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MULTIPLE CRITERIA EVALUATION OF PROJECT GOALS

Abstract

This text is focussed on the quantitative evaluation of project SMART goals using the ANP method. This approach should be used in the project initiation phase. The very first step in all projects: business, home, or education, is to define goals and objectives. It is important to develop several goals that will enable us to be successful. Goals should be SMART – S – specific, significant, stretching, M – measurable, meaningful, motivational, manageable, A – agreed upon, attainable, achievable, acceptable, action-oriented, R – realistic, relevant, reasonable, rewarding, results-oriented, resourced, T – time-based, timely, tangible, trackable.

In our paper we make complex decisions about satisfying project SMART goals based on the ANP method using Super Decisions Software. As criteria we used a general SMART (SMARTER) model, as sub-criteria we use S, M, A, R, T sub-goals and as alternatives different project schedules are applied. We experiment with their mutual dependencies and we try to propose the best methodology for evaluating projects using the Analytic Network Process.

Introduction

Modern project management uses many methods, techniques and tools for evaluating the quality of a project, both in the phase of proposal and in the phase of realization. Any project proposal should look very nice but a deeper study of its aim, time schedule, and resource allocation can detect whether it is likely to fail/to succeed. The majority of methods used for project evaluation are not based on quantitative approaches; sophisticated mathematical methods of multiple criteria evaluation of alternatives are used only very rarely.

The BOSCARD (Background, Objectives, Scope, Constraints, Assumptions, Risks and Deliverables) is a tool used to provide the terms-of--reference for the newly proposed project [Haughey 2011]. It is used in the phase of project initiation. What future events may impact the project? For forecasting the future and customizing the project schedule the Delphi Step by Step technique can help. The MoSCoW method (Must have this, Should have this if at all possible, Could have this if it does not affect anything else, Won't have this time but Would like in the future) is applied when establishing a clear understanding of the customers' requirements and their priorities [Clegg and Barker 2004]. The PEST is a strategic planning tool for evaluating the possible impact of Political, Economic, Social, and Technological factors on a project. The RACI model (Responsibility, Accountability, Consultation, and Information) is a straightforward tool used for identifying roles and respon-sibilities and avoiding confusion over those roles and responsibilities during a project [Smith 2005]. SWOT analysis (Strengths, Weaknesses, Opportunities, Threats) is a well known strategic planning tool used to evaluate the strengths, weaknesses, opportunities, and threats to a project [Armstrong 2006]. It involves specifying the objective of the project and identifying the internal and external factors that are favourable and unfavourable to achieving that objective.

The tool we consider in this paper is called SMART Goals evaluation. Project goals should be SMART [Doran 1981], which very briefly means: S − specific, significant, M − measurable, manageable, A − agreed, action--oriented, R − realistic, relevant, resourced, T − time-based, trackable. SMARTI project adds I − Integrated criteria to SMART goals, SMARTER project is moreover E − Ethical, Excitable, Enjoyable, Engaging, Ecological and R − Rewarded, Reassess, Revisit, Recordable.

For our paper it is more important to evaluate a completed project, final proposals, or project baselines (schedules) whether the SMART goals have been achieved or not. These goals are hard to measure; they have no final quantitative features. That is why we first tried to apply the Analytic Hierarchy Process [Saaty 1980, 1999] for comparing a finite set of projects with respect to general SMART goals (criteria) and individual SMART specifications (sub-criteria). Upon receiving the AHP results we decided to abandon this approach and apply the Analytic Network Process [Saaty 2001, 2003] for this evaluation. In the AHP each element in the hierarchy is considered to be independent of all the others, the ANP does not require independence among elements. It is very

hard to make complex decision on satisfying project SMART goals without applying the ANP method because SMART specifications (sub-criteria) are not independent of each other. The majority of them are judged from sometimes very various points of views and one judgment strongly influences the others. R – goals (sub-criteria) "Realistic" and "Relevant" are typical examples of this dependency.

According to the survey [White and Fortune 2001] three crucial success factors mentioned most frequently by respondents were:
– Clear goals.
– Support from senior management.
– Adequate funds/resources.
That's why we focus mostly on project goals.

1. The ANP process as a tool for SMART goals evaluation

Multiple criteria decision models are used by many industries to quantify, compare, and manage their performance. The Analytic Network Process is one of the most effective tools in cases where the interactions among qualitative and quantitative factors generate a hierarchical or a network structure. Isik at all [2007] presented a conceptual performance measurement framework that takes into account company-level factors (objectives, strategies, resources) as well as project-level (risks, opportunities) and market-level factors (competition, demand).

As a tool for SMART goals achievement evaluation the hierarchy evaluation by the Analytic Network Process (Saaty 2001, 2003) should be used. Two types of the ANP model are theoretically defined: the Feedback System model and the Series System model. The Series System model usually consists of a tree, where the root is a model goal; branches of various levels have the meaning of criteria or sub-criteria of various levels respectively and finally the leaves represent a set of alternatives. Branches and leaves together determine the so-called model clusters (criteria, sub-criteria, project proposals). A crucial role for the project proposal evaluation plays the Feedback System model, where the clusters are linked one by one into a complex network system. We assume that all sub-criteria (within S, M, A, R and T criteria) influence and interact with each other and in the same way all the criteria are interconnected, too. It means that the hierarchy structure can be transformed into

a network structure and the ANP feedback model seems to be a very suitable tool for solving this problem. The ANP super-matrices (non-weighted, weighted, limits) with possible cluster interactions and influences have to be defined and calculated and the most suitable project proposal will be selected according to the synthesis through addition of all the control criteria. The computation itself should be made using, for instance, the SuperDecisions software.

$$
\mathbf{W} = \begin{array}{c} \\ C \\ S \\ P \end{array} \begin{array}{c} C \quad\quad S \quad\quad P \\ \begin{pmatrix} \mathbf{0} & \mathbf{0} & \mathbf{W_C} \\ \mathbf{W_S} & \mathbf{W_{S*}} & \mathbf{0} \\ \mathbf{0} & \mathbf{W_A} & \mathbf{0} \end{pmatrix} \end{array}
$$

where:
– W_C is the matrix of criteria weights with respect to projects,
– W_S is the matrix of sub-criteria weights with respect to criteria,
– W_{S*} is the matrix of sub-criteria weights with respect to each other,
– W_A is the matrix of project weights with respect to sub-criteria.

1.1. The ANP Criteria Level

The criteria level in the ANP process includes the general SMART goals. The goal is a general statement about a desired outcome with one or more specific objectives that define in precise terms what is to be accomplished within a designated time frame. The goal may be performance-related, developmental, a special project, or some combination [Sheid 2011].
– **S-criteria** evaluate who, what, when, where, why and how provides a project.
– **M-criteria** include a numeric or descriptive measurement of a project.
– **A-criteria** consider the resources needed and set a realistic goal.
– **R-criteria** ensure the goal is consistent with the mission of a project.
– **T-criteria** set a realistic deadline.

The project's scope, goals and sub-goals should be clearly outlined, taking into consideration cost, time and quality factors. The project should also be within the capacity of the project team and with incentive and encouragement to push the project forward to reach a more general goal.

1.2. The ANP Sub-criteria Level

Many meanings of the S, M, A, R, T letters are known from the literature. For example, A-criteria should be divided into Actionable, Attainable, Ambitious, Aspirational, Accepted/Acceptable, Aligned, Accountable, Agreed, Adapted, As-if-now, Adjustable, Adaptable etc. [RapidBI 2011].

For the ANP process analysis we have decided to use the following sub-criteria. We don't aspire to actual project evaluation, our aim is to propose a methodology of using the ANP process in this type of problems. Any other sub-criteria can be set or applied.

– **Specific** − What exactly are we going to do, with or for whom? "Specific" in the context of developing objectives refers to an observable action, behaviour or achievement.
– **Significant** − Significant goals are the ones that will make a positive difference in reality.
– **Measurable** − A method or procedure allowing the tracking and recording the project behaviour or progress must exist.
– **Meaningful** – Realization of a project must have a meaning. The goal must be very important.
– **Manageable** – The project must be easy to manage!
– **Achievable** – It must be possible for the project to be done in the timeframe/in this political climate/with this amount of money.
– **Action Oriented** – The plan of "attack" to make each goal real.
– **Relevant** – The project goal being set with an individual is something that can impact, change or be important to the organization
– **Realistic** – It must be an objective toward which you are both willing and able to work.
– **Resourced** – The goal or target being set is something that must have relevant resources allocated to be satisfied.
– **Time Based** – Every project task must have clearly stated a finish and/or a start date.
– **Trackable** – All goals should be trackable so you can see what your progress is. In terms of Project Management, you are tracking progress of project tasks in time, earned value, work etc.

1.3. The ANP Alternatives Level

As the alternatives level the actual projects or project proposals are set. Criteria and sub-criteria weights differ from project to project, according to the different project types and scopes. But these differences are not very distinguished; every project must be built according to similar rules and principles. Until now this part of the ANP process has not been included in our approach.

2. Network Model for Criteria and Sub-criteria Weights

As a tool for setting a dependency network among criteria and sub--criteria, SuperDecisions® software has been used. One hierarchic level underneath the goal node, SMART criteria level as a unique cluster (there are no dependencies – relations among them) starts the Analytic Network Model. Weights of criteria were set identically to 0,2.

The next level, consisting of subcriteria divided into clusters, is a crucial element of the process evaluating importance of each of them within the ANP process. These relations have been set according to the authors' experiences with managing various types of projects. Very often the project managers correlate the time frame of a project and its specificity (originality). The more specific the project, the more time it needs, and the less trackable it is. The most crucial are relations within the clusters A and R. Sometimes, the achievement of certain project goals excludes the achievement of others, while the achievement of one goal accelerates the achievement of another one. Also, a relevant goal must be realistic to achieve. Similar relationships have been observed within and among other clusters (Figure 1). These current weights are based on expert evaluation and calculated using Saaty's pairwise comparisons matrix – as integral part of SuperDecision® Software.
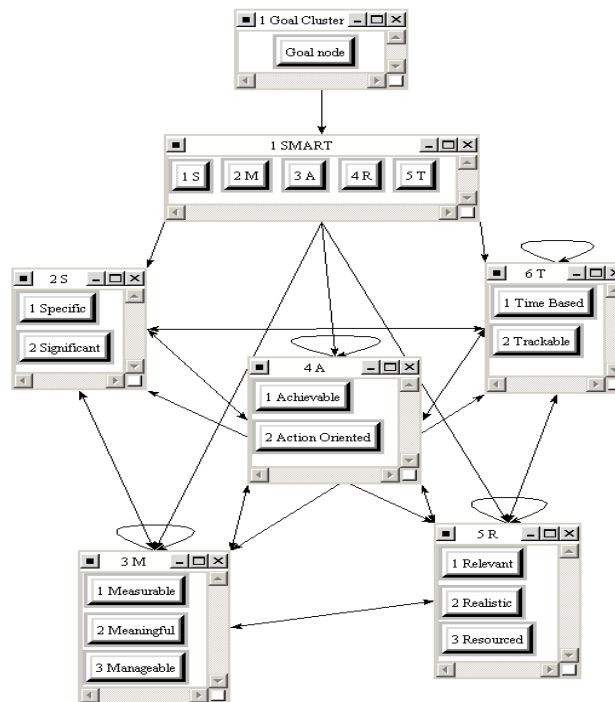
Figure 1. SMART Project Criteria Network (SuperDecisions Software)

2.1. The ANP Model Results

The first ANP result, un-weighted super-matrix for equal criteria weights, gives a good idea about clusters, established connections and their evaluation by weights.

| | 1 Goal Cluster | 1 SMART | | | | |
	Goal node	1 S	2 M	3 A	4 R	5 T
Goal node	0	0	0	0	0	0
1 S	0,2	0	0	0	0	0
2 M	0,2	0	0	0	0	0
3,A	0,2	0	0	0	0	0
4 R	0,2	0	0	0	0	0
5 T	0,2	0	0	0	0	0
1 Specific	0	0,6	0	0	0	0
2 Significant	0	0,4	0	0	0	0
1 Measurable	0	0	0,4	0	0	0
2 Meaningful	0	0	0,3	0	0	0
3 Manageable	0	0	0,3	0	0	0
1 Achievable	0	0	0	0,6	0	0
2 Action Oriented	0	0	0	0,4	0	0
1 Relevant	0	0	0	0	0,3	0
2 Realistic	0	0	0	0	0,4	0
3 Resourced	0	0	0	0	0,3	0
1 Time Based	0	0	0	0	0	0,6
2 Trackable	0	0	0	0	0	0,4

Figure 2. First part of un-weighted matrix – Goal node and criteria

	2 S		3 M			4 A		5 R			6 T	
	1 Specific	2 Significant	1 Measurable	2 Meaningful	3 Manageable	1 Achievable	2 Action Oriented	1 Relevant	2 Realistic	3 Resourced	1 Time Based	2 Trackable
Goal node	0	0	0	0	0	0	0	0	0	0	0	0
1 S	0	0	0	0	0	0	0	0	0	0	0	0
2 M	0	0	0	0	0	0	0	0	0	0	0	0
3,A	0	0	0	0	0	0	0	0	0	0	0	0
4 R	0	0	0	0	0	0	0	0	0	0	0	0
5 T	0	0	0	0	0	0	0	0	0	0	0	0
1 Specific	0	0	0	0,7	0	1	1	0,5	0,7	1	1	1
2 Significant	0	0	0	0,3	0	0	0	0,5	0,3	0	0	0
1 Measurable	0,7	0	0	0	1	0,6	0	0,4	0	0	0,8	0,7
2 Meaningful	0	1	0	0	0	0	0	0,6	0,8	0	0	0
3 Manageable	0,3	0	0	0	0	0,4	0	0	0,2	1	0,2	0,3
1 Achievable	0,6	0,7	0	1	0,8	0	1	1	0,8	0	0	0
2 Action Oriented	0,4	0,3	1	0	0,2	0	0	0	0,2	1	1	1
1 Relevant	0,3	0,4	0	0,4	0	0,25	0	0	0	0	0	0
2 Realistic	0,5	0,5	0	0,4	0	0,5	0	0,7	0	0	1	0
3 Resourced	0,2	0,1	1	0,2	1	0,25	0	0,3	1	0	0	1
1 Time Based	0,6	1	0	1	0,5	0,4	0,4	0	0	0,3	0	1
2 Trackable	0,4	0	1	0	0,5	0,6	0,6	0	0	0,7	1	0

Figure 3. Second part of un-weighted matrix – Sub-criteria

Next, the ANP results and the limit matrix are used to calculate the final weights. The limit calculation gives the following weights for SMART sub-criteria (Figure 4). As supposed, the most important sub-criteria are those, usually mentioned first within S, M, A, R, T – Specific, Measurable, Action Oriented, Resourced and Trackable.

Subcriteria	Weight
1 Specific	0,159
2 Significant	0,008
1 Measurable	0,096
2 Meaningful	0,017
3 Manageable	0,064
1 Achievable	0,102
2 Action Oriented	0,129
1 Relevant	0,021
2 Realistic	0,059
3 Resourced	0,107
1 Time Based	0,101
2 Trackable	0,136

Figure 4. Sub-criteria limit weights

Figure 5 shows the sub-criteria weights in graphical form. We tried to calculate some typical cases based on different input assumptions but these criteria weight values remained very similar or the same. It is surprising that the "Significant" sub-criteria have the lowest limit weight. Analyzing this situation we have discovered that sometimes project managers do not

understand what the expressions "Significant project, significant goal" mean. Often, they assume that every project is significant and therefore they have unrealistic expectations with regard to the values of this sub-criteria weight.
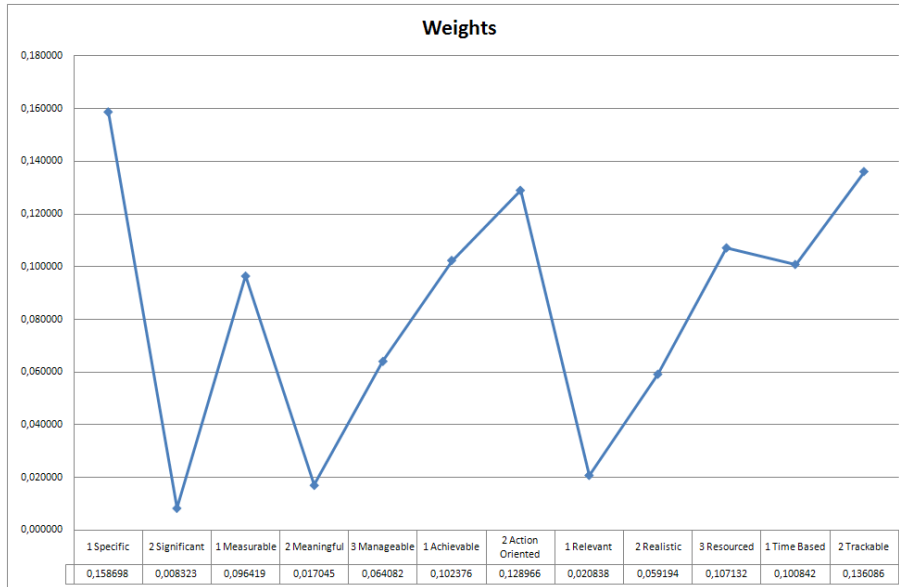
Weights

	1 Specific	2 Significant	1 Measurable	2 Meaningful	3 Manageable	1 Achievable	2 Action Oriented	1 Relevant	2 Realistic	3 Resourced	1 Time Based	2 Trackable
	0,158698	0,008323	0,096419	0,017045	0,064082	0,102376	0,128966	0,020838	0,059194	0,107132	0,100842	0,136086

Figure 5. Sub-criteria limit weights – chart view

Conclusions

The aim of the paper was to analyse quality and quantity of various criteria frequently used while evaluating a project within a project management process. We have chosen the SMART approach to evaluate the fulfilment of project goals.
- The methodology used seems to be useful for the analysis of various projects according to more or less differing criteria.
- The ANP method allows description and research of complex dependencies among the important project criteria from various points of view. Network dependencies are typical for this problem.
- Our future research will be focused on criteria weights and on actual project proposal assessment. These weights have to be estimated by experts' judgement, because the set of SMART criteria requires the soft system approach.

Acknowledgements

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