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# An Enactment method of software process with constraints in time

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Software products are desired on large scale and high quality. Usual software development processes require many creative works that are required complex and high technique. They exist only vague states in the mind of project managers, and they have not been described. It is actual to study method to describe them formally and to execute them.

Many software process description models have been proposed. Among these models, models focus on objects (called Object-centered process) and models focus on structure and ordering works (called phase-centered process) have been studied. They are model given formal definitions. Phase-centered process is formally established by assigned checkpoints as phases of detailed objects to object-centered process. However in these description models, constraints in time are not considered formally. When constraints in time are defined, we hope that these models can apply to problems for scheduling related constraints in actual software development.

In this paper, we propose the method of enactment based model described formally constraints in time. Object elements are products that are created and modified in enactment process of software process. Activities are works to create object elements. And phases are sets of activities to create object elements in some phases.

First, we are assign required times to each activities which are guessed necessarily. Required times are estimated by project managers and workers. We calculate the required times for each phase from that of activities. We decide to assign required times to all phases.

We describe about constraints in requirement for all object elements. To create products with high performances and rich functions, there are some trade-offs between constraints in requirement and constraints in time. When the project term is not in time for

the date of payment, the development time is given priority and working hours are cut down by declined requirement of performances and functions. In this case, it is necessary to describe the definitions of enactment sequences (called scheduling) under constraints in quality of products which get total enactment time. There is that constraints in requirement as conditions to decide the trade-offs. And scheduling problems on software development project which is most important elements to decide on required times to create object elements, defined the problem for restriction of requirements.

Secondly we introduce enactment graph that includes coconstraints in time to the phase-centered process. The enactment graph is a graph which shows enactment sequences on actual software development with time. We define the enactment graph formally and specify the method to create it. This method is created by some enactment graphs. The shortest enactment graph is created on the progress of the method. This graph is checked up whether it can execute in the given term. If the time of the shortest enactment graph is longer than the given term, we make re-assign workers to phases, in order to cut down time reductions of requirement, or change of check-point. Then in the method which the enactment graph is created, to assign workers to phase, it happened that first assignment suit to workers report, it is necessary to find the most suitable assignment which can finish the project in the required term. Then the most suitable assignment is to assign different developers to parts which can execute parallel in phase-centered process. We discuss about shorting for deterioration of requirement and methods to restructure of phase-centered process and enactment graph.

The number of check-points increases the amount of works in each phase-centered process grows, we found there are some trade-offs caused by rollback of enactment.

We describe formally constraints in time on object-centered process and phase-centered process, and proposed the enactment graph to add phase-centered process to constraints of time and workers. And we specify the method which can not finish the development project in the required term. To re-assign workers to phases and change check-points require cost more, but the products do not decline. While to decline requirements requires less cost, but the products happen to decline requirement. To use these three methods, we discuss about the methods to decide on the executions the highest requirements and the shortest time.