Prioritization of BSC Strategic Goals of Higher Education Institutions Using the AHP, ANP and PageRank Centrality

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Abstract

Strategic planning using the balanced scorecard (BSC) is a standard activity in many higher education institutions (HEIs). In BSC, goals are deployed into BSC perspectives. In non-profit HEIs, those perspectives are (from bottom to top): the finance perspective, the learning and growth perspective, the internal processes perspective, the costumer perspective, and the mission perspective. In terms of for-profit HEIs (e.g. private universities), the finance perspective is at the top of the map (rather than the mission perspective). In the current literature, we can also find totally new BSC perspectives that are adjusted to the particular HEI's needs. Nevertheless, when a HEI's administration selects a specific, strategic map design, they place strategic goals into the map and connect them with respect to the existence of the influences between goals. In theory, a goal from a particular perspective can influence any other goal from the same perspective, as well as any goal from any other perspective that is above its perspective.

Following the creation of the strategic map of goals, there is often a request to prioritize goals within the strategic map to determine the most crucial goals. In this paper, we present several possible means of prioritizing BSC goals. Three of them are the direct applications of three specific methods: the analytic hierarchy process (AHP), the analytic network process (ANP), and the PageRank centrality. Additionally, we propose the use of an integrated approach of two of them. The main disadvantage of applying the AHP is that influences between goals are generally not included in the goals' priorities calculations. The main disadvantage of the ANP is that many BSC goals will weigh 0.0, because the graph that is associated with the BSC strategic map of goals is almost always reducible. This issue can be solved through the application of the PageRank centrality. The use of this method ensures that the original BSC map will become irreducible. However, applying the ANP or PageRank only considers the influences between goals in a BSC map and does not take the importance of each goal to the HEI into consideration. To ensure that both goals are achieved, we proposed and applied an integrated approach that combines the AHP with PageRank centrality.

In this paper, all the aforementioned concepts are applied and demonstrated in the case of the BSC strategic map of goals for the Faculty of Organization and Informatics at the University of Zagreb and can be applied to other HEIs' strategic maps of goals.

Keywords: *analytic network process, ANP, analytic hierarchy process, AHP, PageRank centrality, balanced scorecard, BSC*

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Introduction

- Project: Development of a methodological framework for strategic decision making in higher education
  - Croatian Science Foundation
  - Project Leader: prof. Blazenka Divjak, PhD
- Strategic planning is *usual* activity in HEIs
- There are many approaches that can be used related to strategic planning
- Balanced ScoreCard (BSC) is one of them (one of the most used)
- BSC decomposes strategic goals to operative and tactical goals
  - They are not equally important
  - Prioritization (and ranking) of goals is related to MCDM
- Analysis of applying AHP, ANP and PageRank centrality for prioritization of goals from BSC strategic map
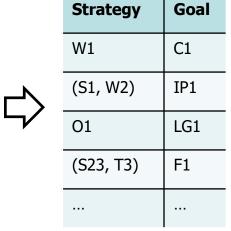
Strategic planning by BSC
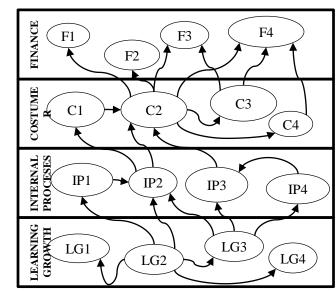
- Identifying the vision, mission and strategic goals
- SWOT analysis of each strategic goal
- Creating the strategies (corrective, defensive, offensive)
- For each strategy – (operative/tactical) goal has to be defined
- Goal has to be logically joined to the perspective (4 or 5)
- Influences between the goals have to be defined

SG1

S1 S2 S3	W1 W2
O1 O2	T1 T2 T3

Strategy	Goal
W1	C1
(S1, W2)	IP1
O1	LG1
(S23, T3)	F1
...	...
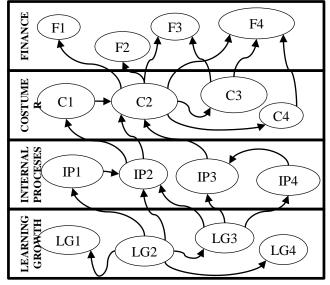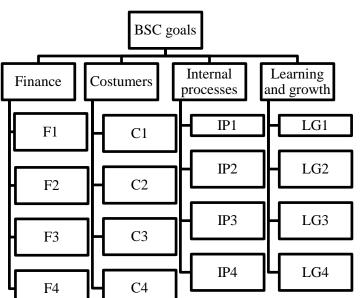
The AHP prioritisation
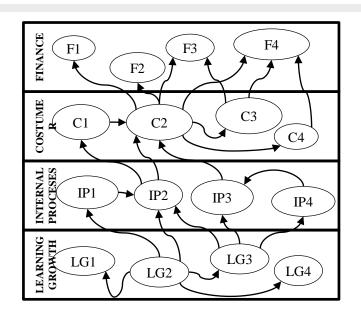
- Transform the BSC strategic map of goals to a hierarchy
- Pairwise comparisons of the goals in each perspective (Saaty scale)
- Comparisons of perspectives
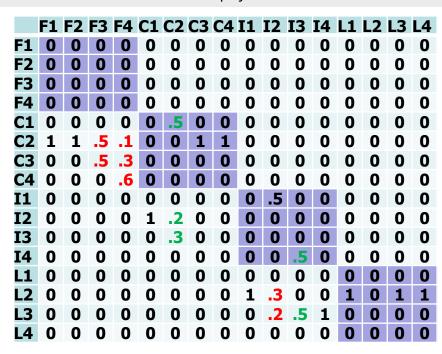
	F	C	IP	LG
F	1			
C		1		
IP			1	
LG				1

- Aggregating the results
- (The other possibility is to pairwise comparison of all goals at the same time (16x16 comparison matrix) – not good idea)

- **Limitation**: Influences between goals are not considered

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	F1	F2	F3	F4	C1	C2	C3	C4	I1	I2	I3	I4	L1	L2	L3	L4
F1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C1	0	0	0	0	0	.5	0	0	0	0	0	0	0	0	0	0
C2	1	1	.5	.1	0	0	1	1	0	0	0	0	0	0	0	0
C3	0	0	.5	.3	0	0	0	0	0	0	0	0	0	0	0	0
C4	0	0	0	.6	0	0	0	0	0	0	0	0	0	0	0	0
I1	0	0	0	0	0	0	0	0	0	.5	0	0	0	0	0	0
I2	0	0	0	0	1	.2	0	0	0	0	0	0	0	0	0	0
I3	0	0	0	0	0	.3	0	0	0	0	0	0	0	0	0	0
I4	0	0	0	0	0	0	0	0	0	0	.5	0	0	0	0	0
L1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L2	0	0	0	0	0	0	0	0	1	.3	0	0	1	0	1	1
L3	0	0	0	0	0	0	0	0	0	.2	.5	1	0	0	0	0
L4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1. Creating the matrix of influence
2. Pairwise-comparisons of goals from the same cluster that influence a certain goal
3. Pairwise comparisons of clusters (to achieve stochastic matrix)
4. Powering … Leeds to [0] … Some goals achieve 0.0

*1 cluster analysis is possible

Conclusions
- Influences are considered, BUT
- The matrix is reducible (ANP can't give the priorities)

- A type of eigenvalue centrality (Social Network Analysis)
- Steps:
  - Matrix of influences and normalisation to stochastic matrix (S)
  - *OR take the weighted supermatrix from ANP (S)*
  - Calculate the G=0.85·S+0.15·F
  - Powering to k

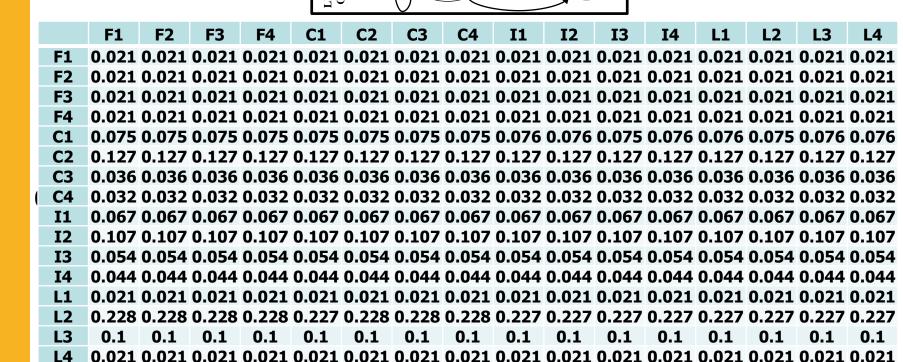|	F1	F2	F3	F4	C1	C2	C3	C4	I1	I2	I3	I4	L1	L2	L3	L4
F1	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021
F2	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021
F3	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021
F4	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021
C1	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.076	0.076	0.075	0.076	0.076	0.075	0.076	0.076
C2	0.127	0.127	0.127	0.127	0.127	0.127	0.127	0.127	0.127	0.127	0.127	0.127	0.127	0.127	0.127	0.127
C3	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036
C4	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032
I1	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067
I2	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107
I3	0.054	0.054	0.054	0.054	0.054	0.054	0.054	0.054	0.054	0.054	0.054	0.054	0.054	0.054	0.054	0.054
I4	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044
L1	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021
L2	0.228	0.228	0.228	0.228	0.227	0.228	0.228	0.228	0.227	0.227	0.227	0.227	0.227	0.227	0.227	0.227
L3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
L4	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021

- All three methods were applied in the case of the prioritization of strategic goals of Faculty of organization and informatics Varazdin
- 5 perspectives:
  - Mission (3)
  - Public responsibility (how is FOI seen by UniZG, Ministry, agencies) (4)
  - Shareholders (students, scientists, local community, public and private sector) (6)
  - Processes (Organization) (13)
  - Learning and growth (7)

- Prioritization of FOI strategic goals
  - Goals' labels – first column
  - AHP ranks – second column
  - ANP priorities – 0.00 for all goals
  - PageRank ranks – Third column

- Differences are visible (low Spearman rank correlation)

- Even though, the PageRank centrality takes into account the influences between the goals, it does not consider the goals' strengths with respect to the general strategic goal
  - Future research: prioritization that includes both, goals importance (strengths) and influences between goals … WINGS

M1	1	30
M2	6	30
M3	8	30
J1	19	26
J2	2	17
J3	3	28
J4	12	27
D1	24	23
D2	5	29
D3	16	21
D4	22	25
D5	4	15
D6	15	16
P01	9	7
P02	11	5
P03	33	18
P04	18	10
P05	17	13
P06	26	14
P07	25	20
P08	30	19
P09	31	24
P10	32	9
P11	27	6
P12	29	22
P13	28	30
U01	7	12
U02	10	1
U03	23	3
U04	21	8
U05	14	2
U07	13	11
U08	20	4

Thank you for your attention

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