The PPSE software: Project Portfolio Selection Environment.

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1. INTRODUCTION

Project portfolio selection is an important problem that arises repeatedly over an organization's lifetime, because the need of continuously investing in projects. However, organizations are often confronted with having more projects to choose than the resources to carry them out and thus one of the main management tasks is to select from an array of projects the efficient project portfolio that better adapts to the organization´s objectives (Ghasemzadeh et al., 1999).

Traditionally, decision-makers (DMs) in organizations have carried out this selection process based on their intuition or experience or using simple mathematical models (Cooper et al., 2001; Moore and Baker, 1969). Nowadays, the size and complexity of many organizations make this process more complicated especially when many important aspects are taken into account simultaneously (the features of each candidate project, the available resources, the project interdependences, the objectives and priorities of the DM or DMs of the organization, etc). As a consequence solving this problem (project portfolio selection) has received significant attention from both researchers and practicing managers (Archer and Ghasemzadeh, 1999; Martinsuo and Lehtonen, 2007; Say et al., 2003; etc.).

In our case, to solve this problem we present a solver addressed to help the DM or DMs select and schedule simultaneously a project portfolio in an easy and efficient manner. This solver, Project Portfolio Selection Environment (PPSE), uses a flexible Mathematical Model, a Metaheuristic algorithm to solve it and an user-friendly software with a Windows interface which allow the DM or DMs to consider their preferences throw an interactive decision process.

Relating the model, it is a Nonlinear Binary Multi-Objective Mathematical Model (Carazo et al., 2010) that take into account all of the most important factor mentioned in the literature: multiple objectives, available resources, project interdependencies, preferences of the DM/s and other technical and strategic constraints (mandatory projects, project versions, etc.).

Relating the Metaheuristic Algorithm, PPSE uses a Multiobjective Metaheuristic algorithm as the search engine, called Scatter Search method for Project Portfolio Selection (SS-PPS). This algorithm allows obtaining an approximation of the efficient set of a Multi-objective optimization problem based on Scatter Search. It is an adaptation of the evolutionary method SSPMO (Molina et al., 2007) and consists in two phases. An initial phase: generation of an initial set of Efficient Points using MOAMP (Caballero et al., 2007) and a second phase: (the Scatter Search phase) that consists on the combination and improvement of solutions via Scatter Search.

This Metaheuristic, SS-PPS, originally was designed to provide an approximation to the set of efficient portfolios (the Pareto Set), without any suggestion regarding which of them better represents a final choice. This is, without including preferences of the DM. To solve this problem, the solver was modified to allow incorporating the organizations preferences throw an interactive process to determine the solution that best fits the DM or DMs preferences.

This way, an Interactive tool was included in PPSE, based on the interactive scheme called **g**-dominance proposed by Molina et al. (2009), but more modified to extend this scheme to the case of a group of DMs. The aim of the method is to reduce the size of the approximation of the efficient frontier using information supplied by the DM/s in the form of a reference point g, which corresponds to a desired level for each of the criteria by each DM. For the case in which there are several[1] DMs the solver maximizes the consensus among the members of the group combining the preferences of all the DMs to obtain a solution acceptable to the group. To do this, we have modified the g-dominance scheme to find a reference point **g** representing a compromise for each DM involved. In this procedure, we followed the classic scheme of using the referent points based on scalarized achievement functions (Miettinen, 1999). According to this scheme, given a reference point and a distance L, we compute an efficient solution fitting the preferences of each DM, which is the efficient point (most preferred solution [PS]) that minimizes the distance L to each reference point. Then, the software calculates the super-ideal reference point **g** of the (most) preferred set of solutions obtained. Once this point **g** is calculated, the PPSE solves the problem again but using this compromise reference point, generating a new representative set of g-efficient solutions to be shown to the DMs. Now, the DMs can (if they wish) set a new set of reference points again and repeat the

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[1] See Molina et al. 2009 for the interaction with g-dominance for one decision maker.

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process until the consensus of all DMs is obtained for a single common solution.

2. DESCRIPTION AND PROPERTIES OF PPSE

The PPSE environment consists of two modules: a user interface to let the DM to easily input (Create) and/or modify problem data step-by-step (Edit); and a resolution module (Solve). The latter module determines (or approximates) the set of efficient portfolios and, if desired, supports DMs in exploring the solution space to find the most preferred solution.

Figure 1 summarizes the structure of PPSE and Figure 2 shows the first screen (–Main Screen of PPSE–) you can see when you open the solver.
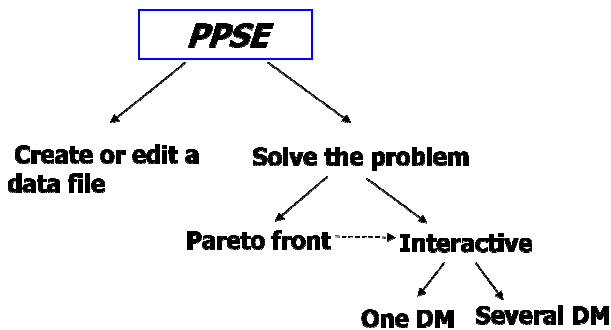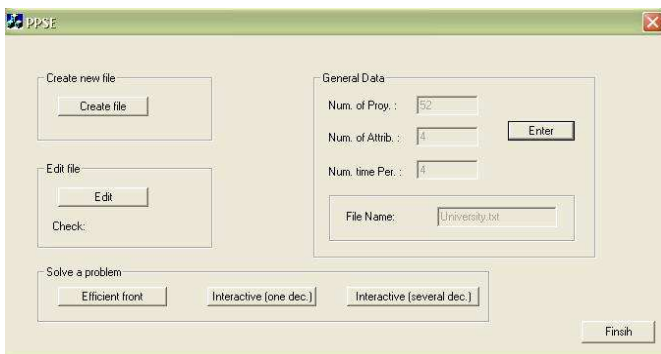
Figure 1. Structure of PPSE


Figure 2. Main screen of PPSE

- ▪ Create or Edit an input file. PPSE is provided with several friendly tools to create and edit the input files for the software.

- ▪ Solve a selected file. PPSE offers three possible options: Efficient frontier, Interactive (one DM), and Interactive (several DM).

  Efficient frontier. In this option the software solves the selected file and determines (an

approximation of) the set of efficient project portfolios to be loaded by the interactive module.
Interactive (one dec.). The DM incorporates new information either by changing the reference point (column g) or by selecting a representative solution from those shown under the heading Solutions (See Figure 3). The process repeats until the DM is satisfied with the solution presented.

Figure 3. Screen of interaction with one DM.
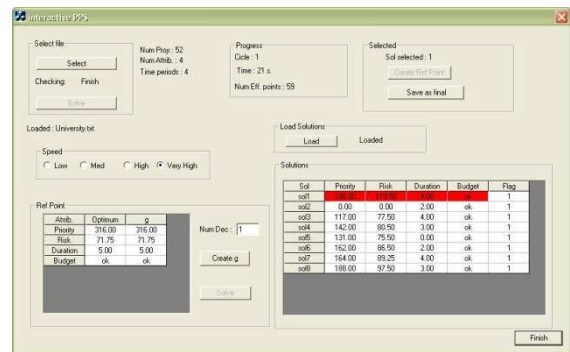
- ▪ Interactive (several dec.) The main characteristic of this option is the possibility of involving several DMs instead of a single one. Here the software requires (in a new screen) the initial reference points g^i and the distance measure (L1, L2, Linf) and based on the previous information, computes the most preferred solution for each DM and the super-ideal point **g** that contains the best value, for each attribute, of the solutions generated. This super-ideal point will be used as a common reference point to carry out the interactive procedure, similar to the case of a single DM.

Conclusions:

The PPSE software is a tool to address, in an easy and simple way, by means of user-friendly software the entire problem of project portfolio selection and scheduling, that is, the creation and edition of the data files, the resolution of the problem and support for the DM(s) in exploring the solution space in order to obtain the most preferred solution. Also, it has the flexibility to cover and solve a wide range of practical situations, in both state and private contexts in a short period of time, so it reduces the resources and time necessary to obtain an efficient solution.

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