessary for the foward planning of infrastructure services was also also raised.

3. *Authority without Responsibility*

One raised a fundamental issue of accountability of Local Authorities in Malaysia in general, what he termed as *authority without responsibility*. Although authority has been vested in the Local Authorities, this is without any responsibility. He quoted the Building Act 1974, which expressly exempt Local Authorities from any responsibility. The 1974 Act section 95 (2) provides:

> *"The state Authority, local authority and any public officer or officer or employee of the local authority shall not be the subject of any action, claim, liabilities of demand whatsover arising out of any building or other works carried out in accordance with the provisions of this Act or any by-laws made thereunder or by reason of the fact that such building works or the plans thereof are subject to inspection and approval by the State Authority, local authority.....and nothing in this Act or by-laws made thereunder shall make it obligatory for the State Authority or the local authority to inspect any building.........to ascertain that the provisions of this Act .....are complied with or that plans, certificates and notices submitted to him are accurate. "*

"If the country is serious in making our Local Authorities to be more accountable in the near future, maybe its time that we start reviewing this Act" he asserted.

Appendix 4-A
Contract Model

(after The Chartered Institute for Building, 1992; and Powell-Smith, V. and Chappell, D (1986))

A. Intention of Parties

1. *Contractor's Obligation*

The contractor shall with due diligence carry out and complete the Works in accordance with the Contract Documents and shall be to the reasonable satisfaction of the Project Manager (PM). In doing so the contractor is obliged to:

- do his work 'to his best capability'.
- complete the work by the date for completion stated in the contract
- comply with project managers instructions
- inform (make application to) PM as soon as it becomes apparent that regular progress is or is likely to be affected (give reasons why) and propose a new date for completion
- inform the PM when project has been completed.

2. *Project Manager's Duties*

The Project Manager shall issue any further information necessary for the proper carrying out of Works, issue all certificates and confirm all instructions in writing in accordance with these Conditions. These include:

- accepting and ensuring the processing all applications for development control, on behalf of the Local Authority, from client (or its agents) non-stop in the best time possible
- accepting all data submitted along with application by client to be deemed as accurate and in compliance with relevant by-laws
- preparing a Master Plan to direct, co-ordinate and monitor the execution of the project in association with the project team.
- achieving good communications and motivating all personnel
- setting priorities and effective management of time
- coordinating the project team's activities and output
- preparing and provide the contract documents and descriptive schedules necessary to carry out works

- monitoring project resources against planned levels and inform contractors regarding divergence from contract and specifying divergence
- Receive tender proposals from the contractors
- updating client with the projects progress
- identifying any existing or potential problems, disputes, or conflicts and resolving them, with the co-operation of all concerned in the best interest of the project
- review and verifying request for extension of time
- certify completion

3. *Client's Duties*

The client (or its agent) is responsible to make application for approval of development control to the Local authority. In doing so the client must make sure that:

- all application must be genuine
- submission for application are made at the Approval Centre
- data provided during submission is accurate and in compliance with relevant by-laws (based on trust system).
- it agrees with the valuation of approval managers in the granting of extension of time if deemed necessary
- it provides additional information regarding projects from time to time as required by the approval manager (and project team)
- it liaise only with the approval manager for any enquiry regarding the submission.

B. Commencement, Completion and Penalty

1. *Extension of Contract Period*

If it becomes apparent that the Works will not be completed by the date of completion, for reasons beyond the control of the Contractor, then the Contractor shall so notify the Project Manager who shall make, in writing, such extension of the time for completion as may be reasonable.

1a *Grounds for extension of time by contractor* (Clause 25)

- contractors must apply for extension of time
- compliance with PM's instructions (project manager has the right to instruct time to be extended)
- clients failure to provide information

- delay on the part of other project team members (or outside agents input, eg. EIA report)
- late instructions
- contractors unforseeable inability to obtain information (thought that he has the capacity to tackle problem)

1b *After granting and extension of time the Approval Manager* must then:

- fix a new completion date
- confirm the completion date already fixed
- distribute the new completion date to project team

2. *Completion Date*

The Contractor shall notify the Project Manager of his completion of work and the Project Manager shall certify the date when in his opinion the Works have reached practical completion.

3. *Penalty for Non-Completion*

If the Works are not completed by the completion date or by any later completion date (as fixed in the extension of time clause), then the Contractor shall pay to the Client liquidated damages at the rate of $...x....per week for every week or part of a week during which the Works remain uncompleted.

4. *Completion and Consensus Agreement by Default*

If a request for consensuas agreement is not reponsed to, it is assumed that the contractor has no objection to the conditions and that he is to take full responsibility for the consequences afterwards.

5. *Disputes*

The Project Manager will take the role of an arbitrator if there are disputes between parties involve in the project

Two modes of operation will be available, a *passive* and an *active* mode. In the passive mode, the arbitrator (project manager) monitors the agent proposal process and intercedes when a problem is evident (or when the time limit is exceeded). In the active mode, it mediates during the agents plan-making process when called upon by the agents (iterative).

To solve dispute, both sides must either agree to choose one proposal, cooperatively reivsed one, or serached for a new solution that will be acceptable to all parties. Disputes must only be conducted in a close session (not in the open).

Appendix 4-B
Clause 25

1.0 Clause 25 - Extension of time

Although an extension to the time of a contract will not in itself require the Client to make any extra payments, it will decrease the time that the Contractor may be late in achieving Practical Completion, and so decrease the amount of Liquidate and Ascertained Damages recoverable by the Client. It is very important that the Project Manager should carefully record all that happens to the Contract, and therefore be in a position to consider any request for an extension of time.

An extension of time is a further period beyond the original completion date stated in the Agreement, which will then establish a new completion date. An extension will be granted only when the following procedures are accurately and timeously carried out:

Action sequence

Contractor

25.2.1.1 If it becomes reasonably apparent that the progress of the works is being or is likely to be delayed then the Contractor will give written notice to the Project manager with an explanation of what has happened or is likely to happen, and also state which one or more Relevant Events refer.
Note the words 'reasonably apparent'; the contractor is expected to act responsibly in his supervision and be therefore able to forecast likely delay. *The notice must be in writing and sent immediately, not at the end of the Contract.*

25.2.1.2 A nominated sub-contractor affected by the above notice must receive a copy of the notice.

25.2.2 For all the relevant events referred to in the notice, the Contractor has to give to the Project Manager, in writing, either at the same time or as soon as possible,

25.2.2.1 Particulars of the expected effects,
25.2.2.2 An estimate of the expected delay beyond the completion date whether or not concurrent with delay from any other relevant event.

25.2.3 The Contractor will give the Project Manager and any affected nominated sub-contractors any further notices, in writing, that he considers necessary or as the Project manager requests, in order to update the estimate and intimate any changes in the information.

It is envisaged here that a somewhat *continuous dialogue* be established between the Contractor and the Project Manager to attempt to keep the whole situation in a close focus. The Project Manager has to *form an opinion* as to the award of an extension of time based on the evidence of the Contractor and his own observations.

25.3.1 If after receiving any notices, particulars and estimates, it is the Project Manager's opinion that

25.3.1.1 Any of the delays stated are caused by a relevant event,
25.3.1.2 The completion of the works is likely to be delayed beyond the completion date,

then he shall, in writing, give the Contractor an extension of time by fixing a later completion date which he*then* estimates to be fair and reasonable, with a copy to every nominated sub-contractor, even those not notified under Clause 25.2.1.2.

Notice again that the Project Manager's obligation in fixing a new completion date is to be *fair and reasonable* in his estimation of the extension of time and that this can only be in regard to the cause of the delay. As will be seen later, the Contractor has a duty to try to reduce the effects of delay and his actions may well have some bearing on the Project Manager's decision.

When the Project manager fixes a new completion date, he will state

25.3.1.3 Which of the relevant events he has taken into account,

25.3.1.4 The extent, if any, to which he has taken into account any instruction requiring the omission of work as a variation issued since the fixing of the last completion date.

If practicable, the new completion date shall be fixed by the Project Manager not later than *one-week* after the notice has been received, and if that time does not remain then not later than the completion date in the Appendix.

This underlines the importance of the written notice, together with all the particulars and estimates as well, since the Project Manager cannot, and is not obliged to, give a decision until he has received them all, and then the one-week period will commence.

25.3.2 Even after the granting of an extension of time, the completion date could not be fixed at an earlier date because of a variation for the omission of work being taken into account by the Project Manager. This is always provided that the Project Manager considers the new date to be fair and reasonable and that the variation was issued after the date of the last grant of an extension of time. (No new date can be fixed that is earlier than the original date in the Appendix)

25.3.3 The Project manager will make a final review of the progress of the Contract within a one-week period, starting at the date of Practical Completion, and state in writing to the Contractor (with a copy to every nominated sub-contractor) one of the following three things:

25.3.3.1 Fix a fair and reasonable new completion date taking into account any of the relevant events, whether reviewing a previous decision or otherwise, and whether or not the Relevant Event has been notified in a notice, OR

25.3.3.2 Fix a fair and reasonable new completion date earlier than that previously fixed because of a variation for the omission of work issued after the date of the last grant of an extension of time,

OR

25.3.3.3 Confirm the last fixed completion date.

The Project Manager's decision is affected by the Contractor's always using his best endeavours to prevent delay in progress, however caused, and preventing the works from being completed beyond, or further beyond, the completion date (Clause 25.3.4.1 refers).

The Contractor's best endeavours would not be taken to mean working overtime, or significantly increasing his labour force, which would all amount to a serious extra expense. Rather it could be an adjustment to his programme in the short term, or possibly a re-allocation of labour.

25.3.4.2 The Contractor has to satisfy the Project Manager that he has done all that he can reasonably do, to proceed with the works.

25.3.5 As mentioned previously, the Project Manager will notify (in writing) every Contractor of each decision in the fixing of a new completion date.

25.3.6 As stated before, no new completion date can be fixed which is earlier than that given in the Appendix.

List of Relevant Events

25.4.1 *Force majeure*

This is sometimes quoted as an 'Act of God' but could probably have a wider meaning. It is intended to cover matters of a very exceptional or extreme nature which are outside the control of either party. Care must be taken to ensure that none of the Perils in Clause 22 is included under this heading.

25.4.2 Loss or damage under Clause 22 Perils

The list of Perils and their exclusions are contained in Clause 1.3. Remember that some exclusions are not normally an insurance risk and some other arrangements may have to be made.

25.4.3 Civil commotion, local combination of workmen, strike or lockout affecting
any of the trades employed upon the works,
any trades engaged in preparation,
any trades engaged in manufacture,
any trades engaged in transportation.

Clause 22 Perils covers riot and commotion affecting the works. It covers all the building operations before the works are actually built, on or off site and including a possible transport strike.

25.4.4.1 Compliance with the Project Manager's instructions under Clauses

- **2.3** Discrepancy between documents
- **13.2** Variations
- **23.2** Instruction for postponement
- **34** Antiquities
- **35** Nominated Sub-contractors

All Project Manager's instructions under these clause numbers can give cause for delay. The organized Contractor will be documenting records to enable proof of delay to be established, if required, and to the Project Manager's reasonable satisfaction.

25.4.6 Not having received from the Project Manager in time or due time. necessary instructions, details or levels for which the Contractor specifically applied in writing. Provided that the date it was requested (bearing the completion date in mind) was neither unreasonably distant from, nor unreasonably close to, the date on which the information was needed.

The essence here is that the information was requested and in writing. 'In due time' must allow the Contractor the usual margin so allow him properly to plan his operations. As to when the request was made, it would be unreasonable to request finishing details before the work is out of the ground. However, it is not unreasonable to plan fairly well in advance and information would then be requested in good time. Conversely, if the application is too late, there can be no successful application for a grant of extension of time.

25.4.7 Delay on the part of Sub-contractors (team mebers) and client agents which the Contractor has tried to avoid or reduce

This means delay in the completion of Sub-contract Works which, in turn, causes delay in the progress and completion of the Main Contract Works. The Project Manager must expect the Contractor to have taken some kind of avoiding or ameliorating action to help the situation.

25.4.8.1 The execution of, or failure to execute, work outwith the Contract, either by the Client direct or by persons (agents) engaged by him

Clause 29 defines the type of work and persons engaged to carry it out and this event absolves the Contract from responsibility for any delay on their part.

25.4.8.2 The supply, or failure to supply, goods which the Client has agreed to provide

The comment on the previous clause is relevant here.

25.4.10.1 The Contractor's inability to secure labour, which is outside his control and could not have been reasonably foreseen

The expression 'reasonably foreseen' puts the onus upon the Contractor to have taken preliminary steps to check the labour market and make his plans accordingly.

The criterion is that the situation is outside his control. This might be very difficult to substantiate.

25.4.12 Failure of the Client to give in due time

(a) Immediate information about the project when required,
(b) In accordance with the Contracts Details
(c) After receipt by the Project Manager of any required notice to be given by the Contractor,

The Project Manager will need to instruct the Contractor what to do next in consequence of the Employer's default. Thus the Project Manager could confirm the failure by instruction which becomes a variation under Clause 13.1.2. A further Relevant Event could then arise under Clause 25.4.5.1.

Appendix 4-C
Project Exchange - Export Utility

In MicroPlanner, the export facility allows a user to take information *from* an existing project and translate it into a form which can be used in other projects, programs or systems. The utility Project Exchange allows a user to export the project data to:

i. *Database Program* - for keeping statistical information about resource usage, activity durations, or critical activities
ii. *Spreadsheets* - for performing further analyses of project detail
iii. *Word Processors* - to incorporate selected project data in written documents.

We can choose individual activities and events for export - this could be described as *horizontal* selection. Similarly, a user can select the categories of information to be exported - i.e. the *vertical* selection.

Record 23	Field	Field	Field	Field
Record 24				
Record 25				
Record 26				
Record 27				
Record 28				
Record 29				

Figure 1- Records and Fields

Refreing to Figure 1, each activity or event is referred to as a Record and each category of information (for example duration, or deadline) is referred to as a Field.

2. Selecting Records

Records are highlighted and selected as illustrated in Figure 2

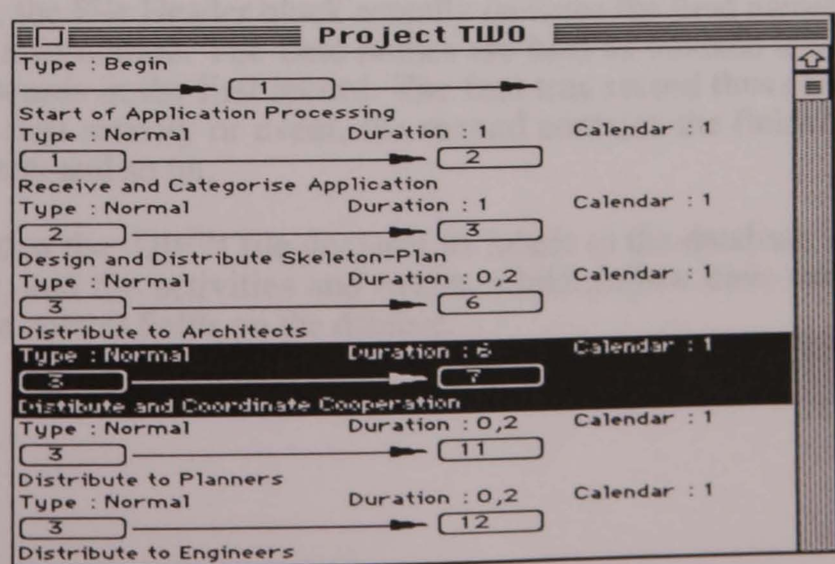


Figure 2 - Activity 3 → 7 is selected for Export

3. Export Field Selection

Having selected the recors, the user is now required to choose the fields of information to be transfered. The following window illustrated in Figure 3 will appear with all fields preselected:

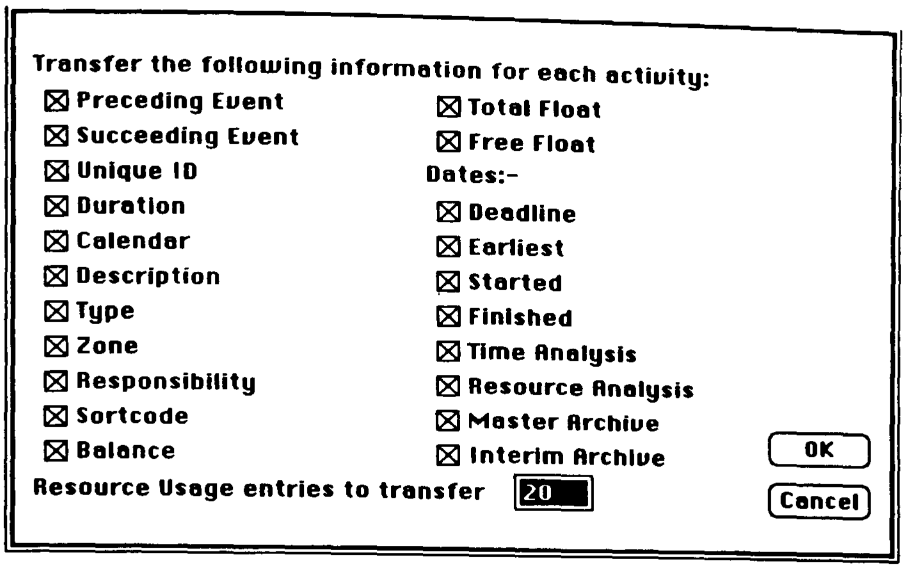


Figure 3 - Field Selections

Once selected, we can now export the records and field to a File, using the Text, or .DIF™ file format.

4. Exporting to .DIF™ Files

The .DIF™ standard specifies that there must be three parts to the file, namely:
i. The File Header block which contains information about the number of records and fields in the file.
ii. The data blocks which consists of records and each of these consists of fields. They also have additional information to mark the beginning of each record and field.
iii. The End-of-File block which tells the destination that this is the end of the file.

.DIF™ Database Format
In this format, the File Header block actually contains the field names as well as the file structure information. The field names are held as indexed labels - numbered from 1..... onwards in the first record. The first true record thus contains the field values of the first activity or event, the second contains the fields for the second activity or event, and so on.

The result is that the .DIF™ file declares its labels to the database within the File Header block, and the activities and events which follow have their field values slotted into the correct fields on the databse.

The Header used by this format is illustrated in Figure 4.

Name	Remarks				
I No	Four character or less -alphanumeric				
J No	Four character or less -alphanumeric				
Unique ID	One character -alphanumeric				
Duration	Enter as days only				
Calender	Numeric - 1 to 6				
Description	Up to 254 alphanumeric characters - visible character or notes				
Type	Enter the Type characters as follows:				
	Start	Lead	Finish	Lag	Hammock
	Normal	Conse	Key	Non-split	Begin
	Ladder	End	Dummy	Reverse	
Zone	Zone label (up to 12 visible character)				
Resp	responsibility label - entered as Zone				
Sortcode	Sortcode - up to 8 alphanumeric				
Balance	Entered as Duration				
Tot. Flot	Entered as Duration				
Free Flot	Entered as Duration				
Deadline	Entered as 1Jan96, 1-Jan-96				
Earliest	Entered as Deadline				
Started	Progress date - entered as Deadline				
Finished	Progress date - entered as Deadline				
E Start	Start date for the Time-Analysis Early Schedule				
E Finish	Finish date for the Time-Analysis Early Schedule				
L Start	Start date for the Time-Analysis Early Schedule				
L Start	Finish date for the Time-Analysis Early Schedule				
St. Master	Start date for the Master Archive - entered as deadline				
Fin. Master	Finish date for the Master Archive - entered as deadline				
St. Interim	Start date for the Interim Archive - entered as deadline				
Fin. Interim	Finish date for the Master Archive - entered as deadline				

Figure 4- Header Format

Appendix 4-D
Program Listing

•••••••••• Management System for Development Control ••••••••••

Abu Hasan Ismail
School of Architecture
University of Sheffield

•••••••••••••••••••••••••••••• June 1996 ••••••••••••••••••••••••••••••

```
--••• XFCNs and XCMDs used in this stack •••

-- XFCNs
--  DialogList   : Displays dialogue box with a number of items from
--           which the user can choose (©1988 AnalytX).
--  HPopUpMenu   : Allows hierarchical pull down menu button
--           (by Guy de Picciotto).
--  IsRunning    : Checks if other applications are running under
--           Multifinder (©1988 Steve Drazga).
-- XCMDs
--  CreditsDialog : Displays picture resources in a smart way
--           (by Jay Hodgdon)
--  Highlight    : Highlights buttons when the mouse passes by
--           (by Ron Janzen).
--  MultiScroll  : Allows more than two fields scroll together
--           (by Oscar F. Hills)

-- Import : Allows to Import Text or Data
             (by Gary Bond)

-- Export : Allows to export Text or Data

--•••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••

on openStack

 hide menubar
 hide message box
 hide tool window
 hide pattern window

 -- delete existing map card and add new card if been away
 global beenAway
 if beenAway is 1 then
  clearMap
  importData
  put 0 into beenAway
 end if
```

```
  -- avoids unnecessary repetition in setting global variables
  global GVSetup
  if GVSetup is true then exit openStack

  -- setting version number
  go cd "New File"
  put "Version 2.01" into cd fld "VersionNo"

  -- check HyperCard version
  if the version < 2.0 then
    beep 3
    put "Current HyperCard version is " & the version & "!" & return &¬
    "Management System requires HyperCard version 2.0" & return &¬
    "or later!" into theMsg
    answer theMsg
    doMenu "Quit HyperCard"
    exit openStack
  end if

  -- setting global variables for End Of File,
  -- file I/O path, User, etc.
  global EOF,TransferPath,MoreInfoPath,UserInfoPath,UL
  global saveLevel,limitLevel
  put "@" into EOF
  put (name) into LN
  delete first word of LN
  delete first char of LN
  repeat until (last char of LN is ":")
    put empty into last char of LN
  end repeat
  put LN into TransferPath
  put TransferPath & "MoreInfo:" into MoreInfoPath
  put TransferPath & "UserInfo:" into UserInfoPath
  put 1 into UL


  -- check configuration file and read from it
  put TransferPath & "Management System Config" into CFN
  if FileExists(CFN) then
    open file CFN
    read from file CFN until EOF
    put empty into last char of it
    close file CFN
    end if
  else
    play boing
    answer theMsg
  end if

  -- setting for highlight XCMD
  global runHilite
  put false into runHilite
end openStack
```

```
on clearMap
 lock screen
 go card "Management System-2"
 if the result is empty then domenu "Delete Project" -- the card is found
 go card "Managing System 3"
 domenu "New Project"
 set name of this card to "Managing System"
 put "Management System" into bg fld "Title"
 go card "First Title"
 unlock screen
end clearCard

------------------------------ importData ---------------------------
-- Reads message file from FileMaker Pro and interprete it.
-- At the end, it calls doMap.
-------------------------------------------------------------------

on ImportData

 hide menubar
 put "Reading Blackboard... Please Wait..." into message box
 global TransferPath
 lock screen
 put empty into card field "Penalty" of card "Appendix"
 set cursor to 4
 put TransferPath & "Appendix" into FILENAME
 open file FILENAME
 read from file FILENAME until return -- get number of nodes
 if it is empty then
   answer "Error: Could not find file" && FILENAME && "or file is¬
   empty"
   close file FILENAME
   exit importData
 end if
 put item 1 of it into NoOfNodes
 put ";" into delimiter

 repeat with Count = 1 to NoOfNodes

   -- get node name
   read from file FILENAME until delimiter
   put empty into last char of it
   put it into NodeName
   go card NodeName

   -- get parents node
   read from file FILENAME until delimiter
   put empty into last char of it -- delete delimiter

--------------------------------- logout --------------------------
-- save all user information and restart Management System
-----------------------------------------------------------------

on logout
 global currentUserName,userInfoPath,userFileName,EOF,UL
 lock screen
 go card "Records"
```

```
  -- tidying stack
  tidyStack
  -- change button text
  hide bg btn "Logout"
  show bg btn "Login"
  set the textFont of bg btn "Options" to "Chicago hollow"
  set the textFont of bg btn "Query" to "Chicago hollow"
  set the textFont of bg btn "Records" to "Chicago hollow"
  -- remove map card and insert new card
  clearMap
  unlock screen
  choose browse tool
  put "Now compacting this stack. Please wait..."
  hide message box
  -- special visual effect to remind the user
  visual dissolve to gray
  visual dissolve to inverse
  visual dissolve
  go card "First Card"
end logout

--•••••••••••••••••• end of Management System Stack Script ••••••••••••••••••
```

```
••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••
                                  HyperText Stack
••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••

-- All material in this stack copyright © 1992 by Addison-Wesley Publishing

on openStack
  show groups
  adjustToScreen
  pass openStack
end openStack

on closeStack
  deleteLinkBack
  if freeSize of this stack > 10000 then
    put "Compacting the stack..." into msg
    domenu "Compact stack"
    put empty into msg
    hide msg
  end if
  pass closeStack
end closeStack

on suspendStack
  hide groups
  pass suspendStack
end suspendStack

on resumeStack
  global thePendingLink
  show groups
```

```
 restoreLinkBack
 if thePendingLink ≠ empty then show window "LinkTo"
 if short name of this card is "Managing System" then send openCard to this card
 pass resumeStack
end resumeStack

on adjustToScreen
 if top of card window < 20 then
  get rect of card window
  put 20 into item 2 of it
  put min(item 4 of the screenRect, height of this card+20) ¬
  into item 4 of it
  set rect of card window to it
  show scroll window
 end if
 if width of this card > width of card window then
  put item 3 of the screenRect into screenWidth
  get rect of card window
  put 0 into item 1 of it
  put min(screenWidth,width of this card) into item 3 of it
  set rect of card window to it
  show scroll window
 end if
end adjustToScreen

on openCard
 -- updates the index card
 get short name of this card
 if it ≠ "Managing System" and it ≠ "Title" and there is a card "Managing System"
then
  send "fillBlob"&&quote&field "Title"&&word 1 of field pageNo&quote¬
  to card field "Field" of card "Managing System"
 end if
 pass openCard
end openCard

on closeCard
 closeVisiblePopUps
 pass closeCard
end closeCard

on makeLinkBack
 global LinkBackItems, LinkBackMessages
 send "getLinkBackEntry" to this card
 put the result into theEntry
 if theEntry ≠ empty then
  if there is no menu "Link Back" then
   create menu "Link Back"
  end if
  repeat with i = 1 to number of lines in LinkBackItems
   if line i of LinkBackItems = theEntry then
    delete line i of LinkBackItems
    delete line i of LinkBackMessages
    exit repeat
   end if
  end repeat
  put theEntry&return after LinkBackItems
```

```
    get "goLinkBack"&&short id of this card&","&quote&theEntry&quote
    put it&return after LinkBackMessages
    if number of lines of LinkBackItems > 20 then
      delete line 1 of LinkBackItems
      delete line 1 of LinkBackMessages
    end if
    put LinkBackItems into menu "Link Back" ¬
    with menuMessages LinkBackMessages
  end if
end makeLinkBack

on restoreLinkBack
  global LinkBackItems, LinkBackMessages
  if LinkBackItems ≠ empty and there is no menu "Link Back" then
    create menu "Link Back"
    put LinkBackItems into menu "Link Back" ¬
    with menuMessages LinkBackMessages
    set checkMark of last menuItem of menu "Link Back" to true
  end if
end restoreLinkBack

on deleteLinkBack
  global LinkBackItems, LinkBackMessages
  put empty into LinkBackItems
  put empty into LinkBackMessages
  if there is a menu "Link Back" then delete menu "Link Back"
end deleteLinkBack

on goLinkBack anId, theItem
  global LinkBackItems, LinkBackMessages
  if anId ≠ short id of this card then
    visual zoom close slow
    go card id anId
    put number of lines in LinkBackItems into n
    repeat with i = n down to 1
      if line i of LinkBackItems = theItem then
        delete line i to n of LinkBackItems
        delete line i to n of LinkBackMessages
        if number of lines in LinkBackItems > 0 then
          put LinkBackItems into menu "Link Back" ¬
          with menuMessages LinkBackMessages
        else
          delete menu "Link Back"
        end if
        exit repeat
      end if
    end repeat
  end if
end goLinkBack

on getLinkBackEntry
  put empty into theEntry
  if there is a bg fld "Title" then put bg fld "Title" into theEntry
  if theEntry ≠ empty and there is a bg fld "PageNo" then
    put space&word 1 of bg fld "PageNo" after theEntry
  end if
  return theEntry
```

```
end getLinkBackEntry

on closeVisiblePopUps
  global visiblePopUps
  repeat with i = 1 to number of items in visiblePopUps
    get item i of visiblePopUps
    if there is a card field it then hide card field it
  end repeat
  put empty into visiblePopUps
end closeVisiblePopUps

on lockEverything
  lock screen
  set lockMessages to true
  set lockRecent to true
end lockEverything

on unlockEverything
  unlock screen
  set lockMessages to false
  set lockRecent to false
end unlockEverything
```

••

Managing System - First Card

••

Communication Button - Read

••

```
on mouseUp
  put "Architect" into background field "to"
  put "Project Manager" into background field "From"

end mouseUp
open file "Macintosh HD:Hypercard 2.2:propose"
read from file "Macintosh HD:Hypercard 2.2:propose" until eof
put It into background field "project no.2"
close file "Macintosh HD:Hypercard 2.2:propose"

open file "Macintosh HD:Hypercard 2.2:blackboard2"
read from file "Macintosh HD:Hypercard 2.2:blackboard2" until eof
put It into background field "project name2"
close file "Macintosh HD:Hypercard 2.2:blackboard2"

open file "Macintosh HD:Hypercard 2.2:blackboard3"
read from file "Macintosh HD:Hypercard 2.2:blackboard3" until eof
put It into background field "est. start2"
close file "Macintosh HD:Hypercard 2.2:blackboard3"

open file "Macintosh HD:Hypercard 2.2:blackboard4"
read from file "Macintosh HD:Hypercard 2.2:blackboard4" until eof
put It into background field "est. finish2"
close file "Macintosh HD:Hypercard 2.2:blackboard4"

open file "Macintosh HD:Hypercard 2.2:blackboard5"
read from file "Macintosh HD:Hypercard 2.2:blackboard5" until eof
```

```
put It into background field "contract no.2"
close file "Macintosh HD:Hypercard 2.2:blackboard5"

open file "Macintosh HD:Hypercard 2.2:blackboard6"
read from file "Macintosh HD:Hypercard 2.2:blackboard6" until eof
put It into background field "bid spec.2"
close file "Macintosh HD:Hypercard 2.2:blackboard6"

open file "Macintosh HD:Hypercard 2.2:blackboard7"
read from file "Macintosh HD:Hypercard 2.2:blackboard7" until eof
put It into background field "expiry date2"
close file "Macintosh HD:Hypercard 2.2:blackboard7"

open file "Macintosh HD:Hypercard 2.2:blackboard8"
read from file "Macintosh HD:Hypercard 2.2:blackboard8" until eof
put It into background field "response2"
close file "Macintosh HD:Hypercard 2.2:blackboard8"
```

••

Communication Button - Reply

••

```
on mouseUp
 set cursor to 4
 set lockScreen to true
 go to stack "contract file" in a new window
 go to card "response"
 hide titlebar
end mouseUp
```

••

Contract Buttons - Establish-Group

••

```
on mouseUp
 set cursor to 4
 set lockScreen to true
 go to stack "contract file" in new window
 go to card "establish-team form"
 hide titlebar
end mouseUp
```

••

Contract Buttons - Develop Plans

••

```
function btnNameData
 -- this handler stores the name of the application to go to
 -- user. DO NOT MOVE THE POSITION OF THIS HANDLER!
 return "Micro Planner V6.1f"
end btnNameData

on mouseUp
 if the optionKey is down then goStakSetup
 else
  open btnNameData()
  if the result ≠ empty then beep
 end if
```

```
end mouseUp

on newButton
  goStakSetup
end newButton

on goStakSetup
  set cursor to watch
  put "Select the application for this button to open:" into prompt -- Δ
  answer file prompt of type "APPL"
  if it is empty or the result = "Cancel" then exit goStakSetup
  put shortName(it) into btnName
  adjustBtnSize btnName
  set name of me to btnName
  updateBtnNameData btnName
end goStakSetup

function shortName theName
  put number of chars in theName into numNameChars
  repeat with count = numNameChars down to 1
    if char count of theName is ":" then exit repeat
  end repeat
  return char (count + 1) to numNameChars of theName
end shortName

on adjustBtnSize theName
  if length(theName) * 6 > 36
  then set width of me to length(theName) * 6
  else set width of me to 36
end adjustBtnSize

on updateBtnNameData theName
  -- write name back to the data function handler in this script
  get script of me
  put quote & theName & quote into ¬
  char offset(quote,it) to (offSet("end",it) - 2) of it
  set script of me to it
end updateBtnNameData
```

••

Contract Buttons - Assessment

••

```
on mouseUp
  open "Project-department level" with "Macintosh HD:Project Management:Micro
Planner V6.1f"
end mouseUp
```

••

Contract Buttons - Signing & Execute

••

```
on mouseUp
  open "Project-department level" with "Macintosh HD:Database:File Maker Pro"
end mouseUp
```

••

Contract Buttons - Update

••

```
on mouseUp
 open "Project-department level" with "Macintosh HD:Database:File Maker Pro"
end mouseUp
```

••

Contract Buttons - Synthesis

••

```
on mouseUp
 set cursor to 4
 set lockScreen to true

 go to card "Sort-By conditions"
 get card field "architecture"
 put it into ARCHITECTURE
 get card field "Planning"
 put It into PLANNING
 get card field "Engineering "
 put It into ENGINEERING

 go to card "blank card-2"

 put ARCHITECTURE into card field "architecture department"
 put PLANNING into card field "engineering department"
 put ENGINEERING into card field "planning department"
end mouseUp
```

••

Pull Down Menu - File

••

```
on mouseDown
 put rect of me into myPosition
 put "New Project" & ¬
 return & "Open Project" & ¬
 return & "Close Project" & ¬
 return & "Save Project" & ¬
 return & "Print" & ¬
 return & "Exit" into Items
 put HPopUpMenu(Items,0,(item 2 of myPosition) +15 ,¬
 (item 1 of myPosition)+1 ) into userChoice

 set cursor to 4
 set lockScreen to true
 if item 1 of userChoice is 1 then --New Project
  go to stack "project file" in a new window
  hide titlebar
 else
 end if
 if item 1 of userChoice is 2 then---Save Project
 go to card "first card"
 else
 end if
```

```
if item 1 of userChoice is 3 then --Close Project
go to card "blank card"
else
end if
end mouseDown
```

••

Pull Down Menu - Form

••

```
on mouseDown
  put rect of me into myPosition
  put "Message" & ¬
  return &"Project" & ¬
  return & "Contract" into Items
  put HPopUpMenu(Items,0,(item 2 of myPosition) +15 ,¬
  (item 1 of myPosition)+1 ) into userChoice

  --- if item 1 of userChoice is 1 then --contract
  ---  go to card "contract agreement-2"
  --- else
  --- end if

  --- if item 1 of userChoice is 3 then --database 1
  ---  go to card "database-1"
  --- else
  ---  if item 2 of userChoice is 3 then --database 2
  ---   go to card "database-2"
  --- else
  ---   if item 2 of userChoice is 4 then --database 3
  ---    go to card "database-3"
  ---  end if
  ---  end if
  --- end if
end mouseDown

put rect of me into myPosition
put "Database,Database 1, Database 2, Database 3" & ¬
return & "Drawings,2-D,3-D,Others" into Items
put HPopUpMenu(Items,0,(item 2 of myPosition) + 20 ,¬
(item 1 of myPosition) + 40) into userChoice


if item 1 of userChoice is 1 then -- database 1
go to card "database-1"
if item 2 of userChoice is 2 then -- databse 2
go to card "database-2"
else ---- database 3
go to card "database-3"

end if

else if item 1 of userChoice is 2 then -- drawings
if item 2 of userChoice is 3 then --
picture "arab malaysian",file,zoom,false,,true
```

```
set rect of window "arab malaysian" to 80,115,505,312
set visible of window "arab malaysian" to true
set rect of window "arab malaysian" to 80,115,506,313
hide titlebar
else if item 1 of userChoice is 3 then
end if
end if
```

••

Pull Down Menu - History

••

```
on mouseDown
 put rect of me into myPosition
 put "Project Folder" & ¬
 return &"Contract Folder" & ¬
 return & "Message Folder" into Items
 put HPopUpMenu(Items,0,(item 2 of myPosition) +15 ,¬
 (item 1 of myPosition)+1 ) into userChoice
end mouseDown
```

••

Pull Down Menu - Sort

••

```
on mouseDown
 put rect of me into myPosition
 put "By Zone,CBD,North,South,East,West" & ¬
 return & "By Class,Commercial,Hotel,Residential,Industry,Others" & ¬
 return & "Departments,Architect,Planning,Engineer" into Items
 put HPopUpMenu(Items,0,(item 2 of myPosition) +15 ,¬
 (item 1 of myPosition)+1 ) into userChoice

 if item 1 of userChoice is 1 then -- by zone
  go to card "Sort-By Zones"
  if item 1 of userChoice is 3 then -- by class
   go to card "sort-by-zones"

  else

  end if

 else if item 1 of userChoice is 2 then -- by class
  if item 2 of userChoice is 3 then --
   picture "arch",file,zoom,false,,true
   set rect of window "arch" to 60,130,510,340
   set visible of window "arch" to true
   set rect of window "arch" to 60,130,512,342
  else
  end if
 else if item 1 of userChoice is 3 then

 end if
end mouseDown
```

••

Pull Down Menu - Messages

••

```
on mouseDown
 put rect of me into myPosition
 put "New Message" & ¬
 return & "Extension Request" & ¬
 return & "Assess Request" & ¬
 return & "Contract Violated" into Items
 put HPopUpMenu(Items,0,(item 2 of myPosition) +15 ,¬
 (item 1 of myPosition)+1 ) into userChoice

 set cursor to 4
 set lockScreen to true
 if item 1 of userChoice is 1 then -- new message
  go to stack "new message" in a new window
  hide titlebar

  play boing
 else
  if item 1 of userChoice is 2 then --- Contract Expired
   hide titlebar
   go to stack "messages" in a new window
   hide titlebar
   play boing
   go to card "delay"
  end if
 end if
 if item 1 of userChoice is 3 then --- Extension request
  hide titlebar
  go to stack "messages" in a new window
  hide titlebar
  play boing
  go to card "request for extension"
 else
  if item 1 of userChoice is 4 then --- Contract Violated
   hide titlebar
   go to stack "messages" in a new window
   hide titlebar
   play boing
   go to card "Contract Violated"
  end if
 end if

end mouseDown

put rect of me into myPosition
put "By Zone,CBD,North,South,East,West" & ¬
```

••

Pull Down Menu - New File

••

```
on mouseDown
 if the shiftKey is down then sort lines of me
 else if the optionKey is down then
```

```
  createCardNameList -- rebuild list
  exit mouseDown
 else
  -- go to the card associated with the click
  currentLine
  put the ticks into theTicks
  repeat until the mouse is up
   if the mouseloc is within the rect of target then
    currentLine
    put the ticks into theTicks
   else select empty
  end repeat
  if (the ticks - theTicks) < 10 then
   get the value of the selectedLine
   if it is empty then exit mouseDown
   visual effect iris open
   if the style of me is "Scrolling" then set scroll of me to 0
   go cd it
  end if
 end if
 select empty
end mouseDown

on currentLine
 put (((the mouseV - top of the target) - 4) + scroll of the target)¬
 div (textHeight of the target) + 1 into theLine
 select char 1 to ((number of chars in (line theLine of target)) + 1)¬
 of line theLine to (theLine + 1) of target
end currentLine

on createCardNameList
 -- create the list of card names
 set the dontWrap of me to true
 set the lockText of me to true
 if the style of me is "Scrolling" then set scroll of me to 0
 if "bkgnd" is in the target
 then set the sharedText of target to true
 put empty into me
 repeat with curCard = 1 to number of cards
  set cursor to busy
  get the short name of card curCard
  put it into line curCard of me
  if the length of me > 30000 then
    answer "Sorry, but this field's 30000" &&¬
   "character limit has been reached." --Δ
   exit to HyperCard
  end if
 end repeat
end createCardNameList

on newField
 -- auto builds a new list when this field is pasted
 createCardNameList
end newField
```

••

```
on mouseUp
  set cursor to 4 ---watch cursor
  set lockScreen to true --- freeze on-screen action
  get card field "contribution"
  put it into PROPOSE
  get card field "expiry date"
  put it into DATE
  get card field "contract no."
  put it into CONTRACT
  get card field "outcome"
  put it into OUTCOME
  get card field "to"
  put it into TO
  get card field "from"
  put it into FROM
  get card fld "contract no."
  put it into CONTRACT
  get card fld "project no."
  put it into PROJECT
  get card fld "status"
  put it into STATUS
  get card fld "participants"
  put it into PARTICIPANTS

  go to stack "managing system-3"
  ---go to background "first"
  put PROPOSE into background field "propose"
  put DATE into background fld "expiry date"
  put CONTRACT into background field "contract no."
  put OUTCOME into background fld "outcome"
  put TO into background fld "to"
  put FROM into background fld "from"
  put CONTRACT into background fld "contract no."
  put PROJECT into background fld "project no."
  put STATUS into background field "status & subject"
  put PARTICIPANTS into background field "participants"

end mouseUp
```

****
Buttons - Agreement
****

```
on mouseUp
  set cursor to 4
  set lockScreen to true
  go to stack "managing system-3" in a new window
  go to card "proposed agreement"
end mouseUp
```

****
Buttons - Database
****

```
on mouseUp
```

```
 go to card "database-1"
end mouseUp

*******************************************
Buttons - Building Type & Class
*******************************************
on mouseUp
 go to card "database-2"
end mouseUp


*******************************************
Buttons - Send
*******************************************

on mouseUp
 set cursor to 4 ---watch cursor
 set lockScreen to true --- freeze on-screen action
 get card field "contribution"
 put it into PROPOSE
 get card field "expiry date"
 put it into DATE
 get card field "contract no."
 put it into CONTRACT
 get card field "outcome"
 put it into OUTCOME
 get card field "to"
 put it into TO
 get card field "from"
 put it into FROM
 get card fld "contract no."
 put it into CONTRACT
 get card fld "project no."
 put it into PROJECT
 get card fld "status"
 put it into STATUS
 get card fld "participants"
 put it into PARTICIPANTS

 go to stack "managing system-3"
 ---go to background "first"
 put PROPOSE into background field "propose"
 put DATE into background fld "expiry date"
 put CONTRACT into background field "contract no."
 put OUTCOME into background fld "outcome"
 put TO into background fld "to"
 put FROM into background fld "from"
 put CONTRACT into background fld "contract no."
 put PROJECT into background fld "project no."
 put STATUS into background field "status & subject"
 put PARTICIPANTS into background field "participants"

end mouseUp
```

••
****
Buttons - Export
****

```
On MouseUp
 global LEVELMEMORY,STARTCARD,FIELDNAMES,FILENAME
 put empty into FIELDNAMES
 put the userlevel into LEVELMEMORY
 set userLevel to 5
 set lockMessages to true
 put short id of this card into STARTCARD
 Dialog
 GetFilename
 OpenFile
 GetFieldData
 close file FILENAME
 CleanExit
End MouseUp

On GetFileName
 global FILENAME
 ask "Name or pathname of text file to export to:" with FILENAME
 if it is empty then CleanExit
 put it into FILENAME
End GetFileName

On OpenFile
 global FILENAME,CONTENTS
 open file FILENAME
 read from file FILENAME for 100
 close file FILENAME
 if it is not empty then
  repeat until it is "Replace"
   answer "That file already exists..." with "Replace" or "Cancel"
   if it is "Cancel" then GetFileName
   else if it is "Replace" then open file FILENAME
   else CleanExit
  end repeat
 else
  open file FILENAME
 end if
End OpenFile

On GetFieldData
 global FIELDNAMES,CONTENTS,FILENAME
 set cursor to 4
 put empty into CONTENTS
 if FIELDNAMES is empty then CleanExit
 put id of this background into backtemp
 set lockScreen to true
 go first card of this background
 put id of this card into cardtemp
 repeat
  if id of this background is backtemp then
   repeat with count = 1 to the number of lines in FIELDNAMES
    do "put" && line count of FIELDNAMES && "& return after CONTENTS"
```

```
      if number of chars in CONTENTS > 50000 then
        write CONTENTS to file FILENAME
        put empty into CONTENTS
      end if
    end repeat
    go next card of this background
  end if
  if id of this card is cardtemp then exit repeat
 end repeat
 write CONTENTS to file FILENAME
 set lockScreen to false
End GetFieldData

On Dialog
 global FIELDNAMES
 if the number of background fields is 0 then
   answer "No bkgnd fields on this card to export"
   CleanExit
 end if
 answer "Export which background fields:" with "All" or "Some" or "Cancel"
 if it is "All" then
   set cursor to 4
   repeat with count = 1 to the number of background fields
     put (name of background field count) & return after FIELDNAMES
   end repeat
 else if it is "Some" then
   repeat with count = 1 to the number of background fields
     answer "Export field" && count & ":" && name of background field count
with "Yes" or "No" or "Done"
     if it is "Yes" then put (name of background field count) & return after
FIELDNAMES
     else if it is "No" then next repeat
     else exit repeat
   end repeat
 else CleanExit
 if FIELDNAMES is empty then CleanExit
End Dialog

on CleanExit
 global LEVELMEMORY,STARTCARD
 choose browse tool
 go to card id STARTCARD
 set the userLevel to LEVELMEMORY
 set lockScreen to false
 set lockMessages to false
 exit to hypercard
end CleanExit
```

****
Buttons - Import
****

```
On mouseUp
 set cursor to 4
 set lockscreen to true
```

```
 go to stack contract file
 go to card date
 get field "import"
 Put It into DATE
 go to stack managing system-3
 go to card "proposed agreement"
 Put line 2 of DATE into card field "Est. Start"
 put line 3 of Date into card field "Est. Finish"


 global CARDCOUNT,STARTCARD,LEVELMEMORY,HEADER
 put the userLevel into LEVELMEMORY
 set the userLevel to 5
 set lockMessages to true
 set lockScreen to true
 put the short id of this card into STARTCARD
 answer "Import text file as:" with "Data" or "Text" or "Cancel"
 if it is "Data" then ImportData
 else if it is "Text" then
   answer "Include HEADER information in fields?" with "Yes" or "No"
   put it into HEADER
   ImporText
 else CleanExit
 go to next card
 CleanExit "Compact"
end MouseUp

on ImporText
 global CARDCOUNT,STARTCARD,LEVELMEMORY,HEADER,FILENAME
 put 0 into CARDCOUNT
 repeat
   ask "Name or pathname of text file to import:" with FILENAME
   if it is empty then CleanExit
   if short name of this stack is not in it then exit repeat
   else answer "Can't import current stack!"
 end repeat
 put it into FILENAME
 set cursor to 4  -- use system watch cursor
 open file FILENAME
 repeat
   read from file FILENAME for 16384
   if it is empty and CARDCOUNT is 0 then
     answer "Could not find file:" && FILENAME with "OK"
     close file FILENAME
     CleanExit
   end if
   if it is empty then exit repeat
   put return after it
   if CARDCOUNT is 0 then
     doMenu "New Background"
     doMenu "New Field"
     set the name of last bkgnd field to "Import"
   else
     doMenu "New Card"
   end if
   add 1 to CARDCOUNT
   set the style of field "Import" to scrolling
```

```
    set rect of field "Import" to 0,20,512,342
    if HEADER is "Yes" then
      put "Characters:" && number of characters in it & return & return before it
      put "Lines:" && number of lines in it - 2 & return before it
      put "File:" && FILENAME & return before it
      put "Import card:" && CARDCOUNT & return before it
    end if
    put it into field "Import"
  end repeat
  close file FILENAME
  if HEADER is "Yes" then
    repeat until the short id of this card is STARTCARD
      put " of" && CARDCOUNT after line 1 of field "Import"
      go previous card
    end repeat
  else go card id STARTCARD
end ImporText

on ImportData
  global FILENAME,CARDCOUNT,STARTCARD,LEVELMEMORY,HEADER
  put empty into delimiters
  put 0 into CARDCOUNT
  put 0 into limit
  put 0 into fieldcount
  put 0 into nofields
  answer "Use Tab and Return as delimiters?" with "Yes" or "Other" or "Cancel"
  if it is "Yes" then put "9,13" into delimiters
  else if it is "Other" then
    repeat until it < 256 and it > 0
      ask "Enter an Ascii FIELD separator (0-255):" with 9
      if it is empty then CleanExit
    end repeat
    put it into item 1 of delimiters
    put 0 into it
    repeat until it < 256 and it > 0
      ask "Enter an Ascii RECORD separator (0-255):" with 13
      if it is empty then CleanExit
    end repeat
    put it into item 2 of delimiters
  else CleanExit
  if item 1 of delimiters is item 2 of delimiters then put 1 into nofields
  answer "Include header information in fields?" with "Yes" or "No"
  put it into HEADER
  repeat
    ask "Name or pathname of text file to import:" with FILENAME
    if it is empty then CleanExit
    else if short name of this stack is not in it then exit repeat
    else answer "Can't import current stack!"
  end repeat
  put it into FILENAME
  set cursor to 4
  open file FILENAME
  repeat
    read from file FILENAME until numToChar of item 2 of delimiters
    if it is empty and CARDCOUNT is 0 then
      answer "Could not find file:" && FILENAME with "OK"
      close file FILENAME
```

```
    CleanExit
  end if
  if it is empty then exit repeat
  if charToNum(last character of it) is not item 2 of delimiters then
    put item 2 of delimiters into temp
    if temp is 9 then put "Tab" into temp
    if temp is 13 then put "Return" into temp
    answer "Can't find record delimiter:" && temp with "OK"
    close file FILENAME
    CleanExit
  end if
  if (numToChar of item 1 of delimiters) is not in it and nofields is 0 then
    put item 1 of delimiters into temp
    if temp is 9 then put "Tab" into temp
    if temp is 13 then put "Return" into temp
    answer "Can't find field delimiter:" && temp with "Help" or "OK"
    if it is "Help" then
      answer "Use double record delimiters for records..." with "Continue"
      answer "with no field delimiters. Example: 13 & 13" with "OK"
    end if
    close file FILENAME
    CleanExit
  end if
  repeat until "," is not in it
    put numToChar(7) into character offset(",",it) of it
  end repeat
  if nofields is 0 then
    put numToChar(item 1 of delimiters) & numToChar(item 1 of delimiters) into
check
    repeat until check is not in it
      put numToChar(item 1 of delimiters) & quote & quote & numToChar(item 1
of delimiters) into char offset(check,it) to offset(check,it) + 1 of it
    end repeat
    put numToChar(item 1 of delimiters) & numToChar(item 2 of delimiters) into
check
    repeat until check is not in it
      put numToChar(item 1 of delimiters) & quote & quote & numToChar(item 2
of delimiters) into char offset(check,it) to offset(check,it) + 1 of it
    end repeat
    repeat until (numToChar of item 1 of delimiters) is not in it
      put "," into character offset((numToChar of item 1 of delimiters),it) of it
    end repeat
  end if
  put empty into last character of it
  if CARDCOUNT is 0 then doMenu "New Background"
  else doMenu "New Card"
  add 1 to CARDCOUNT
  if nofields is 0 then put the number of items in it into limit
  else put nofields into limit
  repeat with count = 1 to limit
    if CARDCOUNT is 1 then
      add 1 to fieldcount
      if fieldcount < 125 then
        doMenu "New Field"
        set rect of last bkgnd field to 30,120,482,205
      else
        answer "No more fields can be created!" with "OK"
```

```
      Cleanexit "Compact"
    end if
  end if
  put "Field" & count into fieldname
  set name of bkgnd field (number of bkgnd fields) to fieldname
  set style of bkgnd field fieldname to scrolling
  If nofields is 0 and HEADER is "Yes" then
    put "Field" && count && "of" && the number of items in it & return into
bkgnd field fieldname
    put "Record" && CARDCOUNT && "of file:" && FILENAME & return &
return after bkgnd field fieldname
  end if
  if nofields is 0 then put item count of it after bkgnd field fieldname
  else put it after bkgnd field fieldname
  repeat until numToChar(7) is not in bkgnd field fieldname
    put "," into character offset(numToChar(7),bkgnd field fieldname) of bkgnd
field fieldname
  end repeat
 end repeat
 choose browse tool
end repeat
close file FILENAME
go card id STARTCARD
end ImportData

on CleanExit
 global LEVELMEMORY
 if param(1) is "Compact" then
  doMenu "Compact Stack"
 end if
 choose browse tool
 set the userLevel to LEVELMEMORY
 set lockScreen to false
 set lockMessages to false
 exit to hypercard
end CleanExit
```

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Managing System - Synthesis Card

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```
on mouseUp
 set cursor to 4
 set lockScreen to true

 go to card "Sort-By conditions"
 get card field "architecture"
 put it into ARCHITECTURE
 get card field "Planning"
 put It into PLANNING
 get card field "Engineering "
 put It into ENGINEERING

 go to card "blank card-2"

 put ARCHITECTURE into card field "architecture department"
```

```
  put PLANNING into card field "engineering department"
  put ENGINEERING into card field "planning department"
end mouseUp
```