FUZZY APPROACH FOR SIZING PROJECT BUFFER; WATER SUPPLY PROJECTS IN SRI LANKA

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Degree of Master of Science

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Dissertation submitted in partial fulfillment of the requirements for the degree Master of Science

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DECLARATION OF THE CANDIDATE

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The above candidate has carried out research for the Masters Dissertation under my supervision.

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DEDICATION

Loving Yuhas,

Do a better work when you are grown up

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ABSTRACT

The intellectual views in the context of water distribution projects in Western province, Sri Lanka revealed safety time reservations are always hidden inside project durations imposed under project formalities. Task performers are unintentionally used to waste these safety reservations otherwise could have been exploited as time buffers in the light of uncertainties leading for delays. The study aims to forward an approach for sizing these safety reservations which are undercover and invariably intangible within project schedules. Nevertheless, the methods brought forward in literature under critical chain project management and associated schools of thoughts are found with common pitfalls as being arbitrary apportionments and having impotence for optimally resolving the resource contentions.

Water distribution projects within a predetermined range of magnitudes comprising an identified exhaustive set of recurring tasks are explored for the proposal. The proposed approach is limited for sizing project buffers in critical chains. By delving in to available techniques the study is resorted to fuzzy reasoning so as to avoid the prevailing backdrops under the existing methods of buffer sizing. The proposed approach shades lights on possibility and necessity functions according to the theory of possibility. Fuzzy sets are drawn for the task duration distributions built up of historical information. Fuzzy intersections are formed in between the defined fuzzy Guntt bars considering the precedence relationships between activities. The approach demonstrates the way for Alpha-cuts to drive fuzzy interval arithmetic operations to determine optimistic and pessimistic critical chain durations. Fuzzy sets are drawn to delineate the intersection between fuzzy resource availability (drawn considering the availability of number of task's specialized crews) and the fuzzy balance project duration (drawn considering the outstanding project duration along the timeline). Alpha level effecting on each fuzzy Guntt bar is determined minimizing the sum of violations to fuzzy subsethoods. These subsethoods are gained by fuzzy Guntt bars within the supersets formed by fuzzy intersections between resource availabilities and balance project duration. Minimizing the violations to fuzzy subsethoods is to be performed by an operational research technique known as non-linear programming. Once the sum of violations to subsethoods is minimized, the difference between the pessimistic and optimistic critical chain durations are accepted as optimized project buffer.

The proposed approach is empirically tested with a case study. The algorithm for; violations to fuzzy subsethood minimization problem, is performed with Microsoft Excel Solver Add-in tool. The proposed contention derives shorter buffer contributions for the tasks where fuzzy intersection between resource availability and balance project duration is having greater membership values and vice versa. The same scenario is optimally satisfied for all the tasks by minimizing the sum of violations to subsethoods. The approach resolve resource constrained project scheduling problem without shading lights on resource leveling. Inability of setting the project duration as a constraint in to the mechanism of non-linear programming problem debunks as an issue requiring exclusion. The new approach apart from giving recourse to a conventional fixed apportionment enables a desired orientation of optimization to be satisfied in sizing project buffer.

Key words; Critical chain project management, project buffers, theory of possibility, Alpha-cuts, fuzzy subsethood, non-linear programming

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LIST OF ABBREVIATIONS

- APRT Adaptive Buffer sizing Procedure with Resource Tightness
- ARBP Adaptive Risk Based Procedure
- CCPM Critical Chain Project Management
- CDF Continuous Density Functions
- CPM Critical Path Method
- C&PM Cut and Paste Method
- DI Ductile Iron
- FIS Fuzzy Inference Systems
- Nr Number
- PERT Programme Evaluation and Review Technique
- RCPSP Resource Constraint Project Scheduling Problem
- RD Relative Dispersion
- RF Resource utilization Factor
- RSEM Root Square Error Method
- SLRs Sri Lankan Rupees
- Sqrt Square Roots
- TOC Theory of Constraint
- TraNr Trapezoidal fuzzy Number
- TriNr Triangular fuzzy Number
- uPVC unplasticized Poly Vinyl Chloride

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