A Framework of Evaluating the Risk and PERT Scheduling with Resource Constraints

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ABSTRACT

Most of the works on resource-constrained project scheduling problems(RCPSP) attempt to simplify the problem complexity by assuming that the duration of activity is fixed. This assumption leads to the result that the preciseness of the project schedule planning is dramatically reduced. In the real project life activity duration is a random variable with given density function. To investigate all possible resulting scenarios of schedule and their corresponding risks caused by the scheduling policy and the duration uncertainty, a scenario-based framework for project scheduling and risk evaluating is proposed. The framework consists of two phases: the first stage is to use Monte Carlo simulation to generate a predetermined number of sets of different activity durations. For each set, adopting QSGM(Qualitative Simulation Graph Methodology) to build all possibly feasible schedules, each of the feasible schedules is transformed to activity path, also called PERT-path, by EG(event graph) method. The all possible paths are generated by two folds: decision fork caused by different decision making and chance fork brought by uncertain activity duration. These possible paths and the possible forks construct a decision tree during project evolution. In the next stage a decision-making model based on expected utility and entropy(EU-E) is proposed. The EU-E is a measure of risk and can reflect an individual ’ s institute attitude toward risk. Based on project manager ’ s different preference toward risk, the corresponding optimal activity path of project progress can be found.

Keywords : project scheduling ; recourse constraint ; stochastic duration ; risk evaluation

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REFERENCES

Abeyasinghe, M. C. L., Greenwood, D. J., & Johansen, D. E. (2001). An efficient method for scheduling construction projects with resource constraints. International Journal of Project Management, 19(17), 29-45. Akpan, E. O. P. (2000). Priority rules in project scheduling: a case for random activity selection. Production Planning & Control, 11(2), 165-170. Alcaraz, J., & Maroto, C. (2001). A robust genetic algorithm for resource allocation in project scheduling. Annals of Operations Research, 102, 83-109. Bottcher, J., Drexl, A., Kolisch, R., & Salewski, F. (1999). Project scheduling under partially renewable resource constraints. Management Science, 45(4), 543-559. Bouleimen, K., & Lecocq, H. (2003). A new efficient simulated annealing algorithm for the resource-constrained project scheduling problem and its multiple mode version. European Journal of Operational Research, 149, 268-281. Bushuyev, S. D., & Sochnev, S. V. (1999). Entropy measurement as a project control tool. International

Journal of Project Management, 17(6), 343-350. Demeulemeester, E., & Herroelen, W. (1992). A branch-and-bound procedure for the multiple resource-constrained project scheduling problem. Management Science, 38, 1803-1818. Demeulemeester, E., & Herroelen, W. (1997). New benchmark results for the resource-constrained project scheduling problem. Management Science, 43, 1485-1492. Fernandez, A. A., Armacost, R. L., & Pet-Edwards, J. J. A. (1996). The role of the nonanticipativity constraint in commercial software for stochastic project scheduling. Computers and Industrial Engineering, 31(1/2), 233-236. Fernandez, A. A., Armacost, R. L., & Pet-Edwards, J. J. A. (1998). Understanding simulation solution to resource constrained project scheduling problems with stochastic task durations. Engineering Management Journal, 10(5), 5-13. Fleszar, K., & Hindi, K. S. (2004). Solving the resource-constrained project scheduling problem by a variable neighbourhood search. European Journal of Operational Research, 155(2), 402-413. Golenko-Ginzburg, D., & Gonil, A. (1997). Stochastic network project scheduling with non-consumable limited resources. Internat- ional Journal of Production Economics, 48, 29-37. Hartmann, S. (1998). A competitive genetic algorithm for the resource-constrained project scheduling. Naval Research Logistics, 45, 733-750. Hartmann, S., & Kolosch, R. (2000). Experimental evaluation of state-of-the-art heuristics for the resource-constrained project scheduling problem. European Journal of Operational Research, 127, 394-407. Hartmann, S. (2002). A self-adaptive genetic algorithm for project scheduling under resource constraints. Naval Research Logistics, 49, 433-448. Herroelen, W., & Leus, R. (2004). Robust and reactive project scheduling: a review and classification of procedures. Interna- tional Journal of Production Research, 42(8), 1599-1620. Herroelen, W., & Leus, R. (2005). Project scheduling under uncertainty: Survey and research potentials. European Journal of Operational Research, 165, 289-306. Igelmund, G., & Radermacher, F. J. (1983). Preselective strategies for the optimization of stochastic project networks under resource constraints. Networks, 13, 1-28. Ingalls, R. G., & Morrice, D. J. (2004). PERT Scheduling with resource constraints using qualitative simulation graphs. Project Management Journal, 35(3), 5-14. Kolosch, R., & Hartmann, S. (2006). Experimental investigation of heuristics for resource-constrained project scheduling: An update. European Journal of Operational Research, 174, 23-37. Merkle, D., Middendorf, M., & Schmeck, H. (2002). Ant colony optimization for resource constrained project scheduling. IEEE Transactions on Evolutionary Computation, 6, 333-346. Mingozzi, A., Maniezzo, V., Ricciardelli, S., & Bianco, L. (1998). An exact algorithm for the resource-constrained project scheduling problem based on a new mathematical formulation. Management Science, 44, 715-729. Mohring, R. H., & Stork, F. (2000). Linear preselective policies for stochastic project scheduling. Mathematical Methods of Operations Research, 52, 501-515. Mori, M., & Tseng, C. C. (1997). A genetic algorithm for multi-mode resource constrained project scheduling problem. European Journal of Operational Research, 100, 134-141. Mummolo, G. (1994). PERT-path network technique: a new approach to project planning. International Journal of Project Manage- ment, 12(2), 89-99. Mummolo, G. (1997). Measuring uncertainty and criticality in net- work planning by PERT-path technique. International Journal of Project Management, 15(6), 377-387. Nonobe, K., & Ibaraki, T. (2002). Formulation and tabu search algorithm for the resource constrained project scheduling problem (RCPSP). In C.C. Ribeiro & P. Hansen (Eds.), Essays and Surveys in Metaheuristics (Kluwer Academic Publishers, Boston, pp. 557-588). Pet-Edwards, J., & Mollaghesemi, M. (1996, June 25-27). A simulation and genetic algorithm approach to stochastic resource-constrained project scheduling., Southcon/96. Conference Record (pp. 333-338), Orlando, FL, USA. Pontrandolfo, P. (2000). Project duration in stochastic net works by PERT-path technique. International Journal of Project Management, 18, 215-222. Pritsker, A. A. B., Watters, L. J., & Wolfe, P. M. (1969). A zero-one programming approach. Management Science, 16, 93-108. Sprecher, A. (2000). Scheduling resource-constrained projects competitively at modest memory requirements. Management Science, 46, 710-723. Stork, F. (2000). Branch-and-bound algorithms for stochastic resource-constrained project scheduling (Research Report No. 702/2000). Berlin: Technische University. Stork, F. (2001). Stochastic resource-constrained project scheduling. Unpublished doctoral dissertation, Technische University, Berlin. Tsai, Y. W., & Gemmill, D. D. (1998). Using tabu search to schedule activities of stochastic resource-constrained projects. European Journal of Operational Research, 111, 129-141. Yang, J., & Qiu, W. (2005). A measure of risk and a decision-making model based on expected utility and entropy. European Journal of Operational Research, 164, 792-799. Valls, V., Quintanilla, S., & Ballestin, F. (2003). Resource-constrained project scheduling: A critical activity reordering heuristic. European Journal of Operational Research, 149, 282-301. Van Slyke, R. M. (1963). Monte Carlo methods and the PERT problem. Operations Research, 11(5), 839-860. Wiest, J. D. (1963). Some properties of schedules for large projects with limited resources. Operations Research 12, 395-418. Wiest, J. D. (1967). A heuristic model for scheduling large projects with limited resources. Management Science, 13, B359-B377.