

EVALUATION OF INTER-GENERATIONAL KNOWLEDGE TRANSFER BY USING THE ANALYTIC HIERARCHY PROCESS (AHP)

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Abstract:

The purpose of this paper is to present some results of our research in the field of inter-generational learning dynamics and knowledge transfer, with applications in universities. This topic is important because a university is by its own nature a nested knowledge organization, due to a continuous flow of students and the bottom-up regeneration of the faculty staff. Knowledge creation and knowledge loss are intertwined processes, and both of them are strongly influenced by the age scale. A university is a multilayered knowledge organization, where the inner most layers are represented by older professors who concentrate the fundamental structures of knowledge, and the outer layers are represented by students in their different learning cycles. In this paper we are interested in assessing the choices done by the academic staff, in the context of the determinant criteria and trade-offs in inter-generational knowledge transfer. This has been done in the framework of Analytic Hierarchic Processes (AHP). We thought that this is a proper tool since it mainly belongs to the field of decision-making with the possibility to determine vectors of priorities for the individuals participating in the decisions under study. We considered three main criteria: attitude toward cooperation (C1), attitude toward competition (C2), and attitude toward innovation (C3). Also, we considered as being significant activities: working together in research grants (A1), writing papers for scientific journals (A2), and writing books (A3). These criteria and activities have been structured into a common framework.

Keywords: analytic hierarchy process, knowledge transfer, learning dynamics, university

JEL Classification: D83; I23; J24

1. INTRODUCTION

Universities are social institutions with long life cycle. The venerable Bologna University dates from 1088, and the famous Oxford University dates from 1187. Main activities associated with those days universities were collecting knowledge, preserving it and passing it on. Creating new knowledge was not a part of university's mission. A professor was mostly a scholar and not a researcher. Learning was a process based mostly on transferring knowledge from one generation toward the other. In 1809, Wilhelm von Humboldt established the Berlin University, based on a new paradigm. According to his vision, a university should approach knowledge scientifically. It should *produce* knowledge, not only to *re-produce* it (Harayama, 1997, p.9). Today, the research universities integrate perfectly knowledge generation with knowledge dissemination. Knowledge production and learning processes at individual and organizational levels transform the university into a *knowledge intensive organization*, which fits excellently with the new requirements of the knowledge society. Moreover, they may become *learning organizations* if double-loop learning and organizational integrators are well developed (Armstrong & Foley, 2003; Bratianu, 2007; Bratianu, 2008; Ortenblad, 2001; Stewart, 2001). Learning is a *knowledge intensive process* at both individual and organizational level. It is a strong nonlinear process that integrates several activities: perception, knowledge acquiring, dynamics of tacit and explicit knowledge, dynamics of cognitive and emotional knowledge, structuring and re-structuring through a continuous dynamics, knowledge storage, knowledge removal from the memory, and knowledge creation through a conscious effort (Bratianu, 2009; Bratianu & Orzea, 2009; Fauconnier & Turner, 2002; Pinker, 2007; Lakoff & Johnson, 1999; Nonaka & Takeuchi, 1995). Organizational inter-generational learning is a specific process for those organizations where individuals group themselves in age layers or strata. Universities are such organizations and inter-generational learning is a natural process. The purpose of this paper is to investigate the dynamics of inter-generational learning by using the mathematical model of the Analytic Hierarchy Process (AHP), in the Romanian university environment (Harker & Vargas, 1987; Liang et al., 2008; Saaty, 1994). This topic is important

because a university is by its own nature a nested knowledge organization, due to a continuous flow of students and of the bottom-up regeneration of the faculty staff. Knowledge creation and knowledge transfer are intertwined processes, and both of them are strongly influenced by the age scale. A university is a multi-layered knowledge organization, where the inner most layers are represented by older professors who concentrate the fundamental structures of knowledge, and the outer layers are represented by students in their different learning cycles.

2. INTER-GENERATIONAL KNOWLEDGE TRANSFER

The problem of inter-generational learning and transfer of knowledge is generally summed up in the framework of asymmetric information. The additions of elements from psychology into economics of information lead to the consideration of the some explicit details in this particular problem of asymmetric information. Among these, the most important seem to be the *incentive salience conflict* (conventionally, a conflict between the relative weight in utility attached to tempting versus no tempting goods), the *temporal horizon conflict* (born from the importance attached to distant events versus temporally close one) and the *asymmetric information conflict* (a conflict between the information available in different areas subsumed to the research region). The latest developments in neuro-economics conduced to models of brain as a hierarchical organization (Brocas & Carrilo , 2008) in which, in order to model temporal and informational conflicts an individual is split into an impulsive/myopic agent and a cognitive/forward looking principal. Yet, this dichotomy between impulsive (through temporal horizon conflict and asymmetric information conflict) and reflexive behavior (expressed through incentive salience conflict) a long term object of neuro-economics research (Thaler & Shafrin, 1981; Shafrin & Thaler, 1988; Lowenstein, 1996)-has been also present in the framework of organization theory as the dichotomy between relative ability and absolute ability. Effects of competition in educational institutions regarded as organizations highlighted particular adverse effects in reliance on relative abilities (also referred in this framework as relative performance) instead of absolute abilities (expressed through the measurement of performance against objective standards). Thus, it was found that (Wang & Yang, 2003) in competitive learning game, limited rewards lead to an "ability game", therefore competition among students no longer motivates increased effort. On the other hand, there is a flow of literature devoted to behavioral analysis of the impact of ageing on decision making at the level of firms challenging mostly negative stereotypes (like seniors are less flexible and willing to change, less willing to learn but more reliable and determined than juniors, with a lower adaptability to change). These generalities were splinted into attitude concerning cooperation in teams, attitudes concerning competition and attitudes toward innovation and studied through experiments in laboratories. In this line, there are results (Hamilton et al., 2003) that show that cooperation is a learned trait and that the insight developed over a more elderly person's lifetime may be particular useful in providing a good example for younger workers to emulate. In addressing the problem of ageing versus inter-generational learning in the framework of education institutions as organizations-like Academy of Economic Studies (ASE), Bucharest is-this paper is going to evaluate perceptions of the academic staff toward the attitudes of cooperation in teams, competition and innovation-dimensions that sum highly relevant for the success of modern organizations. Opinion about attitude of cooperation in team is supposed to offer a measure for the individual's intangible temporal horizon conflict, opinion about attitude on competition-in a learning environment- is offering a measure on the asymmetric information conflict of the individual, since he has to be competitive and up to date in his field, while opinion on innovation is seen as an indicator of the salience conflict. The importance of each of these attitudes is going to be evaluated under particular alternatives and also weighted from the point of view of tradeoffs allowed in some situations. Priority vectors for each of these three attitudes and alternatives will be determined for every member of the academic staff who participated in this research through the completion of a certain specially designed survey. This will show how the main actors in the inter-generational transfer of knowledge see themselves or equivalent, what are their priorities in these three main

attitudes. Inter-generational learning in universities is most intensive through the doctoral studies. The highest-quoted professors (obligatory PhD supervisors) are involved through doctoral school in transmitting the most important information to the students and also the state of art of conducting research. The decision of including a professor in this activity is looking at three professional criterions: grants, papers and books. In evaluating accomplishments with respect of these alternatives, some tradeoffs regarding different levels of quality are elaborated by the Romanian Ministry of Education and by the Universities' boards over a few sets of criteria. So, on one hand, in considering the decision to choose in between different members to teach in doctoral school programs, the Board of University is looking whether some obligatory criterions are compelled. On the other hand, a particular professor,(senior lecturer, lecturer) can choose his own level of effort in fulfilling these criterions, given the previously mentioned available tradeoffs regarding different levels of quality (these will be presented in more detail in the next section).The choice a particular professor is taking- in a complex interplay of its own interior conflicts and the exterior imposed criterions-is shaping its current teaching activities and therefore future outcomes.

3. QUALITATIVE AND QUANTITATIVE CRITERIA

In order to provide the reader with some background concerning the particular determinants for attitudes toward cooperation, competition and innovation in a Romanian University like ASE, in the following it will be described in short the determinants of the promotion process that is currently at place. This is strictly connected with the flow of transfer of knowledge since if one has to fulfill some criterions it is also true the backward assertion, namely that the value of a person is the sum of the fulfilled criterions. And this value is very concretely expressed through its wage-a tangible, measurable variable and also through some intangible aspects, like its determinant participation in doctoral school or supervision of Master dissertations-main channels in inter-generational learning in the considered framework. Academic staff in ASE is professionally evaluated according to its participation in scientific grants, number of scientific papers and books and manuals. For being promoted to the next level (assistant, lecturer, senior lecturer, professor, and professor-PhD adviser) the cumulated scores for the previous three alternatives need to surpass some general "cutoff values" established by the Romanian Ministry of Education and Research and each University's board. For example, for someone to apply for a promotion from the position of a senior lecturer to the position of a professor, four main criterions are considered. The first one regards its teaching activities, relations with colleagues inside its Department, evaluations form the students and the number of manuals edited in its specialization. The second one is looking at research activities measured through the number of grants. A minimal number of two is required with the mention that the candidate had to be director in at least an international one. The third criterion is looking also at research activities measured through the number of scientific papers. Five to seven scientific articles are requires and out of these at least four have to be published in ISI quoted journals or indexed in reference international data bases. Also a minimal number of two books, published in selected publishing houses, is asked- and out of these the candidate has to be the first author for at least one of these. The last criterion looks at the so named "professional prestige" which subsumes any other activities like international recognition given by participation at professional associations, membership in editorial boards, distinctions and awards. Given the range of alternatives available for a university professor, its attitude toward competition can be ranked differently whether he chooses to apply for an international grant-with all the risks- or go for all the national competitions and don't bother to go internationally, or whether he is deciding to put a lot of effort into submitting a paper to an international journal instead to take the easy way to publish a larger number of papers into national B+ journals. A teacher's attitude toward innovation can be different if he chooses to spend time to develop a new theory or new empirical methods of estimations and be competitive at an international level or he decides is better from his personal point of view to add several smaller improvements in its professional career. His choices are also affecting the message transmitted mostly to its doctoral students or to the ones whose Master dissertation is supervised. After all, it

matters if a professor is sending the message "you need to be the best" –and for this, take my example-or the message: "satisfying: a pretty good heuristic" (Bendor et al., 2009). This common sense observation is supported by mathematical models of satisfying which explicitly represents agent's aspirations and which explores both single-person and multi-player context. In this context satisfying has a signature performance profile in two contexts: it can induce optimal long-run behavior in one class of problems but not in complimentary class and it generates behavior that is sensible but not optimal. In this paper we are interested in assessing the choices done by the academic staff, in the context of the above presented range of criterions and trade-offs. This had been done in the framework of AHP. We thought that this is a proper tool since it mainly belongs to the field of decision-making with the possibility to determine vectors of priorities for the individuals participating in the decisions under study and also there is the possibility to determine individual numerical scales-since verbal interpretations can differ from one person to another (Liang et al., 2008). A second reason for this approach is that the latest developments in neuro economics proved that asymmetry of information in learning can be modeled at an individual's scale also in terms of an hierarchic organization (Brocas & Carrilo , 2008) .

4. AHP FOR DETERMINING INDIVIDUALS VECTORS OF PRIORITIES

The framework constructed for analysis includes a hierarchy with the three criterions at top: attitude toward cooperation (C_1), attitude toward competition (C_2) and attitude toward innovation (C_3) and three specific alternatives located further down the hierarchy: grants (A_1), papers (A_2) and books (A_3).The bottom level of this hierarchy contains possible options according to the relative importance of the factors involved in the three previous alternatives .The analytical process includes making judgments on pairs of elements throughout the hierarchy, one level at a time beginning at the top, based on the respondent's knowledge and according to theirs perceived relative importance of the factors involved. The most heavily weighted alternative outcome in the bottom level is the most likely one. A survey designed according with these principles was electronically distributed among the academic staff in ASE. In order to understand how this was processed, a short presentation of the way in which the questions were posed in this survey and processed thereafter will follow. Numerical results and interpretations will be presented in the next section. In the following it will be presented the general form of the survey considered and one example of answer will be indicated on the right-side. In the next subsection it will be showed how the answers were processed.

In the first page were asked general information about the position of the respondent in ASE: the academic status (professor-PhD supervisor, professor, senior lecturer, lecturer, assistant or PhD student), the Department and the affiliation to a certain Faculty. The second page was devoted to the determination of the priority vectors of the three chosen criterions in determining the quality of the transfer of knowledge. This was done through the formulation of questions in comparative terms, as shown below:

1. Please, indicate on a scale from 1 to 9 (1-indifferent, 9-full agreement) to what extent you agree with the next assertion: "In the framework of inter-generational transfer of knowledge, attitude toward cooperation (C_1) is more important than attitude toward competition (C_2). "
2. Please, indicate on a scale from 1 to 9 (1-indifferent, 9-full agreement) to what extent you agree with the next assertion:" In the framework of inter-generational transfer of knowledge, attitude toward competition (C_2) is more important than attitude toward innovation (C_3)"
3. Please, indicate on a scale from 1 to 9 (1-indifferent, 9-full agreement) to what extent you agree with the next assertion:" In the framework of inter-generational transfer of knowledge, attitude toward cooperation (C_1) is more important than attitude toward innovation (C_3)."

The third page was devoted to the determination of the priority vectors of the alternatives (grants, papers, books) taking into consideration the criteria in the above level of hierarchy. Questions were formulated as follows:

4. With respect to the problem of inter-generational transfer of knowledge, from the point of view of the attitude toward cooperation please indicate, on a scale from 1 to 9 (1-indifferent, 9-full agreement) to what extent you agree with the next three assertions:

4.a. Participating in research grants (A1) is more important than writing scientific papers (A2).

4.b. Writing scientific papers (A2) is more important than writing books or manuals(A3).

4.c. Participating in research grants (A1) is more important than writing books or manuals (A3).

5. With respect to the problem of inter-generational transfer of knowledge, from the point of view of the attitude toward competition please indicate, on a scale from 1 to 9 (1-indifferent, 9-full agreement) to what extent you agree with the next three assertions:

5.a. Participating in research grants (A1) is more important than writing scientific papers (A2).

5.b. Writing scientific papers (A2) is more important than writing books or manuals(A3).

5.c. Participating in research grants (A1) is more important than writing books or manuals (A3).

6. With respect to the problem of inter-generational transfer of knowledge, from the point of view of the attitude toward innovation please indicate, on a scale from 1 to 9 (1-indifferent, 9-full agreement) to what extent you agree with the next three assertions:

6.a. Participating in research grants (A1) is more important than writing scientific papers (A2).

6.b. Writing scientific papers (A2) is more important than writing books or manuals (A3).

6.c. Participating in research grants (A1) is more important than writing books or manuals (A3).

The forth and the last page was devoted to determining the priority vectors for the alternative schemes of equivalence regarding the alternatives in the above level of the hierarchy.

7. With respect to research grants, please indicate, on a scale from 1 to 9 (1-indifferent, 9-full agreement) to what extent you agree with the next assertions:

7.a. Other professional objectives are more important than participation as a director or member in CNCSIS (national) research grants.

7.b. Is more important to participate as a director or as a member on a CNCSIS (national research grant) than elaborating/or making efforts to become a member in international research grants.

7.c. Other professional objectives are more important than to participate as a director or as a member on a CNCSIS (national research grant) than elaborating/or making efforts to become a member in international research grants.

8. With respect to scientific papers, please indicate, on a scale from 1 to 9 (1-indifferent, 9-full agreement) to what extent you agree with the next assertions:

8.a It is more important to write a large number of articles publishable in national B+ journals than writing papers publishable in national ISI journals.

8.b. It is more important to write few papers publishable in national ISI journals than taking the risk of submitting a paper to an international ISI quoted journal.

8.c. It is more important to write a large number of articles publishable in national B+ journals than taking the risk of submitting a paper to an international ISI quoted journal.

The last question, question 9 asked for the number of participations in national research grants, international research grants, number of papers published in national ISI journal, number of paper published in international ISI journals with an impact coefficient less than 1 and number of papers published in international ISI journals with an impact coefficient greater than 1.

Paired comparison judgments in the AHP are applied to pairs of homogeneous elements and summarized in a matrix of judgments. Scoring is applied to rank the three alternatives in terms of each of the three criteria considered. Matrix of judgments is determined assuming values equal to one on the main diagonal and also reversibility of the preferences-so that if C_1 is preferred to C_2 at a corresponding absolute value of 5, the C_2 will be preferred to C_1 at an absolute value of $1/5$, which is 0.2. The corresponding vector of priorities is calculated in an eigenvalue formulation. The solution is obtained by raising the matrix to a sufficiently large power, then summing over the rows and normalizing to obtain the priority vector. The process is stopped when the difference between components of the priority vector obtained at the k -th power and at the $(k+1)$ power is less than some predetermined small value. The vector of priorities is the derived scale associated with the matrix of comparisons (Saaty, 1994). Finally, alternatives are scored by checking off their respective ratings under each criterion and summing these ratings for all criteria. This produces a ratio scale score for the alternative. The scores thus obtained of the alternatives can in the end be normalized by dividing each one by their sum. For the example considered in the section above, the pair wise comparison matrix is given in Table 1.

Table no. 1. The pair wise comparison matrix for criteria C_1 , C_2 , and C_3

Absolute judgments amongst criteria	C_1	C_2	C_3
C_1	1	5	6
C_2	0.2	1	8
C_3	0.16667	0.125	1

Table no. 2. Vector of priorities for the criteria pair wise comparisons

Vector of priorities	C_1	C_2	C_3
C_1	0.768293	0.768293	0.768293
C_2	0.134146	0.134146	0.134146
C_3	0.097561	0.097561	0.097561

The interpretation is that, in the view of the particular person who answered the survey, in the prevalent attitude determining inter-generational learning and knowledge transfer is cooperation, corresponding to C_1 , since it has the highest value: 0.768293. Second, it comes the necessity to be competitive, corresponding to a value of 0.134146 and the last important would be to be innovative-in the sense presented in the section above, with a value of 0.097561 in the priority vector. Similarly were determined the pair wise matrices of judgments of the three alternatives (Grants- A_1 , Papers- A_2 , Books- A_3) with respect to each of the previous three criteria together with the determined values for the priority vectors. In Table 3. is given the pair wise matrix of judgments of the three alternatives with respect to C_1 and corresponding vector of priorities.

Table no. 3. Pair wise matrix of judgments activities A_1 , A_2 , and A_3 with respect to C_1

Absolute judgments amongst alternatives A_1, A_2, A_3 with respect to Criterion 1	A_1	A_2	A_3
A_1	1	4	3
A_2	0.25	1	4
A_3	0.3333	0.25	1

Vector of Priorities	A ₁	A ₂	A ₃
A ₁	0.61898	0.61898	0.61898
A ₂	0.220113	0.220113	0.220113
A ₃	0.160907	0.160907	0.160907

5. NUMERICAL RESULTS AND CONCLUSIONS

The survey was delivered to 4 distinct Departments of ASE and the rate of response was 30%. Out of the received answers, 17.3 % were valid answers. The priority vector of the criterions considered to influence the inter-generational learning was calculated as an average on the individual vectors of priority-presented in table 1. The weight of the Alternative 1 (Grants) from the point of view of the attitude to cooperation-Criterion 1 is calculated again as the average over the individual values in the corresponding priorities vectors, as shown in table 3. Results weighted for all the respondents are summarized in Table 4. In order to establish the composite or global priorities of the alternatives considered we lay out in a matrix the local priorities of the alternatives with respect to each criterion and multiply each column of vectors by the priority of the corresponding criterion and add across each row, which results in the composite or global priority vector of the alternatives. Corresponding results are presented in Table 5. Similarly were determined vectors of priority averaged over all the respondents for the trade-off criterions with respect of grants and papers , where 1 means-other are more important, 2-is a compromise at a national level and 3 is going international with respect to the considered alternative. The results are presented in table 6.

Table no. 4. Synthesis in the Distributive Mode

Distributive Mode	C ₁	C ₂	C ₃
	0.693693	0.183968	0.124902
A ₁	0.604529	0.630678	0.638076
A ₂	0.246879	0.247676	0.236087
A ₃	0.155292	0.121646	0.128091

Table no. 5. Synthesis

Distributive Mode	C ₁	C ₂	C ₃	
A ₁	0.414859	0.136212	0.062385	0.613972
A ₂	0.169421	0.053493	0.023082	0.247196
A ₃	0.106569	0.026273	0.012523	0.143

Table no. 6. Synthesis for the trade-off criterions regarding Grants-A₁ and Papers-A₂

Distributive Mode	A ₁	A ₂
1	0.694924	0.645866
2	0.175785	0.204687
3	0.129291	0.149447

From the point of view of the inter-generational learning in the Academy of Economic Studies from Bucharest, for the academic staff, the most important appears to be cooperation-with a weight of 0.693693, and the most preferred channel for cooperation is through national research grants. By looking at the results in table 5 we see that it also appears that option 1-doing something else but grants and papers-is most preferred. So we conclude that this also checks the fact that cooperation in the sense of something else but grants and papers are preferred channels for inter-generational learning and knowledge transfer.

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