AHP IN PERSONNEL MANAGEMENT: CAN THE KEY COMPETENCIES CHANGE WITH COMPANY'S STRATEGY?

Katerina Kashi
VSB - Technical University of Ostrava
Department of Management
Ph.D. student
katerina.kashi@vsb.cz

ABSTRACT

Many companies today use competency models in human resources management. Well-designed competency models can be used by the company in many ways. They can aid human resource management in the following ways: recruitment, performance management, training and development, recognition and awards, compensation and succession planning. The main aim of this article is to determine key competencies for a top manager in a middle size automotive company. Firstly, the paper begins with a description of competency models and their development and utilization. Next, the competencies are decomposed so that AHP can be used for their evaluation, and weights are computed according to AHP methodology for individual competencies. Then, individual competencies are ranked in order of importance. Further, the author compared the current key competencies rankings with results from last year to see if there have been any changes in the rankings as a result of changes in the company's strategy.

Keywords: AHP; Analytic Hierarchy Process; competency models; key competencies

1. Introduction

In today's competitive environment companies must think about their business strategy, especially when it comes to the kind of competencies a business needs to have in order to compete in a specific environment. Competency models, which should be designed for all key positions in the company, show what competencies are necessary for an individual position. The question is what the key competencies in each position are and can they change according to a company's strategy? The objective of this article is to present a competency model where a group of competencies and individual competencies are ranked according to importance in order to determine key competencies for a top manager position. The evaluation by AHP will be executed in a middle sized automotive company and performed by five experts in the company who will decide in consensus on the competencies preferences. The results will be compared with last year's results in order to see if the company's strategy or manufacturing scope can change the ranking of key competencies. The hypothesis is that the key competencies will change slightly with the company's strategy/manufacturing scope.

2. Competency models

A competency model is a framework which lists the competencies required for effective performance in a specific job or group of jobs. A competency is a human capability which is required for effective performance. It can be comprised of personal characteristics, knowledge, skills and abilities. Personal characteristics can include: work habits, cooperation with others, manners, mental agility, proactivity etc. Knowledge is acquired through learning and experience and can be described as awareness, information or understanding about rules, principles, theories, concepts etc. Skills represent the capacity to actually perform mental or physical tasks with a specific outcome such as managing a six sigma project or leading the lean team. Ability is often a composition of several capacities which enable us to learn and perform. These are usually very difficult to develop since they have a strong component of innate capacity, e.g. the ability to think analytically is more natural for some individuals than others (Marelli, Tondora & Hoge, 2005).

Competencies have to lead to effective performance, which means that the performance of a person with a competency must be significantly better than that of a person without it. Competencies are components of a job which are reflected in behavior that is observable in a workplace (Sanghi, 2007). A well-designed competency model can be used by the company's human resources in various ways. It can serve as a base for:

- **recruitment** – measures are developed for evaluating resumes, interview guides, written or performance tests are prepared based on specific (required) competencies,
- **performance management** – guides for managers are developed to help them conduct discussions with their employees about their performance, creation of ratings to help managers in the assessment of each competency, develop such performance appraisal process and forms which incorporate the competencies,
- **succession planning** – develop instruments to assess the employees' competencies who have the potential for advancement, design tools which will help the managers to assess the critical competency gaps in the pool of succession candidates,
- **recognition and rewards** – design recognition and rewards programs which are based on employee's demonstration of highly valued competencies,
- **compensation** – design compensation program where the salary (pay) of employees is increased based on the evidence of their proficiency in selected competencies,
- **training and development** – utilize the competencies to design needed training and other learning activities, create feedback instruments to evaluate employee needs for specific competency development, develop planning guides which provide employees with specific suggestions on how to acquire or strengthen each competency, (Marelli et al., 2005).

The Analytic Hierarchy Process (AHP) can be used to be able to determine the key competencies. The AHP method is a technique which enables one to organize and analyze complex decisions. It helps the decision makers find a solution that best suits the goal and their understanding of the problem. The method provides a rational framework to structure a decision problem, to represent and quantify its elements which relate to those elements of the overall goal, and to evaluate alternative solutions. This method is suitable for competency modeling because of the possibility to decompose the goal/objective to several criteria and sub criteria (Saaty,1994; Saaty & Peniwatti, 2007). Hsiao et. al. (2011) used the Analytic Hierarchy Process to analyze selection criteria for

recruitment of five different roles in the area of information systems. Whereas Zolfani et. al. (2012) perceived selection of new employees or groups of employees as a fundamental problem in the human resources area. In this research, the AHP method was used to identify which competencies are the most important, i.e. what are the core competencies for the top manager position of a middle size manufacturing company producing automotive parts.

3. AHP method

Analytic Hierarchy Process is a framework of logic and problem solving that spans the spectrum from instant awareness to fully integrated consciousness by organizing perception, judgments and feelings into a hierarchy of forces which influence decision results. The method is based on innate human ability to utilize information and experience to estimate relative magnitudes through paired comparison. The hierarchy represents a complex problem in a multilevel structure with the first level being the goal followed by levels of factors, criteria and sub-criteria. It can decompose a complex problem in search of cause-effect explanations into steps which form a linear chain.

Users of AHP firstly decompose their decision problem into a hierarchy of more easily understood sub-problems, each of which can be analyzed independently. The elements of the hierarchy can be related to any aspect of the decision problem, can be tangible or intangible, carefully measured or just roughly estimated. Once the hierarchy is drawn, the decision makers systematically evaluate its elements by comparing them one to another two at a time, with respect to their impact on the element above in the hierarchy. The AHP then converts these evaluations into numerical values which can be processed and compared over the entire range of the initial problem. A numerical weight or priority, which is derived for each element of the hierarchy, allows often incommensurable elements to be compared to one another in a rational and consistent way. An illustration of a three level decomposition is shown in Figure 1(Saaty, 1994).

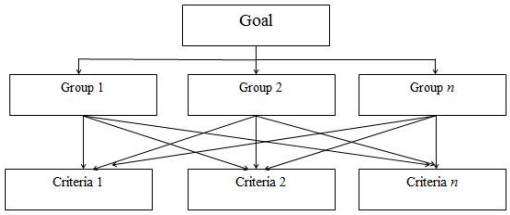

Figure 1. A three level hierarchy

Based on Zmeskal (2003; 2012), the AHP methodology has three main phases: structuring the hierarchy, executing paired comparison between the elements and decision alternatives and synthesizing the results. These priorities are unique within a positive multiplicative constant and therefore belong to an underlying ratio scale. They become unique through normalization. The resulting derived vector reflects the proportion of the decomposition of unity which each element receives.

The results of paired comparisons for n attributes is organized into reciprocal n x n matrix $\mathbf{S} = \left(s_{ij} \right)$:

$$\mathbf{S} = \begin{pmatrix} 1 & s_{12} & \dots & s_{1n} \\ 1/s_{12} & 1 & \dots & s_{2n} \\ \dots & \dots & \dots & \dots \\ 1/s_{1n} & 1/s_{2n} & \dots & 1 \end{pmatrix} \tag{1}$$

This matrix **S** contains the qualified information from an expert user about the relations between all the pairs of attributes. The element s_{ij} can be described as the importance ratio of *i*-th and *j*-th attributes. So there are two basic properties for the elements of Saaty's matrix **S**:

$$\begin{aligned} s_{ii} &= 1 \\ s_{ij} &= 1/s_{ji} \end{aligned} \quad i, j = 1, \dots, n \tag{2}$$

The importance of *i*-th attribute can be measured using the weight v_i. The sum of weights of all *n* attributes must be equal 1.

$$\sum_{i=1}^{n} v_i = 1 \quad i = 1, \dots, n \tag{3}$$

In an ideal situation the Saaty's matrix **S** is consistent and each element s_{ij} can be defined as a ratio of the corresponding weights v_i and v_j:

$$s_{ij} = \frac{v_i}{v_j} \qquad i, j = 1, \dots, n \tag{4}$$

Using the laws of linear algebra it can be shown that the vector of weights $v = (vi_i)$ is the eigenvector of Saaty's matrix **S** and belongs to its largest eigenvalue λ_{max}.

To quantify the relation between *i*-th and *j*-th attributes the Saaty's method uses the integer scale 1 to 9 for the elements of the matrix **S**, where: $s_{ij} = 1$ is used for indifference, 3 – weak preference, 5 – strong preference, 7 – very strong preference, and 9 – absolute preference. An even number of points (2, 4, 6, and 8) can be used for more precise differentiation. The impact of positive preference is expressed in the interval $s_{ij} \in (1; 9\rangle$, the scale of inverse preference belongs to an interval $s_{ij} \in \langle 1/9; 1)$, see Saaty (1994).

In real situations the Saaty's matrix **S** is not fully consistent. If inconsistency is not too large, the vector of weights **v** can be approximated by the vector **w** using nonlinear logarithmic – quadratic optimization to minimize the expression:

$$\sum_{i=1}^{n} \sum_{j=1}^{n} \left(\log s_{ij} - \log \frac{w_i}{w_j} \right)^2 \quad i, j = 1, \dots, n \tag{5}$$

It can be shown that vector **w** minimizing the expression (5) can be calculated using the weighted geometric mean of the elements of Saaty's matrix **S** rows:

$$w_i = \frac{\sqrt[n]{\prod_{j=1}^{n} s_{ij}}}{\sum_{i=1}^{n} \sqrt[n]{\prod_{j=1}^{n} s_{ij}}} \tag{6}$$

The inconsistency of Saaty's matrix **S** can be evaluated by the consistency index *CI* defined as:

$$CI = \frac{\lambda_{\max} - n}{n-1} \tag{7}$$

The more accurate indicator of inconsistency is consistency ratio *CR* defined by Saaty (1994) as:

$$CR = \frac{CI}{RI} \tag{8}$$

where *RI* is the random index (Aguarón et al., 2003; Alonso & Lamata, 2006; Franek & Kresta, 2014) which values are derived from empiric research to make the values of consistency ratio *CR* independent of Saaty's matrix **S** rank (for n=1,2 the RI is equal to 0), see Table 1.

Table 1
Random index (*RI*)

n	3	4	5	6	7	8	9	10
RI (Saaty, 1980)	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49
RI (Aguarón et al., 2003)	0.525	0.882	1.115	1.252	1.341	1.404	1.452	1.484
RI (Franek & Kresta, 2014)	0.525	0.882	1.110	1.250	1.341	1.404	1.451	1.486

The inconsistency of Saaty's matrix measured by consistency ratio CR is considered as CR $\leq$ 0,1 to be able to interpret the elements of **w** vector as the good estimation (approximation) of attributes weights. The RI used by e.g. Expert Choice software uses simple calculation of the RI_{exp} (Daniel & Oyatoye, 2011):

$$RI_{\exp} = \frac{1.99(n-2)}{n} \tag{9}$$

A measure of consistency for RGMM method of weights approximation was proposed by Aguarón & Moreno-Jimenéz (2003) calling it the GCI. From a practical point of view, the interpretation of the GCI is analogous to that proposed by Saaty for the Consistency

Ratio used with the Eigenvector Method in conventional AHP. The GCI can be calculated as follows:

$$GCI = \frac{2}{(n-1)(n-2)} \sum_{j \geq i} \left(\log(s_{ij}) - \log \frac{w_i}{w_j} \right)^2 , \tag{10}$$

where n is the number of criteria, w_i/w_j is the ratio of approximated weights. The approximated thresholds were estimated by Aguarón & Moreno-Jimenéz (2003) where: GCI_{max} for n=1,2 is 0.31; for n=3 is 0.3147; for n=4 is 0.3526 and for n>4 is 0.37.

Using the geometric mean formula (6) the local weights **w** are calculated for each matrix **S** in AHP structure (each group of criteria / sub criteria). The global weights represent a relative distribution of weights across the whole group of sub criteria. To calculate global weights the local weights for *i*-th particular sub criteria group w_i has to be multiplied by relevant *j*-th criteria local weights w_j as follows:

$$w_{ij} = w_i \cdot w_j \tag{11}$$

where w_{ij} are the particular global weights. The sum of global weights in AHP structure has to be equal to 1:

$$\sum_{i,j} w_{ij} = 1 \quad \text{for all possible combinations of } i, j \tag{12}$$

4. Utilizing AHP within competency models

Evidently there is not a single unified competency model that would work for everybody, since every company requires different competencies from its employees. The preferences in competencies could differ based on the company's business, size, people, culture etc. Pulakos (2009) has used a general competency model which does not divide individual competencies into any groups, i.e. strategic thinking, planning work, technical proficiency, critical thinking, learning and development, communicating with others, representing the organization and collaboration with others. However, we believe that a model with "general" competencies can be established. Based on the results of the author's previous research executed in 2011 where employees of one manufacturing company located in the Czech Republic were asked about their satisfaction with the performance appraisal system and the choice of evaluated competencies, the following competencies were mentioned the most often: work with information, problem solving, leadership, change management, effective communication, active listening, negotiating, team cooperation, motivating others, relevant professional knowledge, business knowledge, strategic thinking, analytical thinking, proactivity, creativity, mental agility and emotional resilience (Kashi, 2012). Table 2 shows the division of each group of competencies and their description.

Table 2
Competencies explanation

Groups	Competencies	Explanation
MAN	work with information	manager's ability to work well with new information, its organization and also the ability to convey the message to his/her subordinates
	problem solving	the ability to weight pros and cons in uncertain or ambiguous situations calling for a high level of judgment or perhaps intuition
	leadership	the skill or rather gift to lead people
	delegating	the skill to hand over any work which can be done by others. This can be used as highly motivating tool for empowering employees
	change management	the manager's ability to deal with change, implement and execute any changes in company, i.e. within company's restructuring or product change
INT	effective communication	good communication skills
	negotiating	how well can the manager negotiate i.e. with his/her suppliers, employees, co-workers etc.
	active listening	the ability to listen to his/her subordinates' needs, ideas without immediate refusal
	team cooperation	how well does the manager cooperate with other team members, is he/she supportive and helpful
	motivating others	very important skill of a top manager, the ability to motivate his/her subordinates for their best possible performance
TECH	relevant professional knowledge	top manager's specific knowledge i.e. HR manager's knowledge of the legislation and labor code, quality manager – the knowledge of ISO norms etc.
	business knowledge	thorough understanding of general business functions and specific areas of knowledge
	strategic thinking	ability to come up with alternative viable strategies or business models that deliver customer value. It is a management competency required to carry-out strategy.
	analytical thinking	the ability to use logical and optimization techniques to make decisions
PER	proactivity	manager's ability to respond quickly but within the company long term goals. This competence also includes abilities such as dedication, commitment and responsibility
	creativity	ability to come up with original solutions or ideas
	mental agility	ability to grasp problems quickly, to understand whole situation in a timely manner
	emotional resilience	manager's ability to deal with stressful situations, i.e. working under stress, meeting deadlines etc.

Source: Sanghi (2007), modified by authors

For our model we began with the competencies from Table 2 from which we selected the ones that were chosen most often by the employees as the most important competencies.

Then, based on consultation with experts (company's HR managers) these competencies were divided into the four following groups (criteria): managerial competencies, interpersonal competencies, technical competencies and personal qualities. Each group was then divided into several (4 or 5) sub-criteria, which belong into the particular group. We used this division because the individual competencies, in our opinion, belong into these groups.

Proposal of the decomposition of competencies for the utilization of AHP is shown in Figure 2.

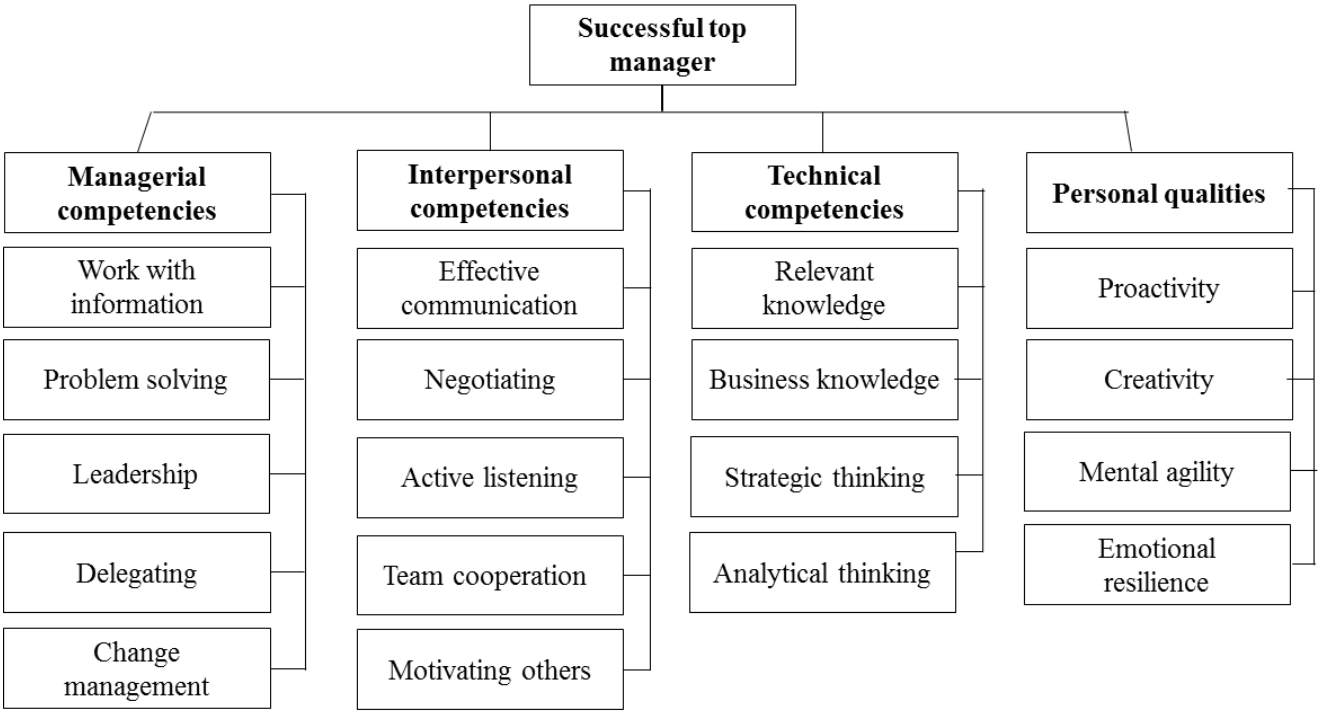

Figure 2. The decomposition of competencies for the utilization of AHP

To be able to identify key competencies, one position (the top manager) was chosen for this illustration. The evaluation was executed via interview and the company's experts i.e. company's HR manager, financial manager, production manager, quality manager and CEO decided the preferences for each pair. The experts assessed the criteria based on the following information. The assessors (the five experts) assigned the following values if the row was preferred before a column: A – the elements are indifferent, B – there is a slight preference, C – there is a strong preference, D – there is a very strong preference, E – there is an absolute preference. If the column was preferred before a row the reciprocal values were assigned, e.g. 1/A, 1/B, 1/C, 1/D, 1/E. The letter evaluation was intentionally proposed by the authors to eliminate the problem of assigning an average number to all comparisons. An example is shown for the first level of the decomposition in the following Table 3.

Table 3
Pair-wise comparison table - example for competencies groups for year 2013

Objective	Managerial	Interpersonal	Technical	Personal
Managerial	A	B	B	C
Interpersonal	1/B	A	1/C	B
Technical			A	C
Personal				A

5. Results

The evaluation of the criteria and sub-criteria was done by five experts in the manufacturing company in order to find out if the competencies had changed with the change of a strategy/manufacturing program. The company's strategy is very general and concentrated on developing customized products that serve their diverse customers and add shareholder value. The matrices were completed based on the expert's decisions. The experts had to decide in consensus on all pair-wise comparisons. The results for individual matrices for each competency are described and evaluated below. Firstly, experts evaluated groups of competencies based on pair-wise comparison. Then, the weights for individual groups of competencies were calculated based on the formulas (see Equation 6). Tables 4 and 5 show the pairwise comparisons that were made for the competency groups in 2013 and 2014. These illustrate the changes in thinking of the decision makers in the company, and show how they have changed their preferences resulting in changes in the weights/priorities (see Table 6 for comparison).

Table 4
Pair-wise comparisons, weights and consistency for groups of competencies for 2013

Competencies	Managerial	Interpersonal	Technical	Personal	Weights (w_i)
Managerial	1	3	1/3	5	0,263
Interpersonal	1/3	1	1/5	3	0,118
Technical	3	5	1	7	0,564
Personal	1/5	1/3	1/7	1	0,055
λ_{max}	4,135	*CI*	0,135		
RI	0,882	*CR*	0,153		
N	4	*CR* (RI_{exp})	0,135		
RI_{exp}	0,995	*GCI*	0,154		

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Table 5
Pair-wise comparisons, weights and consistency for groups of competencies for 2014

Competencies	Managerial	Interpersonal	Technical	Personal	Weights (w_i)
Managerial	1	5	2	7	0,498
Interpersonal	1/5	1	1/5	3	0,101
Technical	1/2	5	1	7	0,352
Personal	1/7	1/3	1/7	1	0,049
λ_{max}	4,142	*CI*	0,142		
RI	0,882	*CR*	0,161		
N	4	*CR (RI$_{exp}$)*	0,142		
RI$_{exp}$	0,995	*GCI*	0,177		

Next the consistency ratio was calculated (see Equation 8) using RI estimated by Franek & Kresta (2014), and RI_{exp} calculated from Equation 9. The GCI measure was calculated using Equation 10. GCI and the consistency ratio were within limits in all comparison matrices. The resulting priorities of competency groups for the company for 2013 and 2014 are shown in Table 6. The ranking of individual competencies for both years are shown in Table 7.

Table 6
Global weights for groups of competencies for 2013 and 2014

Competencies Groups	2013	2014
Managerial	26,34%	49,75%
Interpersonal	11,78%	10,12%
Technical	56,38%	35,18%
Personal	5,50%	4,94%

From the aforementioned table, it is evident that the ranking for the groups of competencies has changed. In 2013 the company's experts preferred technical competencies the most, whereas in 2014 they preferred managerial competencies. In 2013 managerial competencies were the second most preferred while in 2014 the technical ones were the second most preferred. Also in 2013, personal competencies were more important than interpersonal ones; however in 2014 these ranked in the opposite order.

Table 7
Ranking of competencies determined for top manager position

	Global weights of competencies for top manager			
Ranking	***2013***		***2014***	
1	Strategic thinking	25,11%	Strategic thinking	15,67%
2	Business knowledge	17,54%	Leadership ↑	15,17%
3	Professional knowledge	8,91%	Change management ↑	14,18%
4	Change management	8,12%	Business knowledge ↓	10,94%
5	Leadership	6,09%	Problem solving ↑	9,14%
6	Delegating	6,09%	Delegating	9,14%
7	Problem solving	4,89%	Professional knowledge ↓	5,56%
8	Analytic thinking	4,82%	Negotiating ↑	3,43%
9	Negotiating	3,99%	Analytic thinking ↓	3,01%
10	Effective communication	3,21%	Effective communication	2,75%
11	Proactivity	2,23%	Work with information ↑	2,13%
12	Active listening	2,07%	Proactivity ↓	2,01%
13	Mental agility	1,97%	Active listening ↓	1,78%
14	Motivating others	1,66%	Mental agility ↓	1,77%
15	Work with info	1,14%	Motivating others ↓	1,43%
16	Stress resilience	0,86%	Stress resilience	0,77%
17	Team cooperation	0,86%	Team cooperation	0,74%
18	Creativity	0,44%	Creativity	0,39%

From Table 7 it is evident that the core competencies (top ten) for a top manager have changed significantly. In 2013 the top ten competencies included strategic thinking with 25.11%, followed by business knowledge with 17.54%, professional knowledge with 8.91%, change management with 8.12%, followed by leadership and delegating with 6.09%, problem solving with 4.89%, analytic thinking with 4.82%, negotiating with 3.99% and effective communication with 3.21%. In 2014, the top ten competencies included strategic thinking with 15.67%, followed by leadership with 15.17%, change management with 14.18%, business knowledge with 10.94%, followed by problem solving and delegating with 9.14%, professional knowledge with 5.56%, negotiating with 3.43%, analytic thinking with 3.01% and effective communication with 2.75%. All changes in the ranking are shown by arrows.

These major differences can be attributed to a change of the top manager's position in the company. In 2013, before all the changes, the company was working in a routine and basically under the parent company's management. This meant that the top managers concentrated mostly on strategic thinking and business and professional knowledge were the most important for them. However, then the SBU of the company in Scotland has gone through a major change and all the manufacturing lines were moved to the SBU in the Czech Republic. When several new manufacturing lines came in and about 50 new operators were hired, the core (and mostly preferred and required) competencies changed. Although strategic thinking remains in first place, it has much less weight; leadership has moved from the fifth place to the second place with a much higher weight. The same has happened with the change management which is now in the third place with a weight of 14.18%, followed by business knowledge where the weight has decreased, and problem solving where the ranking has changed from seventh place to fifth place. Now, the top managers must not only fulfill the parent company's strategy and plan, but they must also lead their subordinates to achieve the new goals and objectives.

6. Conclusions

The key competencies for a top manager in an automotive company have changed in the period of one year. Although the company's vision and mission has not changed at all, the manufacturing program has changed significantly. The company's key top manager's competencies at the beginning of 2013 were different than at the beginning of 2014. The reason is that the company's strategy has changed. In 2013 the company was manufacturing the usual products, however at the end of 2013 many new lines were moved to the plant from another one. Therefore, the managerial competencies in 2014 are different because the managers now have to concentrate much more on leadership and change management instead of on just operational management. The conclusion of this research is that the core competencies should be adjusted if the company's manufacturing program or the strategy significantly changes. Although this study was limited to a particular company, the authors believe that it can bring some innovation into any company's management. However, the author's intent is not to make broad conclusions for the whole domain of competency models but to suggest a way n which HR analysts can apply the AHP approach to their work process. Further research will be focused on different types of firms and positions.

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