THE EFFECTIVE MANAGEMENT OF AEROSPACE PROJECTS THROUGH PROCESS MODELLING

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Abstract

To sustain or improve their competitive position, aerospace organisations must effectively manage product technology and design/manufacturing systems, particularly as these change with new processes. To do this, they must first understand their current systems, and then develop improved systems. Since it is often impractical and usually unwise to experiment with different management organisations and systems, there may be significant advantages to be gained from modelling the organisational system **before** starting the project, in the same way flight simulation is used to model technical systems.

Process modelling of engineering systems, in one form or another, has been practised for a number of years with work flow diagrams, PERT charts, Gantt charts or block diagrams. A basic problem for all these methods of process modelling is that they represent the process in a serial manner and neglect the human component in the project system. This paper presents a novel way of process modelling as applied to project management. The paper indicates a way in which 'systemigrams' (systematic diagrams) may be used to illustrate the interchange of processes and people to help develop an improved understanding of what is happening in projects, and hence improved organisational design.

Keywords: Project Management, Process Re-engineering, Teamworking.

Introduction

The aerospace business has been in the grip of a recession for several years now. Although there are signs at the time of writing that the civil aerospace sector is recovering, there remains a great deal of uncertainty about defence procurement opportunities. This means that all of those involved in the aerospace business: customers with tight procurement budgets, prime contractors and suppliers, are all looking for ways to obtain improved performance as early and as cheaply as possible. The drive for improved competitiveness has led many organisations to examine how they can re-engineer their processes to dramatically reduce cost and time to market. Other initiatives, such as Total Quality or Continuous Quality Improvement have resulted in a much sharper supplier-customer focus with the concept of continually looking at ways to improve quality.

This paper attempts to bring together these three initiatives using a novel modelling technique known as Systemigrams. Systemigrams have been demonstrated to provide an improved understanding of engineering and management process dynamics and help identify process improvements[1].

Project Success

From the perspective of a Customer, the project will be successful if it provides a competitive edge by meeting or exceeding the performance requirements, being delivered on time, within the agreed price, and offering the lowest life cycle cost. From the perspective of the Prime Contractor or Supplier, the project will be successful if it is completed on time within the budget which generates the required cash flow and profitability, and if it provides competitive advantage in the marketplace to enable other orders to be won. Clearly, there is sufficient commonality between these perspectives to consider how the processes where these two interact can be rationalised for mutual benefit.

An investigation into the factors affecting success in managing international projects found that requirements were not really harmonised and the Memorandum of Understanding not clear on important issues[2]. These are both quality improvement areas which would benefit from improving the processes of interaction between

Customer and Supplier.

Process Modelling

Systems Engineering concepts are familiar to all Engineers, providing a logical extension of scientific principles to engineering problems. An engineering process involving tasks to be carried out can readily use such 'hard systems' approaches to generate network or PERT analyses for scheduling project activities. However, a hard systems approach has been found to be inadequate in dealing with many real world problems. 'Soft systems' have been developed to take account of soft, poorly structured systems to be found in situations involving human intervention[3]. The uncertainty which has led to so many project cost overruns and delays may be partly due to the failure of project management to have a good grasp of the problem situation[3]. A process model which helps an understanding of project interfaces, which is where so many problems occur, should therefore result in more effective management.

The soft system methodology and presentation developed by Boardman[1] should help to provide a better understanding of the customer-supplier interfaces.

Project Modelling

Basic Aerospace Project Model

A basic Aerospace project life cycle model is shown in Figure 1. This model shows the overall process, but does not distinguish the different human elements in the system. The process is drawn as a series of activities, but the real world may have several iterations before proceeding to the next stage, and will involve many different people in making judgements on what to do. This model also has inherent assumptions that the product (aircraft, engine, equipment etc) already exists, that alternative suppliers are available, finance is available, etc. Whilst it has the advantage of simplicity, it is too simple to identify opportunities for improvement.

Aerospace Project Model With Decision Nodes

A more sophisticated model is shown in Figure 2, which adds to the series model the opportunity for iteration, and with more detail, begins to clarify who does what in the project process. It therefore improves the understanding of how continuous quality improvement may take place through iterative processes as well as clarifying key Supplier-Customer relationships. However, there is still insufficient indication of the human dimension in the process.

Systemigram Process Model

The basic template for the Systemigram model is shown in Figure 3. Here, the process is initiated by, in this example, an **airline**, who engage an **aerospace contractor** to take responsibility for **an aircraft project** to create the **aircraft** required by the **airline**. The basic systemigram template has been enhanced in this example to distinguish between the organisation (agent) shown in double ellipse, the deliverable milestone, shown as single ellipse, and the human purpose of the interaction, shown as a connecting line.

Figure 4 illustrates how the Systemigram model might be applied to the aerospace project model in Figure 2. Whilst the model appears to have lost the iterative visibility, the human purpose of the interaction shown by the process line is defined in such a way that there may be many interactions back and forwards along the line until the purpose is achieved. For example, the line from the agent **Engineering Department** to **Total Life Cycle Cost and Delivery Timescales** is annotated "to reduce", so there is likely to be several iterations until the optimum is reached.

This presentation provides a visual picture of the processes involved so that improvements may be identified. For example, an obvious process quality improvement could be to bring both Customer and Supplier earlier into the project process loop. A possible representation is shown in Figure 5. Here the Customer involves potential Prime Contractors in strategic partnership alliances to help develop the Invitation to Tender (ITT), and the Prime Contractors involve Suppliers in a similar way so that they can be more responsive when the ITT is issued.

Perhaps the clearest illustration of the way in which Systemigrams can readily communicate key interfaces is shown in Figure 6. This illustrates the human processes which take place when the Engineering Department issue a design. If these questions are answered serially, then there will be much nugatory work carried out in separate functions before the design is optimised, creating unnecessary cost and time delays. A multi-functional team would clearly improve the project process.

Recommendations for Further Work

The systemigram model should be applied to existing project processes to validate its value in representing key processes. Once validated, it should be used to identify required improvements to achieve improved effectiveness.

Conclusion

It is not easy to capture the key project processes in a complex aerospace project so that the improvements essential for survival are readily identified. Hard systems methodologies are too exact for the uncertainties when people are involved - they never do what you expect! Soft systems methodologies have been developed to cater for this uncertainty, and the Systemigram model appears to offer a reasonable presentation to help identify potential improvements.

References

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Figure 1 - Basic Aerospace Life Cycle Model

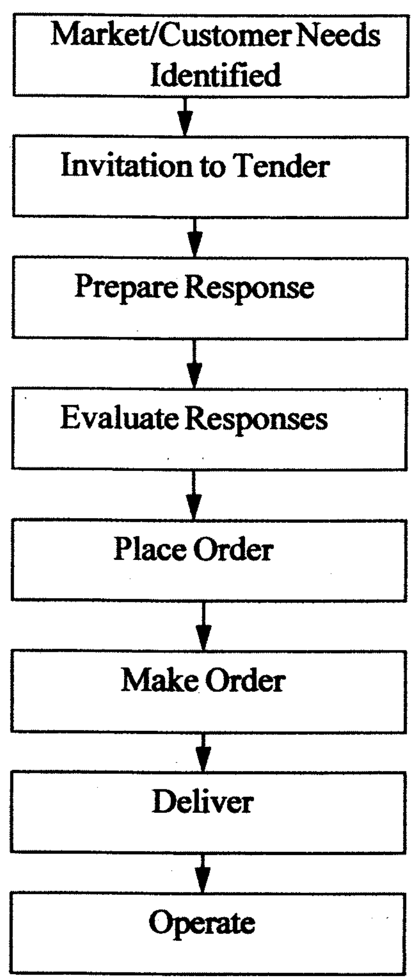

Figure 2 - Aerospace Project Processes - Top Level Model

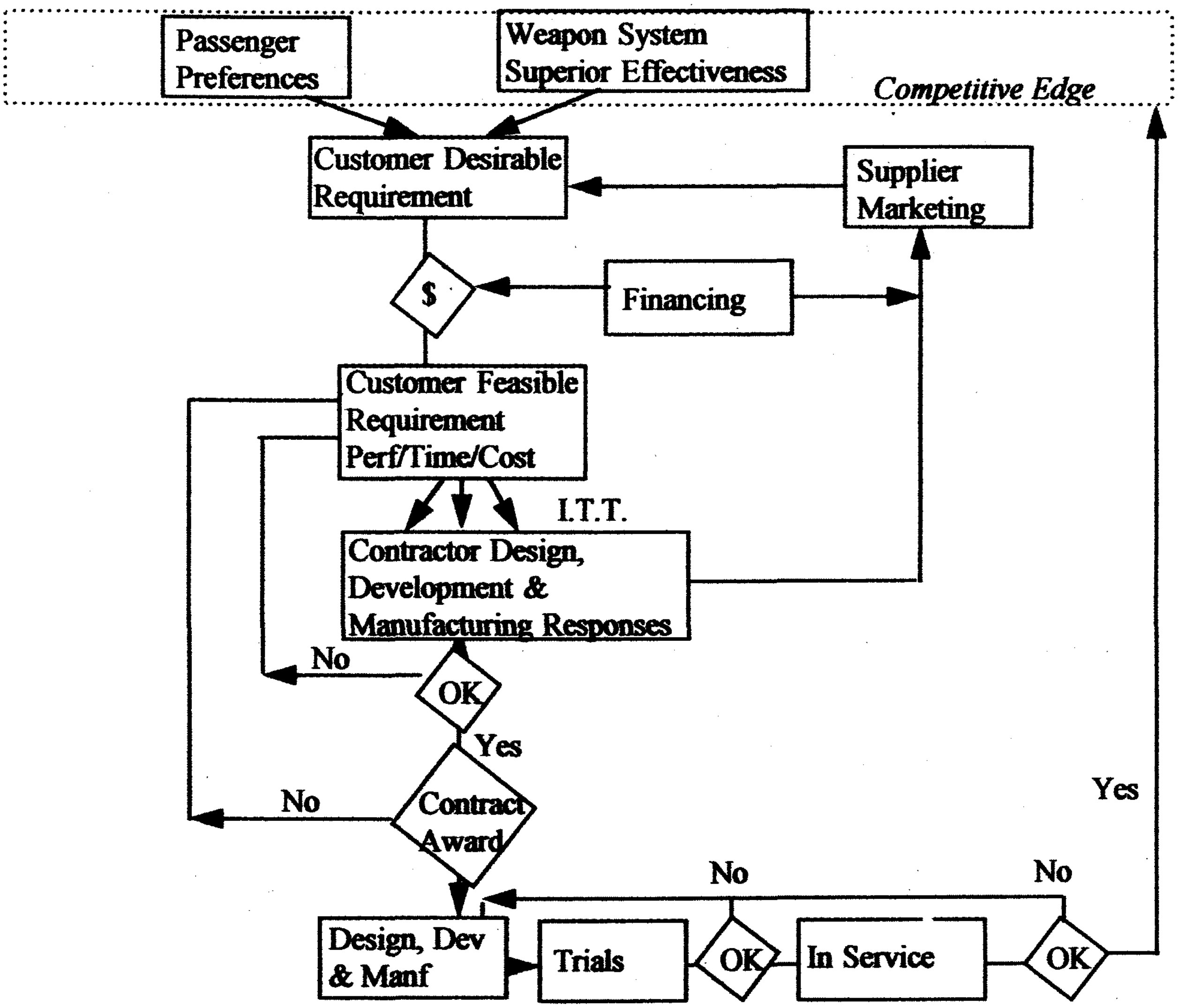

Figure 3 - Systemigram Template for Aerospace Project

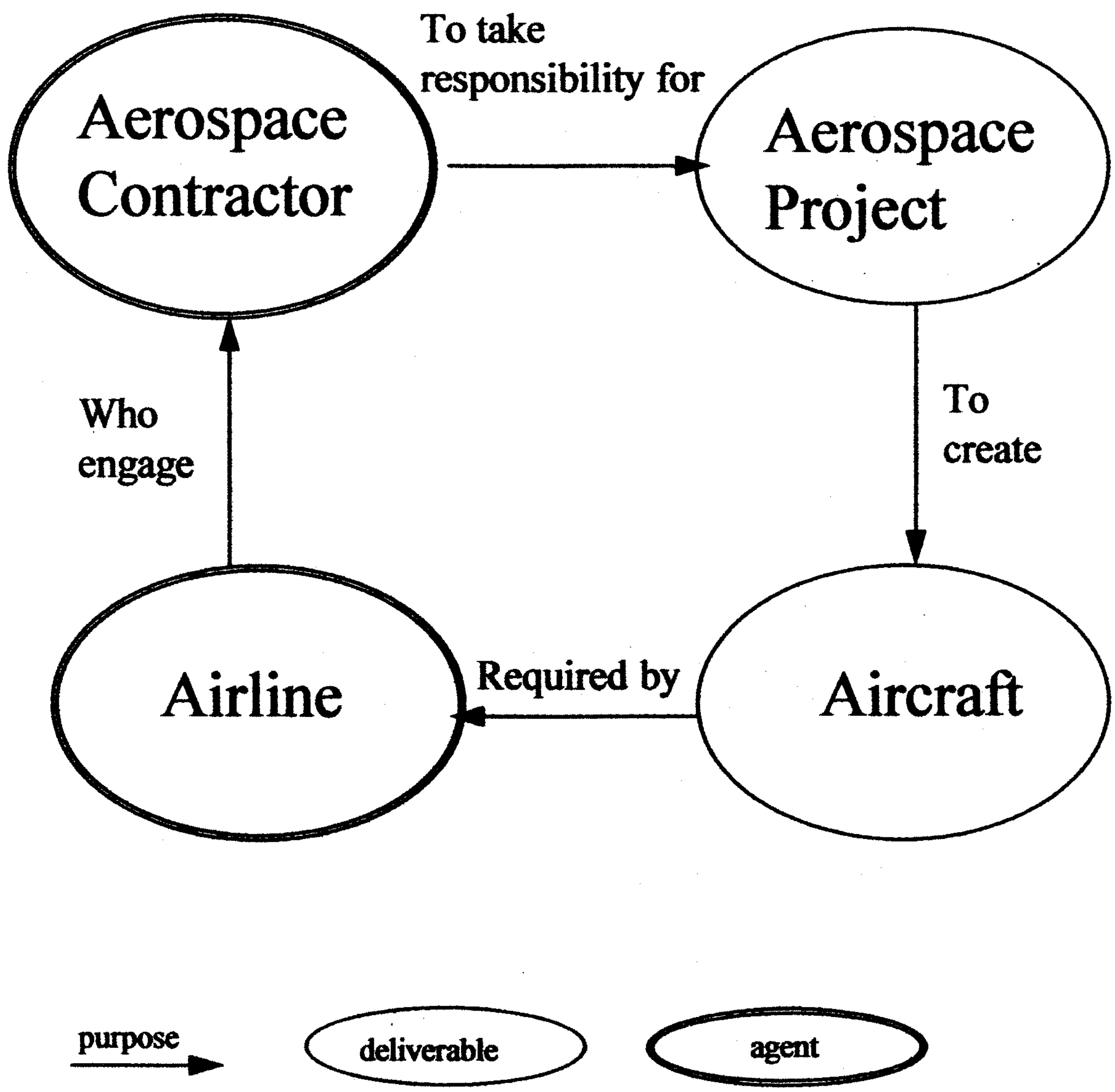

Figure 4 - Systemigram Aerospace Project Model

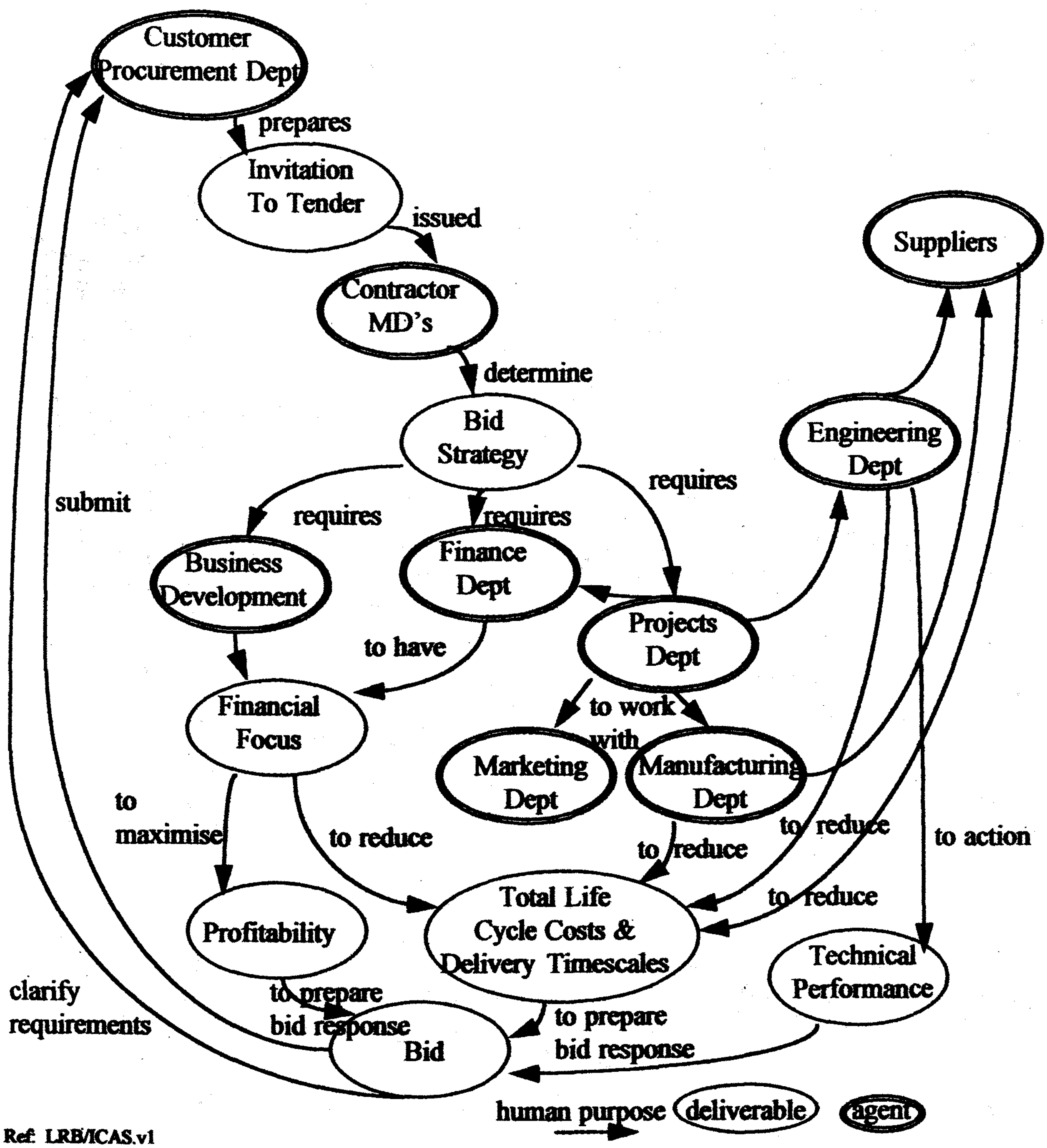

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Figure 5 - Systemigram Aerospace Project Model

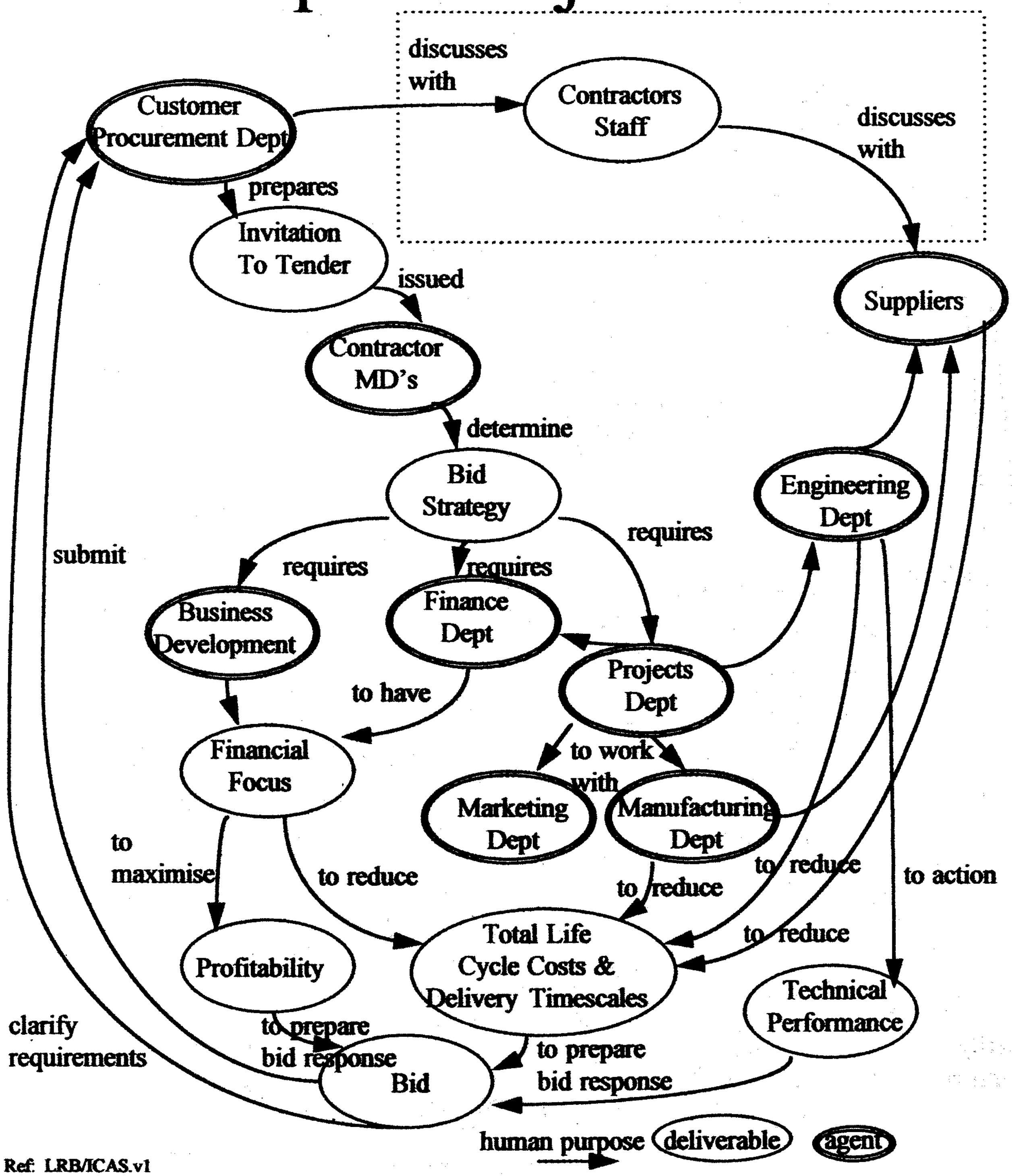

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Figure 6 - Systemigram for Design Process