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# RESOURCE ALLOCATION FOR MONITORING, CONTROL AND SCHEDULING ASPECTS

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**Abstract:** *Every day we meet new challenges that interfere in the workflow of different projects. Resources are scarce; therefore we need to carefully allocate them in order to obtain the desired results. The best way to deal with change in modern organizations involves project management. Therefore the question is which tools are best used to support structure, automation and efficiency of complex business processes. In recent years the world has experienced an unprecedented number of outbreaks of Avian Influenza (AI). These outbreaks have led to substantial economic losses and in some cases human illness and loss of life. In some countries, extensive social impacts have also been documented among farmers and the public in general. Decision-makers will have to choose future strategies for prevention, monitoring and control of AI to reduce these impacts. The objective of this paper is to present a conceptual framework appropriate for strategic decision making regarding epizootic animal diseases with potential implications for human health, where the emphasis is placed on the allocation of resources between three important areas of action: prevention, monitoring and control. We particularly investigate the aspect of resource allocation and scheduling. We attempt to integrate the automatic allocation and task scheduling to it. The database containing the information about the project, tasks, resource is designed. The tasks may be concurrent and requires many skills. The project activities are subject to considerable uncertainty which can lead to schedule disruptions. Hopefully, in this paper a model can be developed that cannot provide with a proper resource allocation with approximate formulations that can lead to maximum results of the studied project.*

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## 1 INTRODUCTION

Traditional project management deals with many phases: definition, planning, executing, control and closure of the project [1]. Each of them is important. One of the interesting issues is the scheduling and allocation which is in the planning phase. Scheduling is the process where tasks in the project are ordered to execute by the time. Allocation is the process where available resources in the project are assigned in order to execute the given task. Scheduling and allocations are usually complex depending on constraints and factors considered in a project. A project is a major one-time undertaking dedicated to some well-defined objectives and involving considerable personnel and equipment. It is usually initiated either by some need of the organization or by a customer request. The time and the resource estimations provide the duration and resource requirements for each activity as well as temporal constraints between activities that are connected by precedence relationships. The main purpose of this paper is to apply a known methodology on a real business project in order to evaluate its outcome based on the resources used. The research on the resource constrained project scheduling problem (RCPSP) has widely expanded over the last few decades . The vast majority of these research efforts focus on exact and suboptimal procedures for constructing a workable schedule assuming complete information and a static deterministic problem environment. Project activities are scheduled subject to both precedence and resource constraints, mostly under the objective of minimizing the project duration. The resulting schedule, subsequently referred to as the *pre-schedule,* serves as the baseline for executing the project.

## 2 SOFTWARE PROJECT MANAGEMENT METHODOLOGY

The components that affect the scheduling and allocation are the criteria and constraints. Criteria are factors that need to be considered in the problem. The constraints are the conditions that the scheduling or allocation must meet. Certain criteria must be optimized to generate the optimal schedule/allocation. In a project environment, these guidelines might be a list of things to do. A methodology could also be a specific approach, templates, forms and even checklists used over the project life cycle. Some companies use methodologies that cover all aspects of the business, from pre-sales activities to operational support. Other companies use methodologies only during design and development. There is no universal methodology available; everybody uses its own methodology. Even similar

methodologies get adapted to the specifics of the company, i.e. many project managers have realized that "methodologies from the book" must be modified and tailored to suit their own project needs.

A company that uses certain methodology should make it transparent to the customers as much as possible. Furthermore, some companies offer their customers to choose from a set of methodologies the one that will be used for the project realization. This makes it possible for the customer to track the progress and to know exactly what intermediate results and deliverables should be available at certain points in time. Finally, a methodology must not be too complex or inappropriate in any way to be seen as a burden for the people who use it. It must be light, understandable and goal oriented, it must be seen as a tool for achieving success. It should make the life easier. Resources, be it people, money, hardware or similar, are necessary throughout the whole project development. Based on experience and specifics of each project it is possible to foresee the trend of amount of necessary resources in regards to each project phase. Early phases as well as later phases involve less human resources. Hardware, on the other hand, is a resource that grows towards final phases. This is characteristic for software development since final phases involve tests where it is actually attempted to simulate real environments. Of course, there can be more or less differences to what is presented here. Furthermore other resources, such as money, must be planned in advance according to inputs that are available at the beginning of the project. Every project manager must know the trends of resource consumption and according to the experience and available inputs (there are also software tools available for such purposes) must plan exact amounts of necessary resources for the whole project. During project development there will usually be necessary to do certain corrections, but the goal of planning is to make later corrections as minor as possible. First phase of a project is the initiation. In this phase it is decided if the project will be done or not. The decision is based on the Project Decision Report as a result of undertaken activities at this stage. Analysis and Design team must analyze customer's requirements and if possible provide a solution proposal. If it turns out that requirements analysis has a negative outcome due to complexity, risks or some other reason, the analysis and design team will suggest to the project manager to make a decision not to do the project. An immediate consequence must not necessarily be a final "no go", but further negotiations with the customer could take

place. The next phase of a project is the analysis, its main goal is to answer the question "WHAT should be done?"

There are number of important activities at this phase. A user requirements specification contains thorough description of the product requirements in terms of its functions, interfaces and other features from the perspective of the user. Both requirements must be reviewed

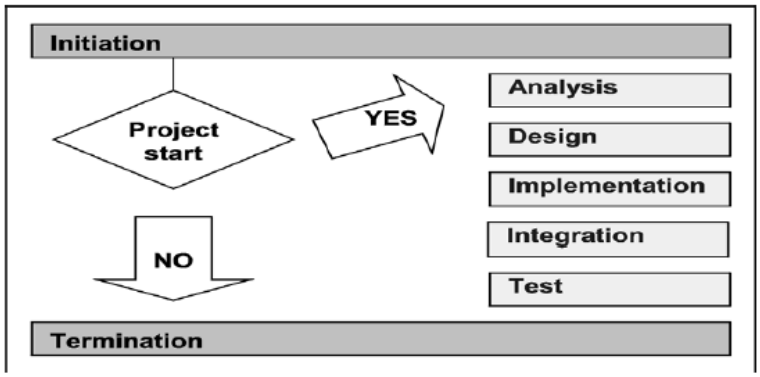


**FIG.1**

## 3 AUTOMATION OF A BUSINESS PROCESS

Since the introduction of Sourcing Allocation Standards, PVLs (preferred vendors lists) role in controlling spend with low value and high number of transactions became crucial. In all regions the priority in the past year and also in the current fiscal was to improve the PVLs so that the PVL and Sourcing compliance to reach their target. In each region, the CPO (Central Purchasing Operations) has a person that receives the updates, checks them and uploads the template in the system, using normal SAP tables update process. So there are 3 persons, one in each CPO (Central Purchasing Operations) that are checking the PVL templates submitted by PVL submitters and whenever there are some errors spotted, send back the respective list and ask to be corrected. In EMEA each month we have an average of 2000 PVL lines that are checked manually. This occupies the respective half of the time of the respective person.

*Table 1. Milestones*

| Milestone | Description | Phase |
|---|---|---|
| M100 | Project "Kick Off" meeting | Initiation |
| M200 | Completion of analysis | Analysis |
| M300 | Completion of design | Design |
| M400 | Code complete | Implementation |
| M500 | Integrated system | Integration |
| M550 | Beta release | Test |
| M600 | Market release | Test |

*Table 2: Activities and dependencies*

| No. | Activity name | Code | Preceding activities |
|---|---|---|---|
| 1 | Design process | D | - |
| 2 | Obtain management approvals | A | D |
| 3 | Find open source software for design of the application | OSS | D |
| 4 | Design application | DA | D |
| 5 | Link application with external documents | LE | D,DA |
| 6 | Design checking logic | DL | DA |
| 7 | Test the application | TA | DA, DL |
| 8 | Train the users | T | A,TA |

Of course these are the main activities that on the course of the evolving project will be divided in smaller parts that are easier to manage and to ful fill. The design part will be divided into research and programming. Each step of the programming will have its own research part, in order to find the best solution for the programmers and the users. The design of the external links and the design of the testing logic, can be executed in the same time by different programmers right before the design of the whole application. This way, the activities DA, LE and DL can be divided in two main parts: DA1, DA2, LE1, LE2, DL1, DL2, having the same predecessors.

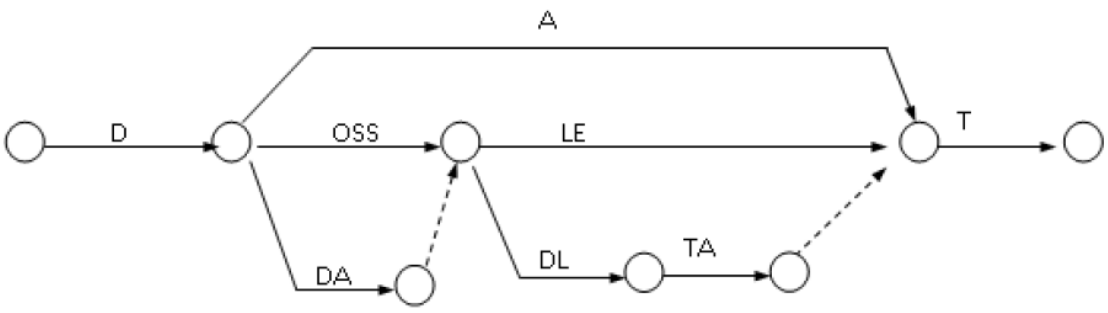


**FIG.2**

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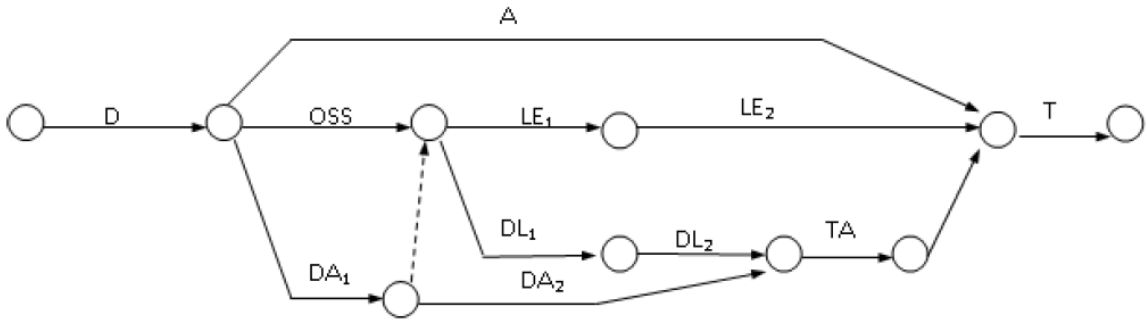


**FIG.3**

Continuing the analysis of the (AoA) network I will fix the total projection time (TPT), meaning the shortest time in which it will be ready. This interval will be determined by a set of sequences named critical activities. The sequence of activities is the critical road. Each activity will have determined an earliest starting time (EST) and an earliest finishing time (EFT) calculated depending on its duration. The critical path will be determined by the activities that have no time reserve meaning that its latest finishing time (LFT) will be equal to the latest starting time (LST).

Furthermore, for each activity there is determined the earliest event time (EET) by going forward with the project phases and the latest event time (LET) will be determined by going backward, and this time has to be exact in order to finish the project in time. These times will be considered as sum of the hours working on the specific activity and following operational research methods and having the each event duration given. From arch analysis I can conclude that only the approval and the link to the external documents are not critical activities. The other activities have to start when they are scheduled so the project finishes in time. From the practical point of view, the theoretical outcome is close to the actual project development, as the approvals can be obtained while the project is in progress. Also the external documents that might be needed in the application can be created or included in the application while it is in progress. Anyway, this is a rough analysis of a project because the resources needed were not taken into consideration. The analysis will go deeper into the project's phases. Therefore I will define the resources such as people and hardware and also their load during the development of the project. Also the activities have been detailed.

### 3.1. Exploring Problem Definition

Relating to the project management, many information must be collected. Some may be identified as constraints and some may be identified as factors. Typical information are typical skills, staff and their skills, project details and their tasks as well as task information. The details may vary but most of the time, it is found that tasks' deadline is needed for scheduling. Besides, each task may need more than one skill and each staff may have many skills. The available date of each staff is also not the same. Thus, the data needs to be known in priori before the schedule and allocation can be done. However, in reality, such information may be changed during the project execution. For example, staff may be reduced or some task may require more staff to keep up with the plan and so on. Then, the created schedule/allocation may need to be adjusted. The main issues are the timing of each task and skills of each tasks which are required to perform scheduling and allocation. Note that the previous assignment of the tasks to the staff must be included to show the date that each staff is not available. This assumes one staff can hold one task at a time in general.

### 3.2. Allocation and Resource Assignment

Based on the earlier problem domain, the allocation of each task in the project can be created using the existing algorithm. In the project management, the approach is basically to match the appropriate available staff to each task. The complication occurs when there are more than one staff available for such a task and when there are many tasks that require the staff with the particular skill. Another issues may be the case when one task requires many staff of the same skill, *etc*.

In our prototype, we consider as following for each task.

1. Check the duration of the task and find the staff that are available during the time.
2. Check the require skills of the task and the available staff.
3. Assume that one skill of a task requires one staff. For each skill of the task, find the staff that has the skill. If there are many staff that hold such a skill and each staff has more than one skill, we pick the staff with the least number of skills. This assumes the staffs with the least number of skills have a limited choice to do other tasks.
4. If there are many staff, we pick the staff with the least pay rate. Note that steps 3-4 may be interchanged or updated depending on the criteria or business rules.

### 3.3. Schedule Creation

To create a schedule, the prototype considers ASAP schedule and ALAP schedule. ASAP schedule assumes to start the task as earliest as possible. Thus, we can view a remainder time which is the deadline subtracted by the earliest task finish time. For ALAP schedule, we assume to delay to start the task as late as possible. That is the deadline of a task is used to schedule in this case. In the application, both schedules can be created. A user can be view the schedule using ASAP and ALAP compared with the total task period. At this point, the schedule and allocation are independent.

## 4 CONCLUSIONS

The appearance and development of the project management has occurred as a consequence of the need to adapt the theory and practice of management to the projects specific. In practice, the application of the tools and techniques of project management is facilitated by the use of specialized software for project management.

The things presented and explained here give a rough overview of what is a project management in a software development area and what it consists of. The goal was to present at least most important aspects, terminology and procedures at both theoretical and practical level. In project management software, scheduling and resource allocation are key parts in the planning phase. Scheduling is process that order the tasks according to time frame. Allocation is the process of assigning the proper resource (staff) to each task. Typically, both of them are related to each other. However, in most of the project management software, they are considered separately. The allocation may be more complicated since the matching of the skills between tasks and available staff is required. Besides, they are many criteria to be considered such as: Can each staff hold more than one task? Can one task may be assigned to many staff? Can staff be reassigned to the task? Etc. Thus, these criteria are business rules to be integrated in the algorithm. The common goal of the scheduling / allocation to create the assignment that minimizes the total project cost while all the tasks can be finished within the time frame. To be more effective, considering the scheduling/allocations both at the same time are possible but complicated. For example, the allocation of the task and staff are considered together with the time frame of each task. Also, the staff may be reassigned to some shorter period of the task or the staff may be assigned to more than one task at a time. During the project execution, the

schedule/allocation plan may be updated to follow up the schedule and resource reassignment may be done to keep up with the plan or changes. Every organization has some specifics that can more or less influence how the projects are managed. Furthermore, within a single organization there are rarely two so similar projects that no significant differences exist in the way the projects are managed. This paper has proposed a model of resource allocation inspired by a real business process. The resources have been allocated in parallel and this has offered the project a robustness and ease in the leveling process. Given the complexity of the project, the use of project management software was very useful in order to illustrate better the theory through practice. Therefore a project manager can better evaluate the loading of each resource and to move activities at different dates so there is an even load of the resources during the project phases. The most interesting part is that this analysis helped me to have a good overview of a past project and to apply the new abilities in future projects.

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