ALIGNMENT SOLUTIONS FOR OPERATIONAL PLANNING IN E-MANAGEMENT SYSTEM FOR AN EDUCATIONAL INSTITUTION

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Abstract

In this paper we describe alignment solutions in the operational planning process of the educational institution. Creating an effective Strategic and Operational plans is critical process of any organization, including educational institutions. During our research and development of the web-based e-Management Control and Evaluation System (e-MCES) for the University of Technology, Jamaica, we have realized that organizational structure of the educational institution is hierarchical but the structure of the Operational Plan (OP) is not. Despite of this, we have created a mechanism of obtaining an overall score of accomplishments of plans on all levels of the institution with strong hierarchy of items and without it. Methods described in this paper are quite theoretical, clearly illustrated and partially implemented in the first version of the e-MCES.

Key words: e-Management Control and Evaluation Systems, Vertical hierarchy alignment, Horizontal alignments, non-Hierarchy alignment, V-index, Strategic and Operational Planning, Taguchi approach.

1. INTRODUCTION

The ability of the successful achievement of goals and objectives of the Strategic and Operational planning is critical, from our point of view, for any educational institution. We observe that this is one of the main indicators of its success. The term “strategic planning” is meant to capture strategic (comprehensive, holistic, thoughtful or fundamental) nature of this type of planning [1]. We follow definitions given by U.S. Department of Energy [2]:

- **Strategic Planning** is a process of developing a mission and long-range objectives and determining in advance how they will be accomplished.

- **Operational Planning** is a process of setting short-range objectives and determining in advance how they will be accomplished.

Strategic and Operational Planning is a critical management process of the educational institution. An understanding of this by the senior leaders of the institution is a prerequisite for the successful achieving its targets [3].

Strategic planning is a part of a multilevel planning processes defined by the scope and duration. We propose that this process has to be based on a strong hierarchical structure of targets, objectives and goals. It means that major tasks will cascade down to a series of minor points, going to all levels below. No one target or objective can be presented in the system independently - all of them are interrelated horizontally and vertically from the bottom to the top and vice versa. In our approach we propose a numeric indicator as a key measurement of objectives/targets accomplishment for each unit or individual of the institution’s planning process [4]. We consider a holistic balance of the institution planning strategy - on the horizontal and vertical perspective. One of the advantages of this approach is **Transparency** of viewing all levels of the institution’s and staff’s achievements. Everybody must feel that he/she is a member of one crew and he/she be able to see his/her role and contribution in the common success. It is easier for employees to understand what and why some goals need to be accomplished. We are absolutely sure that if employees are part of the process, they will accept it. If they know there is no employee participation - it doesn't matter how good the plan, it will not succeed. It will be a chaos in the educational institution [5].

2. A STRUCTURE OF THE INSTITUTION OPERATIONAL PLAN

Every educational institution (University), like any other organization, exists to serve a purpose. Each part of the University (Divisions, Departments, Faculties, Schools, Units, etc.) also exists to carry out some task or mission of its own. An understanding of this unique mission by the senior management of the institution is a prerequisite for the strategic planning process to achieve its targets [5]. Each educational institution has to control their movement according to their Vision while following their Mission Fig. 1.
The Operational Plan is a dynamic document and can be updated yearly depending on real world and market demands. From our point of view, measurability is the main essential feature of well-written goals, objectives and targets; they must be quantified. In Fig. 1 an indicator $S_i$ (light circle) identifies a position of the educational institution for comparison with the target position $T_i$ (dark circle). In our research we propose an algorithm which calculates a distance (which is a real number) between the centers of the circles $S_i$ and $T_i$, and which we consider to be a measure of the success of the institution on the way to achieving its targets. At each appraisal period the position of the educational institution may be:

- **Unaccomplished:** In this case a circle $S_i$ is to the left of target $T_i$. The institution hasn’t achieved all its goals for that period (as in the Academic Years 2009, 2010, 2011, 2013 in the Fig. 2). We have $\Omega < 100$.
- **Accomplished:** In this case the circle $S_i$ perfectly matches $T_i$. The institution has achieved its goals. We have $\Omega = 100$.
- **Overfilled:** In this case the circle $S_i$ is to the right side of $T_i$. The institution has not only achieved its targets, but has exceeded the set of achievements (as in Academic Years 2012). We have $\Omega > 100$.

Actually $\Omega$ is a number. Using Fig. 1 we can see that the number $\Omega = 100$, where $i$ indicates appraisal period (2009/2010, 2010/2011, etc.), indicates the ability of the institution to achieve and execute its Strategic Plan [6]. The mechanism of obtaining $\Omega$ described in details in [5, 6].

Almost each educational institution has a hierarchical structure where every unit / individual (child element of the structure), except one, is subordinate to a single other unit/individual (parent element of the structure). From the first glance Operational Plans (OP) of the Institution and its units (Division, Faculty, Schools, Departments, etc.) have the same hierarchical structure. But it is not exactly true. Here we would like to mention, that Operational Plan of the educational institution is *almost hierarchical*. This means that some unit/individual may have not a single parent unit/individual, but two or more. For example, two different departments collaborate in one research project. For each department itself, this job can be considered as a part of their operational plan as a research project and should be reflected as one item of the plan. For the Faculty (if these two departments, for instance, belong to it) it is one research project (not two) and evaluation of its accomplishment must follow different procedure, than for items with hierarchy structure. If these departments belong to two different Faculties, there is a level above (e.g. Academic Affairs Division), which must consider this research project as a one.

The success of accomplishment of the entire Institution’s Operational Plan depends on how well this plan is presented and specified on each level of the institution’s hierarchy; highlighting what exactly must be done by each unit and individual. We think that only high level of discipline of achieving targets/objectives on all levels of the institution can provide final success of the institution. To support it the institution has to have a structural mechanism of balancing all “chains” of its hierarchical plans. Kaplan and Norton stated: “The annual planning process provides an architecture around which the alignment process can be executed” [7]. There are many general discussions around the alignment process in the Theory of Management and applied areas, but after our systematic research we have not found a precise definition, which can be used for creating quantitative computer algorithms to measure accomplishment of the OP. We are trying to fill out this gap introducing a Vertical Hierarchical, non-Hierarchical, and Horizontal alignments between elements of Institution’s Operational Plan.

### 3. VERTICAL HIERARCHICAL, NON-HIERARCHICAL, AND HORIZONTAL ALIGNMENTS

Here are several definitions of terms we use in our research:

**Definition 1:** The Object of Responsibility (OOR) is a member of the Academic/non-Academic staff or Unit (Division, Faculty, College, School, Department, etc.) of the institution, which is responsible for accomplishing some objectives/targets.

**Examples:**
- Prof: Elma White – member of academic staff of some department (OOR as a member of the Academic staff)
- School of Engineering (OOR as a Unit of the Institution)

**Definition 2:** V-index is the Total Accomplishment by the OOR/OORs its/their goals/objectives/ targets within the appraisal period.

**Definition 3:** $\Omega$ is a Total Accomplishment of the University Targets in the process of achieving their targets within Academic Year.

**Definition 4:** Vertical hierarchical alignment (VHA) – any link between nodes at the two neighbored levels (level up and level down) in the institution operational plan, which actually delegates/inherits some pieces of plan, which must be done on these levels.

**Examples:**
- Faculty of Engineering and Computing (FENC) Operational Plan describes a research activity: “Publish 10 papers in the International reviewed journals”.

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**Fig. 1:** Achieving Targets by the Educational Institution During 5 Years Strategic Planning [6]
• The Department of Computing Science (DCS), which belongs to the FENC, must publish 5 papers in the International journals. This is an example of inheritance (deriving) some items on level below from the “parent” plan.

Definition 5: non-hierarchical alignment (nHA) - any link between nodes at the two different levels or two different nodes of hierarchy in the institution operational plan, where OOR shares some items of its operational plan with other unit(s).

Examples:
• DCS participates in research with other department, even from other Faculty.
• Member of Academic Staff of one department writes a research paper in collaboration with a member of Academic staff from other department.
• “Bachelor of Science in Computing and Information Technology” (BSCIT) programme, which belongs to DCS, describes its own research activity: “Publish three papers in the International reviewed journals”. At the same time the “Bachelor of Science in Computing with Management Studies” (BSCMS) programme, which belongs to DCS as well, describes its own research activity: “Publish one papers in the International reviewed journals”. This paper must be written in cooperation with BSCIT programme.

Definition 6: Horizontal alignment – link between any pieces of OOR’s plan on one level. It may be a parts of plan of some individual or/and parts of plans of neighbored OORs.

Example:
• One person must to align his/her targets for upcoming appraisal period to achieve 100% accomplishment.

Educational institution goals do not just happen. They are orchestrated at the top of the institution and executed at the individual level. It means any institution’s goals are completed by individuals in their day-to-day efforts, which should be guided by a structure that provides clear direction and support from managers. Individual goals (targets-assignments) that are centered upon and derived from institution’s objectives and create a foundation for success. This clear linkage is also a communication tool because individuals know how what they do, fits with the work of others and that it is important since their efforts are interwoven with others in their school/department [8].

In our vision each target of Operational Plan must be comprehensive, clear, and personalized. Each target must be associated with some OOR, which assigned to accomplish it. There are no targets without strict relation to the person or Unit who/which must do it. Targets on intermediate levels (between institution targets and final executor) have their own hierarchical structure. For example, institution target “Journal publications” has subtargets on lower levels - Divisions, Faculties, Schools/Departments, and members of staff.

In the e-MCES each Institution Goal, Units’ objectives and individuals’ targets have a unique identification (ID) - \( x_i \). This is usual technique for storing information in the database. Fig. 2 presents a hypothetical structure of institution’s goals, Divisions’/Faculties’/Schools’/Programmes’ objectives, and individuals’ targets for all institution and shows a links between objectives of these authors. Suppose that three persons - Head of Academic Division (Deputy President), Dean of some Faculty, and Lecturer of the School of this Faculty are involved in common task - e.g. they are writing a scientific book. The contributions of each member of this team are as follows - Deputy President - 50%, Dean - 30%, Lecturer - 20%. The structure shown in Fig. 2 is not hierarchical, because \( x_{n+1} \) target has more than one parent objective of the institution’s goals \( \{ x_{n+1}, \ldots, x_{n+p}, \ldots, x_p \} \). Unlike these non-hierarchical relations, we have hierarchical relations. For example \( x_{n+1} \) element of the Programme Operational Plan (Level 6) must be done by some member of staff (Level 7) which is described by set of targets \( \{ x_{n+1}, \ldots, x_{n+p}, \ldots, x_p \} \).

Let us consider the hypothetical structure, presented above, from different points of view.

1. The target \( x_{n+1} \) for lecturer (coauthor of the book) is a part of his individual OP for the year and it is included to OPs of the Programme, School he/she belongs to. In these plans this item is presented as an item of “writing one scientific book”.

2. The same book on the Faculty level must be consider as one, not two books, despite the fact that the Dean of this Faculty is a next coauthor of the book.

3. From Deputy President point of view there is still one book, not three, even the fact, that the Deputy President is the third coauthor.

How to deal with this non-hierarchical structure of the Operational Plan? Below is our solution.
4. IMPLEMENTATION OF THE VERTICAL HIERARCHICAL, NON-HIERARCHICAL, AND HORIZONTAL ALIGNMENTS

Figure 3 presents a transformation of the institution’s hypothetical Operational Plan structure into the table of the relational database.

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
<th>Level 6</th>
<th>Level 7</th>
</tr>
</thead>
<tbody>
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<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>ID_1</td>
<td>x_1</td>
<td>x_1+x_2</td>
<td>x_1+x_2</td>
<td>x_1+x_2</td>
<td>x_1+x_2</td>
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<td>x_3+x_2</td>
<td>x_3+x_2</td>
</tr>
<tr>
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<td>x_5</td>
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<td>x_5+x_2</td>
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<td>x_5+x_2</td>
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<td>0</td>
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Fig. 3: Items of the Institution’s Hypothetical Operational Plan Structure into the Table of the Relational Database

It shows two types of subordinates relations of the OP’s items:

- **Trivial Subordinate Relations (TSR)**, where items on below level have only one parent item from the level above, e.g., - ID_1, ID_2, and ID_3 rows. Elements (items of the individual plan) on 7th level belong to one element \( x_{n+1} \).

- **Non-Trivial Subordinate Relations (nTSR)**, where one item has more than one parent item from the levels above, e.g., - ID_4, ID_5, and ID_6 rows.

**Note:** For further discussion we will not differentiate a term alignment and term relations. An alignment is more management term, but relation is a technical term, which fits better when we describe technical solutions.

An expression \( \{W_{n,o}, R_{n,o}\} \) presents a pair of two numerical values, where: \( W_{n,o} \) - weight (in %) of the \( x_{n+1} \) element on individual level (7) of the \( x_{n+1} \) Programme objective (Level 6); and \( R_{n,o} \) - a real accomplishment of the target (may be 0 - if this item not done at all, between 0 and 100, if it has not been done completely, or 100, if it has been done completely). Pairs \( \{W_{n,o}, R_{n,o}\} \) and others on the figure have the same meaning. First three pairs in Fig. 3 present a Trivial Subordinate Relations. In terms of Theory of Strategic Management these are vertical alignments of the targets.

For the Programme item \( x_{n+1} \) (see Fig. 2) we can calculate its accomplishment using a \( V \)-index, which is equal to \( \sum_{i=1}^{n} (W_{n,i} \times R_{n,i}) \). Details of this technique are described in [9].

In lights of this information let us look deeply into different points of view on the \( nTSR \), which describes a target \( x_{n+1} \) - “Writing a scientific book” by three authors:

1. **Lecturer point of view**: His/her contribution within this job is 20%. Within his/her individual plans — this value lesser than 100, because he/she must do another job during the year. For Programme’s OP it has value, within a Programme.

2. **Dean’s point of view (from the Faculty OP)**: Dean’s contribution within a team of authors (three persons) of writing the book is 30%. It is easy to see that from the Faculty point of view (without Deputy President) this weight is different, because on Faculty level there are just two coauthors - Dean and lecturer. New weights for these two coauthors are:

\[
\bar{W}_{n+1} = \frac{1}{2} \times \left( \frac{100}{100} \times W_{n+1} \right) = 60
\]

for the Dean, and

\[
\bar{W}_{n+1} = \frac{1}{2} \times \left( \frac{100}{100} \times W_{n+1} \right) = 40
\]

for the lecturer.

3. **Deputy President’s point of view**. This is a trivial situation, because all others coauthors belong to Division of Academic Affairs, heading by Deputy President. All weights are as was described above - Deputy President - 50%, Dean - 30%, and Lecturer - 20.

In this section we have described alignments process in the operational plan based on examples, where we have not considered a nature of elements of plans. Next section describes an approach, when parent objective has different types of child targets. During our research of this problem, we have realized that well known scientific “Taguchi Method” for Experimental Design [10] is very appreciate to solve the problem [9].

5. SOLUTION FOR MULTIPLE CRITERIA OF DIFFERENT OBJECTIVES AND CASE STUDY

A Taguchi approach is a statistical tool in nature and is based on the systematic approach of Design of Experiments (DOE), conducting optimal number of experiments, which are characterized by a number of different types of parameters-factors (in our case – objectives/targets), using a mathematical instrument called set of orthogonal arrays. In terms of this method, we can consider the “accomplishment of the plan” for some OOR as an experiment. This Plan can be accomplished with different results of success—in this case we have
different results of experiments. The problem is - “how to evaluate the success of that accomplishment”, and “how to combine multiple criteria of different objectives (parameters) of evaluations into a single number”. We will examine how to measure accomplishment of some objective, which consists of multiple targets and express the overall value of it in terms of a single number. Hereinafter in this section under Objective for accomplishment we consider a set of different types of targets. We say that the sense of desirability associated with evaluations and measured values, in addition to the units of measure - we call it the quality characteristic (QC) [11]. This sense is a direction in which the result is expected to go. We have three types of QC:

1. **Bigger is Better** (QC = B). In this type of measurement, the larger magnitude of evaluation will preferred over small ones. An example:- External reviewer of new module (course) for students has to have it in scale 0 - 10 (0 - unsatisfactory, 10 - is outstanding). Actually, in example, presented below, his has assigned the rate = 7 for this course.

2. **Smaller is Better** (QC = S). Here the smaller magnitude of the results always preferred over the others. The theoretical target is zero. The example:- The Quality Assurance Tester must run an application 100 times, and if it has not failed during this time - the quality is good. But, in example, presented below, it failed 5 times of 100.

3. **Nominal is Best** (QC = N). In this type of measurement, affixed value is always desired. Generally, plus or minus deviation are treated equally by considering the magnitudes only. The example:- The software must be installed on 20 computers in computer lab. But it has been installed only on 15, which is not what supervisor desired.

Suppose we have one Objective from the Operational Plan of Department of Computer Science (DCS) - “Develop a new 4 credits module for students, which includes a development lecture notes, giving examples of solutions (develop Applications for these lectures, test them and install on 20 machines of computer lab)”. It is obvious that at least three experts from different units are involved - one from Academic staff (development of the lecture notes and living examples), second one - from Technical Assurance unit (testing applications), and third one - is from Technical Support unit, who is charged to install this software. Here we have three targets, with weighting within an Objective. Each target has a different QC, and different measurement scales. It means that total accomplishment of Objective is an overall evaluation criterion. In our particular case, each target of the Objective has specific information and is described by Table 1:

Here we have a situation where targets of Objectives are different by nature and directions in which the result is expected. The Head of DCS can use a Taguchi’s Overall Evaluation Criterion (OEC) to obtain an accomplishment of this Objective, which is comprised hierarchically to the units below, and at the same time joins different targets from different units as a one Objective. According Taguchi approach [10, 11], the expression for a formula calculating an OEC for the Objective is

\[
OEC = \frac{RO_i - W_1}{B_i - W_1} \times WT_1 + \left(1 - \frac{RO_i - B_i}{W_2 - B_2}\right) \times WT_2 + \left[1 - \frac{B_3 - RO_i}{W_3 - B_3}\right] \times WT_3
\]

After replacement of variables by their actual values, we have

\[
OEC = \frac{7 - 0}{10 - 0} \times 65 + \frac{1 - \frac{5 - 0}{100 - 0}}{25} + \frac{1 - \frac{20 - 15}{20 - 0}}{10} \times 0.7 \times 65 + 0.95 \times 25 + 0.75 \times 10 = 76.75
\]

Here we have a value for the accomplishment of the Objective with three different by nature targets and different criteria of evaluation each of them. This value is equal to 76.75.

### 6. CONCLUSION

Methods of the Strategic and Operational planning management should be based on clear understanding of criteria of its measurements. In computerized management systems, like e-MCES, which we have developed for the University of Technology, Jamaica, this is critical. But our approach and practical solutions of the building online e-Management and Control System, has not only practical effect. Rather, it delivers precise definitions of cascading and alignment process of managing of plans’ elements of...
any organization, which widely generally discussed within Management Society. We have found and defined relations between elements of Operational Plans and described procedure of calculating a value of accomplishment of some parts of the Plans and overall Plan’s success itself. These procedures are not limited by elements with the same type. We have shown how to get an overall score a $V$-index of accomplishment using a real number. We suppose that these solutions, approaches, and examples, which presented and described in this paper can be useful for researchers and practitioners, who are involved in processes of development and building management evaluation systems for educational institutions.

REFERENCES


