Use of Analytical Hierarchy Process to prioritise human resources in substitution problems.

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ABSTRACT

In general, software project is usually to figure out the restrictions of resource limitations. When a software project is running late, the project manager is struggling to assess the impact of delays on the general project duration. Based on the time-cost trade-off approach, the matter are often alleviated by the substitution of other suitable resources that are in greater supply. Analytic Hierarchy Process which can be a popular decision-making model for tackling multiple criteria problems. The proposed method can be considered an element weighting mechanism to achieve a better level of consistency. It will help the project manager to realize a far better replacement of the human resource and increase the prospect to urge a successful result. The approach is illustrated by an example in three steps, identifying all possible resources within the substitution process, analysing the wants and substitution constraints and developing the hierarchy of criteria for prioritisations.

CHAPTER- 2

INTRODUCTION

Software project development includes variety of activities that end in a delivered product (software). As software becomes more and costlier to develop, the project managers got to pay more attention to regulate the progress. Unfortunately, late delivery of a software project is extremely common within the data system community. Various researchers administered an identical study. They found that the typical cost was 33%. People are intellectual beings, and that we need them to style and develop software application for accomplishing the software project development. They're the essential drive to urge work done. Many research works are administered attempting to seek out the main keys to successful software project management. Donald Reifer classified these project managing keys into just three, namely Process, People and also the Product. These three factors all directly or indirectly associated with People in completing the project, which indicates the importance of the People in software project development.

At times, when a project is running late, taking correct actions are necessary. The project managers are struggling to assess the impact of delays on the general project duration. Because "people" who work for the software project will generally represent the foremost variable and largest percentage of the entire project costs, the effective use of the excess resource (people) is important. It provides enough flexibility for the manager to recover the excess at various stages of the project. Substituting one person with another can improve the usage, in terms of labor productivity, of this resource. The effectiveness of the utilization of "people" will allow more activities to start out on time. The substitution of other resources can make resource constrained project scheduling easier, particularly when the availability of a specific scarce resource is depleted. The matter is that project managers seldom have time to research on the tactic of substitution. Project managers may resolve the matter by sorting all human resources consistent with some preference. Actually, the priority of alternatives requires considerations of variety of criteria, like experience, personal preference, technical requirements, and therefore the like. Although the substitution process can make the rescheduling process easier, the very task of substituting people is difficult and sophisticated in practice.

Firstly, people are far more “individual” in what they know and the way they behave. Therefore, the replacement of a person by another can only be assessed on a case-by-case basis.

Secondly, one person could also be a substitute in one situation but not in another. For instance, activity A requires a programmer X to develop a C++ program and activity B requires a programmer Y to try to visual programming. Suppose programmer X has good knowledge and knowledge in both C++ and visual programming but programmer Y knows only visual programming. When programmer Y isn't available, programmer X are often assigned to exchange programmer Y but not the other way around.

Thirdly, one-to-one interchanged within the substitution process. People are one of the major resources for software project development but hard to manage and cannot be easily interchanged. Within the substitution process, adding an additional team member might not end in a proportion of reducing the project completion time. Sometimes, if more staff are

involved in an activity, the productivity may drop and further delay the schedule due to communication problems and other human related factors which can end in confusion and error. So only one to one replacement are often considered within the substitution process.

In summary, the proposed method is aimed to answer the below questions:

• What's the sequence of all alternatives within the substitution process?

• Which substitutes will have a better preference?

It ensures to speed up the event of the resource constrained software projects but preserves the initial activities schedule. It's admitted that human resource could also be replaced by equipment but there may have a more complex arrangements.

CHAPTER- 3

LITERATURE REVIEW

a) Title of the Paper- "Evaluating human resource management based on analytic hierarchy process" by Z. Zhixing

As human resource management may be a crucial problem in modern enterprise management, the paper proposed a completely unique human resource management performance evaluation method supported analytic hierarchy process. Firstly, a hierarchy structure with three layers is meant to gauge human resource management performance, which is, first being the target layer, second being the standards layer, and third being the scheme layer. Particularly, during this hierarchy structure, index system for the human resource management performance evaluation is given. Secondly, AHP is exploited to estimate the HRM performance level. Thirdly, a knowledge set are collected from ten various sorts of enterprises. Compared with experts' opinions, it is often seen that the proposed method of analytics hierarchy process can estimate the human resource management accurately.

b) Title of the Paper- "Optimal Allocation of Human Resources in a Medical Laboratory Using Analytic Hierarchy Process" by Aliyeh Kazemi

Nowadays effective human resources management plays a crucial role in success of organizations. Organizations attempt to allocate the most effective possible human resources for each section. These sorts of decisions are one among the difficult challenges that human resource managers face it. Using multi-attribute deciding methods is an efficient tool for human resources managers to ease the method of deciding. Using the tactic and considering qualitative and quantitative criteria the foremost suitable allocation was wiped out a medical laboratory and therefore the absolute best team for every of its section was found. Regarding specific attributes 8 experts were allocated to 3 sections of a medical laboratory. As a result, it had been found that analytic hierarchy process method may be suitable method for allocating human resources to different sections of an organization.

c) Title of the Paper- "Analytic Hierarchy Process- An approach to determine measures for business performance" by Eddie W.L. Cheng, Heng Li

Analytic hierarchy process is becoming quite popular in research because of the very fact that its utility outweighs other research methods. AHP aims at assigning weights to tested elements. Weighting of elements has two major functions. First, it's employed to prioritize elements in order that the key elements are often determined. This might for instance help to determine the key measures for business performance. Second, assigning weights to choose measures may provide a more accurate judgement. It is, therefore useful in making business decisions, like

the evaluation of other marketing strategies, the choice of candidates for job, etc. Additionally, Analytic hierarchy process employs a consistency test to purify the usable questionnaire responses and an iterative process to enhance consistency, which differentiate it from other research methods. It demonstrates a hypothetical example of the way to select the proper candidate for a posted position from a group of weighted selection criteria.

d) Title of the Paper- "The analytic hierarchy process and human resource allocation" by Thomas L. Saaty, Kirti Peniwati, Jen S. Shang

The analytic hierarchy process provides how to rank the alternatives of a problem by deriving priorities. An issue that happens in practise is: what's the simplest combination of alternatives that has the most important sum of priorities and satisfies given constraints? This leads one to think about the interface between the AHP and therefore the approach inherent in linear programming. The priorities of the alternatives often function coefficients of the target function of an LP program. The constraints are determined from existing measurements, like the range for the amount of employees needed and therefore the salaries required for various jobs. Through various examples, it shows the way to apply absolutely the measurement mode of the AHP alongside LP to optimize human resource allocation problems. For instance, one can determine which positions to fill, or which mixture of candidates to rent. It also gave an example of the way to allocate resources to maximise the returns to an organization of its training programs.

CHAPTER- 4

SUBSTITUTION CONCEPT

Generally, it's seldom that each one elements for one resource type are depleted. For instance, it's hard to mention that each one development team members resign from the activity. It's going to be the case that a number of them resigned or are absent for a few personal reasons. Thus replacement or substitution has got to be considered, especially for the human resource issue. Let's understand through an example:

Initial Resource Schedule:

Resource Type	K	L	M	N	O	P	Q	R	S
Requirements	1	2	6	1	0	0	14	1	0

Suppose Resource K is now depleted, the project manager finds that resource 0 is in great supply and may be used as the preferred alternative. The quantity of the replacement is two. Therefore, the wants on the resource vectors for resource type O are going to be changed from 0 to 1.

The new resource schedule becomes:

Resource Type	K	L	M	N	O	P	Q	R	S
Requirements	**0***	2	6	1	**1***	0	14	1	0

THE ANALYTIC HIERARCHY PROCESS (AHP):

The Analytic Hierarchy Process (AHP) was developed in the early 1970's by Thomas Saaty to unravel prioritization problems. Saaty claims that the AHP is a framework for people to structure their own problems and supply judgments supported knowledge, reasons or feelings to derive a group of priorities considered as an optimal solution to a choice problem. Today the AHP has gained wide popularity and acceptance throughout the planet. It's been considered that AHP is one among the powerful tools to assist individual also as group decision makers to convert linguistic assessment to quantitative scales. This will be used as a way of aiding multi objective choice and is widely utilized in different types of problems, like preparation the work schedule, prioritization auditing tasks, and therefore the like.

Selection of an appropriate human resource substitution requires considerations of variety of criteria, like sort of the appliance, experience, technical requirements, time, etc. and may be a relative matter. A Project manager got to choose the simplest one during a set of competing alternatives that are evaluated under conflicting criteria. Since the AHP may be a multi-attribute approach to deciding, it helps the project managers to affect the human resource substitution problem which involves an outsized number of alternatives and criteria. Moreover, it enables us to deal with the intuitive, the rational, and therefore the irrational, all at an equivalent time.

It's commonly agreed that there are an excellent number of things involved within the human resource substitution process. For this proposed method, the connection among selection factors are going to be specified through weighting. Considering these factors, a project manager can determine whether or not the factors are included within the human resource into account. Though the build-up of weighted scores, rank different sorts of human resources consistent with their relative suitability. In other words, the hierarchical data structure of the new method allows project managers to match different selection factors more efficiently, even when an outsized number of things are involved.

There are six steps for prioritizing human resource:

Step 1: For the entire development life-cycle an individual phase, identifying an inventory of human resources substitution factors, which were considered for several past projects within the organisation, and every one possible human resources for substitution for this situation;

Step 2: Analysing the task requirements and every human resource's constraints;

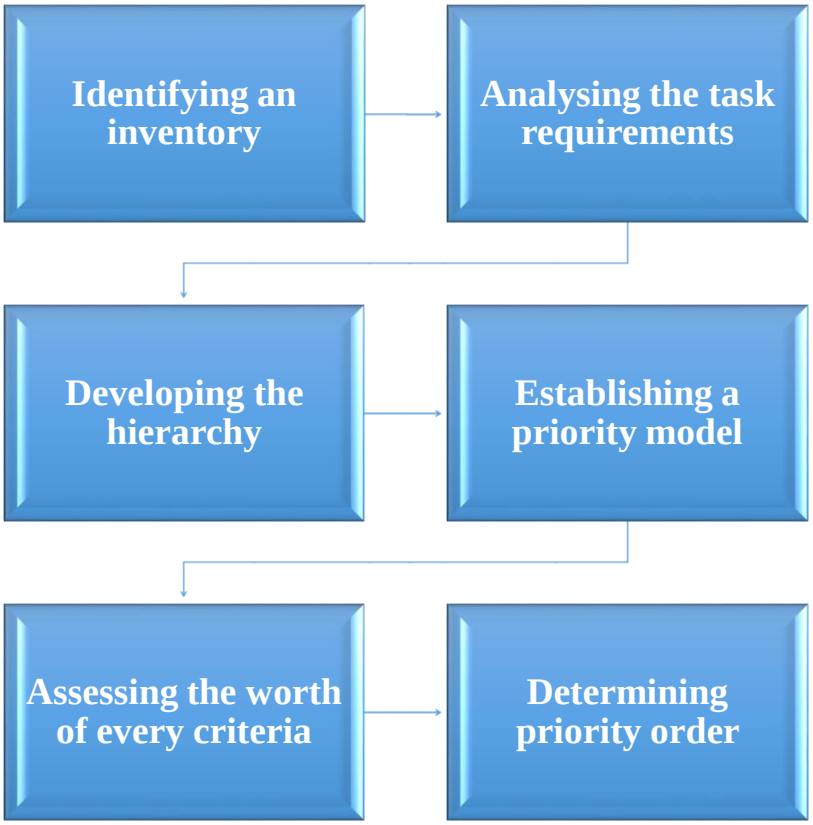
Step 3: Developing the hierarchy of criteria for prioritisations;

Step 4: Establishing a priority model by identifying the importance of criteria through comparison;

Step 5: Assessing the worth of every criteria for every substitution and prioritisation factor;

Step 6: Determining priority order and at the same time also considering other important factors. The very best priority human resource is that the most suitable option of substitution.

The first two steps are often administered by using judgment in persona or other sophisticated methods. The discussion of the judgment remains an open issue. It focuses on the small print of steps three through six which are associated with how the AHP method is applied for human resource prioritisation and substitution.



CHAPTER- 5

AN ILLUSTRATION

To illustrate the algorithm and to avoid any ambiguity or abstruseness which will exist within the explanation, a small example of a human resources substitution process are going to be presented during this section.

Identifying all possible human resources within the substitution process-

This is a preliminary identification process. To spot an inventory of human resources within the substitution process, software project manager must first have variables whose measurements were taken for several similar past projects within the organisation. Let's say, the project manager selects five possible human resources, namely programmer K, Programmer L, System Analyst M, System Analyst N, and Junior Programmer O, for the substitution of the programmer Z.

Analysing the wants of the human resources and therefore the substitutions' constraints-

A lot of points are found after analysis and, without going into detail, a number of them are listed as below:

• Programmer Z is sweet for XY Programming, Networking, Database system design and implementation;

• The activity is especially for doing the XY programming;

• System Analyst N accepts to exchange the Programmer Z.

Developing the hierarchy of criteria for prioritisations-

During substitution process, there are tons of things that are important to project managers. Moreover, each human resource would be expected to possess a special set of things considered important.

This step will include three major tasks:

• Identify overall objective or goal to the choice;

• Identify appropriate criteria to satisfy a goal;

• Identify, where appropriate, sub criteria under each criterion.

For demonstration purposes, a list of factors for the choice problem is listed as below.

Goal	Success Human Resource Substitution Process		
Major Criteria	Organization Attributes	Clients Attributes	Application Attributes
Sub Criteria	• Company Policy • Staff's Preference • Management Attitude • Size of the team	• Client's Preference • Client's Involvement	• Development Complexity • Software Requirements • Hardware Requirements

According to psychological theories, the human mind can most effectively handle 7 +/- 2 pieces of data at an equivalent time and becomes inefficient as the number of data increases. Thus project managers may experience difficulty in attempting to match all the above factors at just the once. To assist software project manager to manage a greater number of things at just once, AHP would enable the project manager to group the factors into different classes or categories, allowing no more than seven factors to be considered at just once. Note that the hierarchy subdivides the level 2 into three main criteria, namely Client Attributes, Application Attributes and Organization Attributes. Additionally, these three criteria are further subdivided.

Establishing a priority model by identifying the importance of criteria through comparison-

The second step in establishing an AHP model is to spot the relative importance of criteria which may be assessed by using pairwise comparison. So as to work out the load that an individual factor will contribute to the general utility, a series of comparison got to be administered. Normally the comparison process are going to be done from the highest level of the hierarchy to the lowest level so as to determine the general priority index. Because the factors themselves don't have a numerical value upon which to determine their relationship, a mechanism which provides a way of comparison is included. During this judgment phase, the AHP requires the subsequent scale of absolute values to precise judgments in making paired comparison.

Scale for pairwise comparison:

1	2	3	4	5	6	7	8	9
Equal Importance		Weak Importance		Moderate Importance		Strong Importance		Extreme Importance

The usage of the above scale is shown as below: Given elements A and B;

• If A and B are equally important, then the rating of comparison is 1.

• If A is weakly more important than B, then the rating of comparison is 3.

• If A is moderately more important than B, then the rating of comparison is 5.

• If A is strongly more important than B, then the rating of comparison is 7.

• If A is extremely more important than B, then the rating of comparison is 9.

Where 2,4,6,8 are intermediate values, between the 2 adjacent judgments, which are used to facilitate compromise between slightly differing judgments. Moreover, a component is equally important in comparison with itself. Utilizing the above scale, comparisons are made with each factor against all other factors. We can use Skill Matrix to segregate the individual and select the one with highest priority.

CHAPTER-6

CONCLUSION

Software project development features a dynamic nature. Therefore, changes are sure to occur, especially regarding staffing problem. The purpose is to introduce a way supported AHP to unravel the matter of prioritisation of alternatives within the human resource substitution process. It provides a proper mechanism which will quantify the choice attributes and allows a software project manager to match factors systematically. Moreover, the presented AHP method can easily be computerized and used as an on-going prioritization tool for software project management. So as to use this method successfully in practice, the subsequent are important requirements:

• Discussing with the alternatives and every one team members before substitution process starts;

• Understanding the requirements of the alternatives;

• Close working with team members and trying to unravel the issues after the substitution process;

• Close monitoring of the event progress;

• Using different points of view to try the evaluation at different development stages;

Therefore, the proposed method and above requirements are beneficial within the human resource substitution process generally. They are going to help the project managers to form a far better decision within the substitution process and improve the prospect of working the project successfully.

CHAPTER- 7

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