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Optimization tools in project portfolio management

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Abstract
In order to improve their competitive positions, organizations have always been looking for tools to improve their business strategies and to use the resources at their disposal effectively and efficiently to achieve their objectives. Unfortunately, to date, most of the proposed tools do not adequately address this need when managing a project portfolio when dealing with project selection and critical resource allocation. The objective of this paper is to propose a heuristic based on the deterministic model to show how senior management can easily control the number of selected projects while verifying the quantity of scarce resources available in order to avoid conflicts and better manage prioritization issues between different projects.

Keywords: Multi-project management; project portfolio; decision; organization; optimization model

1. Introduction
In practice, project management is perceived as a system. That is, a set of interdependent components in the pursuit of a common purpose using a set of theories, tools and techniques appropriate for achieving a specific objective. Project management is becoming institutionalized and focuses all its attention on instrumental scientific knowledge to the point where it continues to place unlimited trust in the use of planning and control tools in the almost magical capacities of high technology as the only means of enabling the evolution of knowledge that can ensure project success or success. The complexity of the environment, the reduction in product life cycles, the desire to introduce new products quickly, the revolution in new information and communication technologies (NICTs) have all contributed to the race for companies to maintain their market share. To survive, organizations must work continuously and be able to get as close as possible to the customer to be the first to serve and satisfy them (responsiveness and creativity).
As a result, they are faced with the question of how to use their resources effectively and efficiently in the context of project portfolio management without compromising their productivity. It is in this spirit of contributing to a perfect understanding of the number of projects that a manager could adequately manage while remaining effective that we set ourselves the objective in this research to initiate the development of a heuristic to overcome the shortcomings of the tool proposed by Merwe (1997).
To achieve this objective, we will first present the state of the art in a multi-project context, then the organizational configuration of portfolio management to finish.

2. Literature review
According to Jessen and Arne (1993), multi-project management has five advantages: the use of a project-based approach, simplicity and efficiency in the management of limited resources, a positive contribution to human motivation, the integration of different knowledge to achieve an objective and the recognition of project management as a professional discipline.
According to Payne (1995), in a multi-project environment, the term project management implies the simultaneous coordination of a project portfolio with at least one common pool of resources.
In the same vein, Cusumano and Nobeoka (1998) [3] point out that most projects managed in a multi-project context share resources with other projects and in this case, the major challenge is to find ways to manipulate resource scarcity.
Tong and Tam (2003), to facilitate the understanding of the distribution of resources in such a context, introduced a fuzzy optimization of the distribution of work by generic algorithms.
From our point of view, one of the most important characteristics of multi-project management that differentiates it from traditional management is the fact that it assigns the management of several projects to a single manager who must manage them concurrently.

However, while the multi-project management approach can promote value for money, because a manager can work on several projects at once, the fact remains that a worker's productivity time is limited because the risk of error increases', because a manager On the other hand, one of the concerns of an unwise mind about managing multiple projects may be how many projects could the manager adequately manage effectively and efficiently?

The empirical studies carried out by Patanakul and Milosevic (2009), with six organizations working in the field of high technology, have tried to shed light on this concern. According to them, this study revealed that from four projects onwards, managers can reach their saturation point, i.e. no longer could move easily between projects and thus lose much of their effectiveness.

In our opinion, it would be difficult to identify an arbitrary number of projects that a manager could successfully manage. However, without taking into account a number of factors such as the nature of interdependencies, project requirements, the geographical location that separates projects, the ability of project managers to deal with obstacles, experience in leading the team but also the working climate within the teams and finally the manager's skills to manage a large number of projects.

Given the importance of this issue, Merwe (1997) attempted to test a response by developing for the first time a formula to determine the number of projects required per manager in a multi-project organization. But its formula seems rather opaque in the sense that it lacks precision on the values of certain parameters. For example, the values of the parameters Px (10% to 50% of the total number of projects) and Py (70% to 100% of the time a manager spends working on projects) are arbitrarily chosen.

Its formula is based on the time available annually for a manager. However, projects carried out by an organization could have a duration greater than or less than one year, the time available to be considered in general in the formula for a manager in a multi-project context should be equal to the project duration with the longest duration among the projects in his portfolio.

In view of all this, we believe it is convincing to develop a tool that would allow the various project portfolio managers to determine the time required to devote to the various projects in their portfolio when they want to remain productive.

3. Organizational configuration of project portfolio management

Today, project portfolio management is at the heart of many companies' strategic processes and is recognized as an asset to increase profitability, productivity and profits within the organizations that apply it, since it only aims to achieve the right projects.

The concept of configuration to reduce the complexity of describing organizations also offers the possibility of considering only a small number of variable layouts instead of examining all possibilities.

The portfolio management process takes the form of a funnel, which generally acts as a barrier or selective filter, with only the desired product passing through the membrane. This argument is reflected in the fact that there are several opportunities available to the organization in the form of projects of all kinds to the point where it is generally called upon to make a selection, that is, to make a first choice to select only those projects that fit within its mission. In principle, the projects selected in this first test are not yet a decisive choice but elements that will be recorded somewhere that should be called an opportunity sheet (business need). Subsequently, the projects contained in this sheet will be re-tested (selection criteria) depending on the objectives of the organization. And those who resist will build the business case and be planned according to the resources available to the company. It is at this stage that the composition of the various project portfolios, the prioritization and allocation of resources according to the contribution or contribution of each project to improving the company's vision, would take place. At this level, these project proposals will still be re-evaluated, and some will still fall along the way for several reasons: lack of appropriate resources, excessive development costs, lack of alignment with the company's strategies. Only a certain percentage could be provided and definitively implemented.

It is this state of affairs that prompted Copper and Al (1998) to consider strategic project portfolio management as a dynamic decision-making process where the list of active projects is reviewed and updated: new prioritized projects, existing accelerated, de-prioritized projects and resources reallocated to active projects.

This vision shows that the strategic process is a task reserved exclusively for senior management. And it is the one who determines the guidelines and directions that the organization must take in order to achieve its objectives, its mission, and the vision it wants to give to the company. However, the opinions of project managers and team members who are the backbone of project implementation are not taken into account at all. Yet it is they who are living with the consequences of the choices made by senior management. This approach shows that managers in the operational sphere are not involved in decision-making and are limited to managing day-to-day operations, programs and projects authorized by senior management through the means at their disposal.

4. Project portfolio optimization model

In this modeling, we will use the queue model, which is one of the oldest and most widely used quantitative analysis techniques.

The main purpose of the design of this tool is to show the various project portfolio managers how the proposed model will help them to effectively manage scarce resources.

In our case, queue theory can be defined as a set of projects in a manager's portfolio pending the allocation of scarce resources to be executed.

4.1 Model assumptions

We make the following assumptions

1. The selected projects are directly allocated to the various managers.
2. Each project portfolio manager waits for scarce resources to be allocated. That is, there is no attempt to influence the procedure.
3. The selected projects are independent (with different objectives) from each other and the average number of selected projects changes over time.
4. The selected projects arrive randomly following a Poisson distribution and come from several sectors of activity.
5. The time spent by each scarce resource to complete an

activity in a project varies and is independent from one project to another, but its average per project is known.
6. The time that the resource must spend in each project when performing a task follows a negative exponential distribution.
7. The average number of projects selected is higher than the average number of managers available.

Underlying assumptions

It is assumed that there are experts in the organization who can estimate 3 durations for each project. They are:

- The optimistic realization time (a): it expresses the time if everything went exceptionally well for the project in question.
- The pessimistic implementation period (b): it expresses the duration if difficulties were encountered during the implementation of the project in question.
- The most probable duration of realization (m): it expresses the duration that, in the head of the person in charge would be the one that would be realized. It represents the mode of distribution.

It is assumed that the duration of a project follows a Beta distribution law. This distribution is chosen because it has beautiful properties: the calculations of the mean and variance are simple, it sticks to reality, and it is defined over an interval [a, b] finite.

Since the analysis of a project focuses on the longest path in the project network and this path is composed of several activities, the properties of a sequence of activities must be considered when each of them satisfies the assumptions listed above.

The total duration of a project, which corresponds to the sum of the durations of a sequence of activities, is equal to the sum of the durations of each of the activities in the sequence. It is therefore the sum of random Beta distribution variables. However, according to the law of large numbers (Central Limit Theorem), the sum of several independent random variables ($n^3 30$) of the same distribution converges to a random variable of normal law. In practice, since we are dealing with large projects, the constraint of $n \geq 30$ will not be restrictive.

Therefore, if we define ds as the average duration of execution of a project of an activity sequence and σ2ds as the variance of this average duration, then the duration of execution of a project follows a law N(ds, σ2ds), where:

ds = S te (for all projects in the portfolio), with te = (a + 4m + b) / 6

σ2ds = S σte2 (due to the assumption of project independence), with σ2ds =[(b-a)/6]^2

Conclusion

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5. Conclusion

The purpose of this study is to show that there are several imponderables that weigh on the manager when managing his project portfolio. As a result, the latter does not have real power over certain aspects that are at the very heart of this management, such as project selection, allocation of critical resources and project prioritization.

The main merit of this work is that it builds practitioners on how multi-project organizations proceed when selecting the projects that will make up each manager's portfolio. Our dearest wish is to be able to develop in our future work a tool that will show the best way for senior management and portfolio managers to proceed in order to have maximum control and consensus in the selection and allocation of scarce resources, which will promote value for money and therefore help portfolio managers to become effective and efficient, given that this is the main limitation that could be attributed to this research.

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