SYNOPSIS

This research is concerned with the study and analysis of multi-agent coordination for project scheduling and proposes a model for resource allocation based on priority rules in order to minimise the project duration by overlapping the activities of the project. In a project management environment, project planning is carried out first and this results in a set of activities, and project scheduling is carried out next. Project scheduling results in allocation of resources and time to the activities. A project should be managed through the integration of activities that can easily share the information. The integration can be achieved by relating the activities of the project and hence improved coordination and flow of project and resource information between the activities become essential to minimise the project makespan.

In order to reduce the project duration, to utilise the resources in an optimum way and to meet the changes, project planning and scheduling need to be integrated with Concurrent Engineering (CE) principles which in turn yields Integrated Project Management (IPM). Coordination defined as the process of managing dependencies between activities is a crucial problem in CE. Crucial for the multi-agent coordination in project scheduling under concurrent engineering environment is the availability of an effective algorithm for resource allocation which would reduce the project duration. Hence, activity dependency, resource allocation and project scheduling in a multi-agent project management environment has been studied and analysed and an algorithm to
identify the interdependencies among tasks, overlapping among activities due to resource constraints in multi-agent project coordination has been designed and developed.

In order to achieve effective project scheduling, a multi-pass priority rule is proposed in this research and priority rules such as Resource require Time Point (RrTP), Resource release Time Point (RiTP), Longest Resource usage Time Period (LRTP) and Shortest Resource usage Time Period (SRTP) have been designed and these rules are used to allocate the resources to tasks. The developed algorithm has two parts: in the first one, every activity belonging to the initial plan is integrated with information regarding its duration as well as the resource instances which are necessary for its execution and it captures the dependency associated with task durations and resource requirements. Thus, the first phase of the algorithm yields a set of tasks, each of which represents one activity in the plan and is constrained by precedence relations and resource usage parameters. Second, it develops a solution procedure that allocates available resources to tasks. The project activities considered here includes sequential and branch-merge patterns with synchronization time rule. Overlapping is concerned with shortening the project duration not by shortening the individual activities, but by increasing the overlap period among them.

A multi-agent system approach, which is presented, is an implementation of project management approach consisting of a standard operating procedure and a coordination mechanism. Activities, resources and important functions are represented as agents and this is implemented as a distributed collection of agents and the agents are
allowed to execute tasks based on the event-control-action rule. Instead of the traditional use of schedules, control policies have been developed in the form of planned resource allocation to tasks that capture the dependencies associated with task execution and the impact of resource allocation on those executions. A software prototype has been designed and developed to test the validity of the proposed concepts and three algorithms for (i) identification of task dependency, (ii) identification of resource dependency and (iii) resource allocation. The prototype is designed using top-down approach and developed through bottom-up approach using the object oriented language Java. The prototype includes five modules: (i) User interface agent module, (ii) project management module, (iii) scheduling agent module, (iv) resource management agent module and (v) service agent module.

By measuring results such as percentage of reduction in project makespan with overlapping and without overlapping for 90 sample projects and for a case study on kidney transplantation surgery project, the results reveals that the algorithm provides better results. Thus, the results show that the prototype is producing significant percentage of reduction in project makespan for resource-constrained project scheduling.