

SUPERVISOR SELECTION IN THE PH.D PROGRAM BY USING THE ANALYTICAL HIERARCHY PROCESS METHOD

Dražen Barković, Ph.D.¹ Ivana Barković Bojanić, Ph.D.²

¹Professor Emeritus, Josip Juraj Strossmayer University of Osijek, Faculty of Economics,
Republic of Croatia, barkovic@efos.hr

²Faculty of Law, Josip Juraj Strossmayer University of Osijek,
Republic of Croatia, ivana.barkovic@pravos.hr

Abstract

This paper focuses on the selection of supervisor for Ph.D. candidate in general, i.e. on the issue of establishing and sustaining a supervisory relationship between the professor and the Ph.D. candidate. While this relationship is essential for the success of the Ph.D. program in general and completion of dissertation in particular, there are many evidences in the practice that such a relationship may contain imbalances in the power between the professor/supervisor and the Ph.D. candidate, which may be discussed in the terms of equity and inequality. Based upon the literature review, this paper briefly presents the (in)equitable relationship between supervisor and Ph.D. candidate, demonstrates the supervisor selection issue by using the analytical hierarchy process (AHP) method and discusses about the equity theory as the guiding aid in establishing and sustaining a supervisory relationship.

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1. Introduction

Long term experience in managing postgraduate studies, especially master and doctoral programs, reveals various significant aspects of managing those studies, which are often underestimated yet they reflect themselves upon the efficiency and effectiveness of Ph.D. students/candidates¹, their professors, Ph.D. program and the university itself.

¹ There are variety of terms across universities that may be used for students beeing involved in the doctoral programm-doctoral student, Ph. D. Student or Ph. D. Candidate. Doctoral student or Ph.

The issue of establishing and sustaining supervisory relationship between the professor and the Ph.D. candidate, i.e. the selection of supervisor for Ph.D. thesis, is rather complex since it involves development of both professional and personal relationship. Even though these relationships may be rewarding for both sides, such relationships may contain imbalances in the power between the professor/supervisor and the Ph.D. candidate. These imbalances are often regarded in terms of equity and inequality.

The focus of this paper is the selection of Ph.D. thesis supervisor. The section 2 of the paper briefly discusses the complexity of supervisory relationship with the particular emphasis on the existence of inequity on either side – professor's or Ph.D. candidates. It presents the equity theory postulated by J.S. Adams (1965) which provides an insight how individuals evaluate social exchange relationships such as those between professor and Ph.D. candidate. Section 3 demonstrate the supervisor selection issue by using the analytical hierarchy process (AHP) method and discusses about the equity theory as the guiding aid in establishing and sustaining a supervisory relationship. Section 4 concludes the paper.

2. The complexity of supervisory relationship

Mentoring and supervision are important processes in educating and professionally developing the Ph.D. candidate to win the Ph.D. title. While mentors and supervisors often have overlapping roles, one cannot use these terms interchangeably without emphasizing their important distinctions. *Mentoring* is a process for the informal transmission of knowledge, social capital, and the psycho-social support perceived by the recipient as relevant to work, career, or professional development; mentoring entails informal communication, usually face-to-face and during a sustained period of time, between a person who is perceived to have greater relevant knowledge, wisdom, or experience and a person who is perceived to have less (Bozeman & Feeney, 2007). On the other hand, *supervision* in the academic contest is a process to facilitate the student becoming an independent professional researcher and scholar in their field, capable of adapting to various research arenas, whether university or industry based (Pearson & Brew, 2002).

D. Student is every student involved in the doctoral programme. The doctoral /Ph. D. Student is granted in the candidate status after competition and examination of all coursework required for the degree, except the dissertation.

As said, the focus in this paper is on the selection of supervisor and the issues embedded in his relationship to the Ph.D. candidate such as trust, equity and the like. Namely, the relationship between a Ph.D. candidate and an academic supervisor is critical to the success of the Ph.D. program in general and it is crucial for the completion of Ph.D. thesis in particular. Many scholars have been examining various issues related to establishing and sustaining an equitable supervisory relationship that leads to education and creation of science professionals (e. G. Bird, 1994, Swayze & Anderson, 1996, Bird, 2001). Yet, it has proven to be very complex and dynamic relationship which has multiple aspects such as managing and research process time-wise, socialization of the Ph.D. candidate into the role of academic researcher, supporting critical thinking, developing academic independence etc. (see for details Lee, 2011). The professional relationship that results from these interactions will help not only to Ph.D. candidates in their future careers, but also professors in their growth as educators and researchers (Carter & Whittaker, 2009). This is true only in the cases when there is trust and equity between these two sides. However, this relationship may suffer from mismatched expectations, lack of trust or equity, which may jeopardize its critical role.

The presence of inequity on either side – professor's or Ph.D. candidate's may be costly in numerous ways. For example, the cost that Ph.D. candidate could bear is related to obtaining Ph.D. degree from the institution, finding a job, ability to publish in desired journals. If one takes into consideration that drop-out rates at the postgraduate/doctoral programs are rather high, approximately 40-50% according to Smallwood (2004), then the relationship factors that can contribute to keep the Ph.D. students /candidates in the program become of critical importance for both Ph.D. candidates and faculty. According to the McWilliam et al. (2002) attrition rates from doctoral programs have a tremendous opportunity cost in terms of resources, time and energy waste, as well as adversely impact many involved – professor's reputation and in some cases the institution's, schools, or doctoral program's reputation. In order to overcome these potential negative outcomes it is important to understand how equity impacts relationships between Ph.D. candidates and supervisors, as well as to understand what makes an equitable student – professor relationship in the Ph.D. program.

2.1. Equity Theory in the Light of Supervisory Relationship

The equitable relationship between the supervisor and the Ph.D. student may be observed and understood by studying theories that underline the equity. The

notion of equity is usually understood as a kind of justice, but one can differentiate two ways of it: equity is the same as a rectification of legal justice as stated by Aristotel or equity is a justice conceived as fairness as stated by J. Rawls. When the term equity is used in higher education, it mainly refers to different conceptions of social justice as equality of opportunities; e.g. to enroll in higher education institutions (equity of access), to complete higher education studies (equity of results).

The equity theory has gained substantial popularity among social scientists due to several factors: (i) the logic behind it is well understood by the scholars and practitioners; (ii) equity is one of the operating norms of the stratification system of Western societies and (iii) it reached rather sophisticated level of theoretization and has been connected to other fields, such as psychology, economics, etc. (Neumann & Neumann, 1984: 269).

One of the most discussed models explaining how individuals evaluate social exchange relationships has been formulated by J.S. Adams in his “Equity Theory” developed in 1965. Adams introduced the idea that fairness and equity are key components of a motivated individual. In a nutshell, the equity theory is based in the idea that individuals are motivated by fairness, and if they identify inequities in the input/output ratios of themselves and their referent group, they will seek to adjust their input to reach their perceived equity.

The inputs are factors that a person has accomplished (i.e. past experience, education, and work) and perceives to be worthy to some return. The outputs are the returns to the individual’s job investment. In modeling context, inequity exists for person (p) whenever he perceives the ratio of his outcomes (O) to inputs (I) and the ratio others (o) outcomes to others inputs are unequal. Mathematically expressed, inequity exists when either of these relationships holds true:

$$\frac{Op}{Ip} < \frac{Oo}{Io} \text{ or } \frac{Op}{Ip} > \frac{Oo}{Io}$$

as well as equity exist when

$$\frac{Op}{Ip} = \frac{Oo}{Io}$$

Adams’ suggested that the higher an individual’s perception of equity, the more motivated they will be, and vice versa - if someone perceives an unfair environment, they will be demotivated.

Adams' equity model consists of four essential postulates: (i) perceived inequity creates tension in an individual, (ii) the amount of tension is proportional to the magnitude of the inequity; (iii) this created tension motivates the individual to reduce it; (iv) the strength of the motivation to reduce the inequity is proportional to the perceived inequity.

Equity theory is a motivation theory with the prime interest to describe how individuals in organizations react to inequitable compensation compared to other co-workers. Adam's equity model alludes to the fact that an employee who believes to be under rewarded for his or her responsibilities and efforts will strive to create a more equitable balance regarding both monetary and nonmonetary rewards. The application of equity theory is often extended to unfair situations, such as an individual who has been allocated a much lighter or heavier work load than a comparative other. Even though the steps are not always taken to fix dysfunctional relationships and alter unfair situation, the inequitable relationship will probably create tension that may be eventually reduced by making the necessary changes in the power base.

2.2. Inequity in the Supervisory Relationship

The existence of inequity in the supervisory relationship, i.e. between the professor and Ph.D. candidate opens the question of unethical people who, by default, are taking the advantage of individual, particular in the cases when the individual has a higher level of tolerance to inequity.² Unethical individuals at the university who might take advantage of others – e.g. supervisor is taking the advantage of Ph.D. candidate - are harmful not only to the Ph.D. program but for the university as whole. For example, one of possible effects is the lost in trust or loss of reputation in the Ph.D. program and/or university. In order to avoid the persistence of such detrimental behavior, one should be acquainted of what makes an effective and equitable relationship between professor and Ph.D. students/candidates.

The Ph.D. candidate and professor relationship is rather complex since it is a personal as well as a professional relationship in which the power may be unevenly distributed. Due to the nature of Ph.D. programs, there are cases when Ph.D. students/candidates are treated more like colleagues than regular students. This is not surprising if one takes into consideration that Ph.D. students/candidates may

² This is one of the complicating factor in the equity theory. Namely, some individuals have higher level of tolerance for inequity than others and become the victims of unethical persons who use them to satisfy their own interests (Tornow, 1971).

be well positioned people in the business or other community that see the Ph.D. title as the additional professional and personal achievement in their career and/or the people that may be linked to the university through industry-university partnership. If the relationship is equitable, then it is rewarding for both sides and can be promoted in so to say value added partnership resulting in joint publications, contacts, research grants, and variety of other opportunities. Yet, if the professor is inequitable in the treatment of the Ph.D. student/candidate, this can have an adverse impact on both sides, especially if the student works to lessen the inequity.

There are also situations in which the student, despite being treated inequitably, does not commit to an action to reduce inequity. When professor takes the advantage of Ph.D. student, one can notice the existence of positional power of the professor in their relationship. Literature review reveals that students occasionally ignore the fact they are being treated inequitably because they view the professor as having power over them: for example, supervisors have been known to change the requirements of a thesis inappropriately in order to delay completion of the degree when a student is especially talented or capable in providing computing or electronic skills to the research group (Bird, 2001). Schniederjans et al. (2012) reviewed academic scholars discussing the professional power being unevenly distributed: a part of the role of a professor in the professor-student relationship is power inherent (Blevins-Knabe, 1992); professor's power comes from the professor evaluating the student and having the authority in the subject in which the professor is expert (Paludi, 1990; Zalk et al., 1990). Not so many Ph.D. students/candidates have the courage to oppose to someone who can significantly influence their careers. Those individuals that do stand up against inequity may be role models to those who follow, but are often hurt in the process, which is an inequity in and of itself (Schniederjans et al., 2012).

Opposite to inequitable professor-student relationship, a fair and equitable relationship with a professor is based on the attitude of the professor towards the student and may encompass following: (i) professor's role should be teaching, not only the course material, but also modeling how to use the knowledge appropriately; (ii) being trustworthy in offering faculty members sensitive information, including objective and equitable evaluation as well as equal learning opportunities for all students without preferential treatment; and (iii) the professor's role should include demonstrating power in the authority of the subject matter (see for details, Blevins-Knabe, 1992).

Schniederjans (2007) proposed a Ph.D. student bill of rights that dealt with issues regarding what Ph.D. students should expect from professors who chair their doctoral committees. This bill of rights contains a few requirements for both fac-

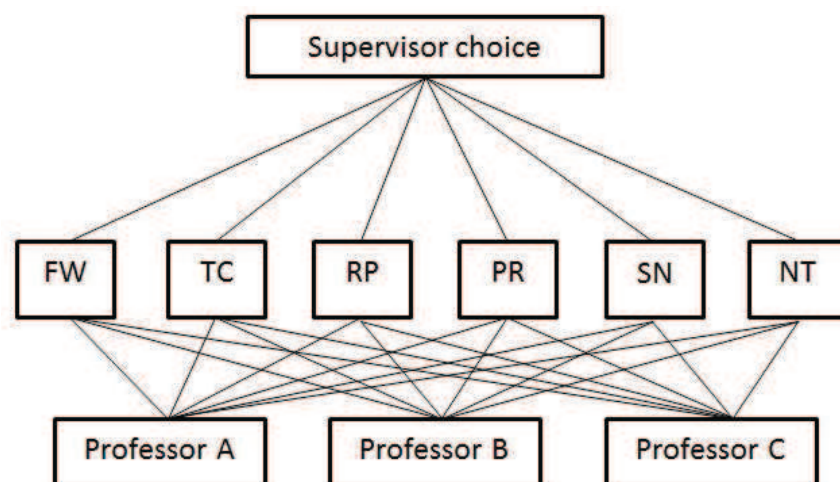
ulty members and students, including: (i) faculty members should make sure the right to select Ph.D. program committee members is given to the student; (ii) the student should be given the right to permit changes in the program committee either before or during the creation of the dissertation; (iii) a committee chair should work with the student on research prior to, during, and after the dissertation; (iv) a committee chair should set up codes of conduct between the student and the chair based on sound ethical values. These are the rights a doctoral student should have and a committee chair should ensure. If the program committee chair fails to ensure these fundamental rights, a student will most likely have problems. Equity theory proposed that when a state of inequity is perceived, that individual would experience a state of distress Walster, Berscheid & Walster (1973).

3. Research methodology

There are not so many studies that have looked into the method of supervisor selection. This article proposes and demonstrates the application of a multiple criteria based selection method using Analytical Hierarchy Process (AHP) for supervisor selection.

The Analytical Hierarchy Process is a popular decision-making tool developed at the Wharton School of Business by Thomas Saaty [Saaty, T., 1991] and allows decision makers to model a complex problem in a hierarchical structure showing the relationships of the goal, objectives (criteria), sub-objectives, and alternatives as shown in Figure 1. Uncertainties and other influencing factors can also be included. It is used in wide variety of decision situations.

Figure 1: The AHP decision hierarchy process



In AHP, the main problem is first decomposed into a hierarchy of simplified sub-problems in which each can be analyzed independently. The elements of the hierarchy can relate to any aspect of the decision problem, tangible or intangible. Once the hierarchy is built, the elements are arranged systematically and compared to one another in pairs using concrete data about the elements or based on human judgments about the elements' relative meaning and importance. A numerical weight or priority is derived for each element of the hierarchy, allowing diverse and often incommensurable elements to be compared to one another in a rational and consistent way. In the final step of the process, numerical priorities are derived for each of the decision alternatives. Since these numbers represent the alternatives' relative ability to achieve the decision goal, they allow a straightforward consideration of the various courses of action Clety (2008).

To determine the weights of each evidence layer, each criterion (or layer) was compared against each other and a judgment on the relative importance of each layer was made and an appropriate score from 1 to 9 was assigned (Table 1). Pair-wise comparison greatly reduces the conceptual complexity by comparing only two criteria at a time. The pair-wise comparison is performed in a square preference matrix from which eigenvalues and eigenvectors are calculated.

Table 1: Example scale for comparisons (Saaty T., Vargas, 1991)

Intensity of importance	Description
1	Equal importance
3	Moderate importance of one factor over another
5	Strong or essential importance
7	Very strong importance
9	Extreme importance
2, 4, 6, 8	Intermediate values
Reciprocals	Values for inverse comparison

In the first phase of the study Ph.D. students at the postgraduate doctoral program "Management" of the Faculty of Economics in Osijek were asked to list all factors they would consider or would recommend that one should consider before selecting a supervisor for a Ph.D. thesis. The simple question – based upon the expert reasoning and academic literature - that was asked was "What are important characteristics that you look for in a faculty member before selecting her or him as a supervisor ?" There were 47 students in the Ph.D. programme during the time of study, of which 23 responded. This resulted in an initial list of 13 items, which is

further reduced using 5 point Likert scale. The selection problem was then formulated using the 6 elements that serve as criteria for selection.

3.1. Criteria for the supervisor selection

The problem in this research is to determine an optimal supervisor selection for doctoral candidate. The criteria or objectives for supervisor are given in Table 2.

Table 2: Criteria summarized

No.	Criteria	Abbreviation
1	Freedom to work. The professor is open to ideas and is flexible about adopting alternative approaches.	FW
2	Time conscious . The professor is conscious about time taken for completion and is generally willing to work towards it.	TC
3	Reputation, publications. Reputation of professor in his or her field.	RP
4	Personal relationship with the professor. Cordial and understanding relationship with the professor.	PR
5	Social networks. The professors social network and relationship with other professors in the institute and outside.	SN
6	Number of thesis guided.	NT

3.2 Qualitative comparison by Analytical Hierarchy Process (AHP)

After defining the main criteria for supervisor selection, they are then ranked against each other in terms of relative importance to the solution of the problem. In this case, each objective is given a ranking of 1 to 4 relative to the other showing how good one objective is better to the other. The results are shown in Table 3.

Table 3: Relative importance of the criteria

	FW	TC	RP	PR	SN	NT
FW	1	1/3	1/2	1/4	1/4	2
TC	3	1	2	1/3	1	3
RP	2	1/2	1	1/2	1/2	2
PR	4	3	2	1	1	4
SN	4	1	2	1	1	3
NT	1/2	1/3	1/2	1/4	1/3	1

The alternative professors who may be the potential supervisors are listed in Table 4.

Table 4: Alternative professors for supervisors

No.	Potential supervisors
1	Professor A
2	Professor B
3	Professor C

The alternative professors and potential supervisors were ranked relative to each other for each criterion reflecting their perceived strengths. Based on intuitive judgments, the relative strengths of the alternative professors (supervisors) were evaluated for each of the criteria above. The ranking of alternatives for each criterion are as shown in Table 5.

3.3. Comparing of alternatives steps

The alternatives are compared by matrix evaluation. The following steps are used:

- The matrix from the relative ranking of the alternatives is squared
- The rows of the square matrix of alternatives is summed to form column matrix
- Sum the column matrix resulting from sum of rows
- Divide each element of column vector by the sum to form eigenvector
- Multiply eigenvectors of objectives by that of alternatives

The result of product of the eigenvectors gives the overall comparison of the alternatives. The results are discussed in next section.

Table 5: Relative importance of alternatives for each criterion

Freedom to work				Time conscious				Reputation, publications			
	A	B	C		A	B	C		A	B	C
A	1	1/2	3	A	1	1	3	A	1	2	2
B	2	1	4	B	1	1	1	B	1/2	1	2
C	1/3	1/4	1	C	1/3	1	1	C	1/2	1/2	1
Personal relationship with the professor				Social networks				Number of thesis guided			
	A	B	C		A	B	C		A	B	C
A	1	1/2	2	A	1	1	2	A	1	3	1
B	2	1	2	B	1	1	3	B	1/3	1	1/2
C	1/2	1/2	1	C	1/2	1/3	1	C	2	2	1

3.4. Results of AHP

The AHP model was created and executed using a simple MATLAB code to execute the matrices. The results from the AHP matrix calculations are summarized in Table 6.

Table 6: Relative importance of the criteria

	FW	TC	RP	PR	SN	NT
FW	1	1/3	1/2	1/4	1/4	2
TC	3	1	2	1/3	1	3
RP	2	1/2	1	1/2	1/2	2
PR	4	3	2	1	1	4
SN	4	1	2	1	1	3
NT	1/2	1/3	1/2	1/4	1/3	1
COLUMN SUM	14,500	6,166	8,000	3,333	4,083	15,000

	FW	TC	RP	PR	SN	NT	Priorities
FW	0,069	0,054	0,063	0,075	0,061	0,133	0,076
TC	0,207	0,162	0,250	0,100	0,245	0,200	0,194
RP	0,138	0,081	0,125	0,150	0,122	0,133	0,125
PR	0,276	0,487	0,250	0,300	0,245	0,267	0,304
SN	0,276	0,162	0,250	0,300	0,245	0,200	0,239
NT	0,034	0,054	0,063	0,075	0,082	0,067	0,062

$\lambda_{\max} = 6,220$, consistency index and consistency ratio are $CI = 0,044$, $CR = 0,035$

FW	A	B	C
A	1	1/2	3
B	2	1	4
C	1/3	1/4	1
Σ	3,333	1,750	8,000

	A	B	C	Priorities
A	0,300	0,286	0,375	0,320
B	0,600	0,571	0,500	0,557
C	0,100	0,143	0,125	0,123

$\lambda_{\max} = 3,023$, consistency index and consistency ratio are CI = 0,012, CR = 0,023

TC	A	B	C
A	1	1	3
B	1	1	1
C	1/3	1	1
Σ	2,333	3,000	5,000

	A	B	C	Priorities
A	0,429	0,333	0,600	0,454
B	0,429	0,333	0,200	0,321
C	0,143	0,333	0,200	0,225

$\lambda_{\max} = 3,148$, consistency index and consistency ratio are CI = 0,074, CR = 0,142

RP	A	B	C	
A	1	2	2	
B	1/2	1	2	
C	1/2	1/2	1	
Σ	2,000	3,500	5,000	
	A	B	C	Priorities
A	0,500	0,571	0,400	0,490
B	0,250	0,286	0,400	0,312
C	0,250	0,143	0,200	0,198

$\lambda_{\max} = 3,061$, consistency index and consistency ratio are CI = 0,030, CR = 0,058

PR	A	B	C
A	1	1/2	2
B	2	1	2
C	1/2	1/2	1
Σ	3,500	2,000	5,000

	A	B	C	Priorities
A	0,286	0,250	0,400	0,312
B	0,571	0,500	0,400	0,490
C	0,143	0,250	0,200	0,198

$\lambda_{\max} = 3,061$, consistency index and consistency ratio are $CI = 0,030$, $CR = 0,058$

SN	A	B	C
A	1	1	2
B	1	1	3
C	1/2	1/3	1
Σ	2,500	2,333	6,000

	A	B	C	Priorities
A	0,400	0,429	0,333	0,387
B	0,400	0,429	0,500	0,443
C	0,200	0,143	0,167	0,170

$\lambda_{\max} = 3,021$, consistency index and consistency ratio are $CI = 0,010$, $CR = 0,020$

NT	A	B	C
A	1	3	1
B	1/3	1	1/2
C	2	2	1
Σ	3,333	6,000	2,500

	A	B	C	Priorities
A	0,3000	0,5000	0,4000	0,4000
B	0,1000	0,1667	0,2000	0,1556
C	0,6000	0,3333	0,4000	0,4444

$\lambda_{\max} = 3,378$, consistency index and consistency ratio are $CI = 0,189$, $CR = 0,363$

Alternatives	Criteria and its averages						Overall
	FW	TC	RP	PR	SN	NT	
	0,076	0,194	0,125	0,304	0,239	0,062	
A	0,320	0,454	0,490	0,312	0,387	0,400	0,386
B	0,557	0,321	0,312	0,490	0,443	0,156	0,408
C	0,123	0,225	0,198	0,198	0,170	0,444	0,206

The AHP analysis shows that the professor A is superior to the other professors regarding the conscious about time taken for completion and is generally willing to work towards it and regarding his reputation of professor in his field.

Professor B is the preferred when one considers his openness to ideas and his flexibility about adopting alternative approaches, as well as his personal relation to student and his social networking. On the other hand, professor B is rated poorly in number of thesis guided.

Professor C is surprisingly rated least in all the objectives (criteria) except in number of thesis guided.

4. Conclusion

As Ph.D. students/candidates are encountering various challenges during their path to obtain the degree, they must realize that inequitable situations most likely will arise. Selecting a proper course of action to inequitable situations may quickly ease the situation and either resolve it or lead to potential option that eventually provide resolution.

In this paper a decision making model based on AHP method has been illustrated for the selection of most suitable professor for the role of Ph.D. thesis supervisor. The method presented and results discussed may serve as the motivation for academic scholars, professors and students. The complexity of establishing and sustaining equitable supervisory relationship may be the focus of more in-depth analysis using much more sophisticated qualitative and quantitative approaches, while students may consider the approach shows to validate their tentative choice and be more confident about decisions they have made or will make regarding the selection of supervisor for their Ph.D. thesis.

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