Competence gaps in software personnel: A multi-organizational study

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ARTICLE INFO

ABSTRACT

Today, the innovation and quality of the software industry's products and services depend to a great extent on the knowledge, ability and talent applied by software engineers. At the same time, human aspects are recognized as one of the main problems associated with software development projects. More specifically, inefficiencies usually come from inadequate verification of software engineers' competences. Another issue is the lack of an established career for software engineers, which adds difficulties to evaluate competences. With these challenges in mind, this paper presents a study conducted in the software industry to test competence gaps among software practitioners, comparing the 360 degree feedback results and self evaluations with that of standard competence levels. The results of this research may be very valuable to organizations immersed in software development projects.

1. Introduction

Despite advances in technology and major shifts in economy, human resources remain an organization's most valuable resource (Saraswathy, Thamaraiselvan, Senthilarasu, & Sivagnanasundaram, 2011). Personnel have been proved to be crucial in the software industry, since software engineering involves people collaborating to develop better software (Lanubile, Ebert, Prikladnicki, & Vizcaíno, 2010). Recently, Colomo Palacios, Casado Lumbreras, Tovar, and Soto Acosta (2011), following the path described by DeMarco and Lister (1987), identified human resources management as one of the main issues in software development. In fact, one of the software industry concerns is related to the development of its human resources talent because the quality and innovation of its products and services depend to a great extent on the knowledge, ability and talent applied by software engineers through the software development process (Rivera Ibarra, Rodríguez Jacobo, & Serrano Vargas, 2010). Therefore, information technology (IT) human resources are gaining importance in today's changing and more and more competitive environment (López Fernández, Martín Alcázar, & Romero Fernández, 2010) and have become crucial for the software engineering process (Polančič, Heričko, & Pavlič, 2011).

In this scenario, management of people in software development projects is particularly critical (Liu, Chen, Chen, & Sheu, 2011) because human aspects are the source of the main problems associated with software development projects and there is abundant empirical evidence which confirms that (Hazzan & Hadar, 2008). Software development is recognized as a human centric and sociotechnical activity (Casado Lumbreras, Colomo Palacios, Soto Acosta, & Misra, 2011) affected by personnel factors, which employs software practitioners who possess high levels of education, specific skills as well as the ability to apply skills to identify and solve problems (Ryan & O'Connor, 2009).

Individual differences have been identified as one of the paradigms for research analyzing human factors in software development (Curtis, 2002). These individual differences could rely, among other factors, on competences (Sharp, Baddoo, Beecham, Tracy, & Robinson, 2009; Turley & Bieman, 1995). Although software practitioners through their competences are the enablers of the Knowledge Society (Hernández López, Colomo Palacios, García Crespo, & Soto Acosta 2010), since they provide knowledge workers with the tool to perform their work, inadequate verification of software engineers' competences is usually one of the main problems within software development projects (McConnell, 2003). Studies in the literature (e.g. Levy Leboyer, 1996; Martin & Staines, 1994) have introduced taxonomies which differentiate between technical and generic competences. However, although software engineers may lack technical competences, only a few studies in the literature (e.g. Colomo Palacios, Fernandes, Soto Acosta, & Sabbagh, 2011)

have analyzed discrepancies between standard competence level and real competence levels regarding generic competences. In addition, presumably discrepancies in competences may vary regarding the employees' position along the software engineering career. There is therefore a need to further investigate into software engineers' competences, considering both types of competences as well as the software engineering career levels. To address these issues, this paper presents a study conducted in the software industry to test competence gaps among software practitioners. These gaps are calculated comparing the 360 degree feedback results with that of standard competence levels. This assessment method comprises a process in which peers, supervisors and other external sources provide anonymous feedback (Atwater & Brett, 2005). This tool provides reports from multiple sources and has become a fundamental tool in personnel and human resources management (Massingham, Nguyen, & Massingham, 2011).

Another issue is related to performance evaluation. In fact, Scullen, Mount, and Goff (2000) suggested that performance evaluation is not free from biases and later Patiar and Mia (2008) reported several investigations in which leniency and halo effects occurred. Thus, self evaluations are expected to be above the 360 degree evaluations, producing the so called leniency effect.

Considering the above mentioned points, the key research questions that motivated our work were:

- Do software engineers present more deficiency in technical competences than generic competences?
- Do discrepancies in competences differ along the software engineering career?
- Are self evaluations systematically above 360 degree evaluations?

The remainder of the paper is organized as follows. Section 2 includes an overview of the origins and taxonomies of competences, section 3 outlines the main software career ladders and Section 4 describes the study conducted, including its research design, sample and main results. Finally, conclusions and future work are depicted in Section 5.

2. Competence concept

Competences have gradually become a strategic issue in areas of academic research, business and education (Aramo Immonen, Bikfalvi, Mancebo, & Vanharanta, 2011). Back in the 1990s the competence approach already marked a new and the importance of competences started to receive attention in the organizational context (Matthewman, 1995). Since that date, organizations are adopting more and more competence centric human resource management approaches as standard practices (De Leenheer, Christiaens, & Meersman, 2010).

The term "competence" has been applied in reference to many different behavior domains (Waters & Sroufe, 1983). Anderson and Messick (1974) catalogued 29 diverse competences ranging from specific skills (fine motor dexterity) to abstract concepts such as consolidation of identity. Though competence is often used in the sense of performance, that is not entirely accurate (Bassellier, Reich, & Benbasat, 2001). According to McClelland (1973), competence comprises the relation between humans and work tasks, that is, the issue is not about knowledge and skills itself, but knowledge and skills required to perform a specific job or task in an efficient way (McClelland, 1973). McClelland (1987) suggested that competences must become the way for predicting individual performance more effectively in organizations.

Several authors (e.g. Levy Leboyer, 1996; Martin & Staines, 1994) set up taxonomies in which particular or technical

competences are referred as those that are necessary to carry out a very specific task in a particular job position, which include knowledge, abilities and skills. By contrast, universal or generic competences are those that, though not linked to a specific activity or function, do make possible the competent performance of the tasks related to the work position, since they involve characteristics or abilities of the individual's general behavior. These competences permit individuals to better adapt to changes in a more efficient and rapid way (Levy Leboyer, 1996). Generic competences may be crucial not only for the success of IT projects (Sukhoo,
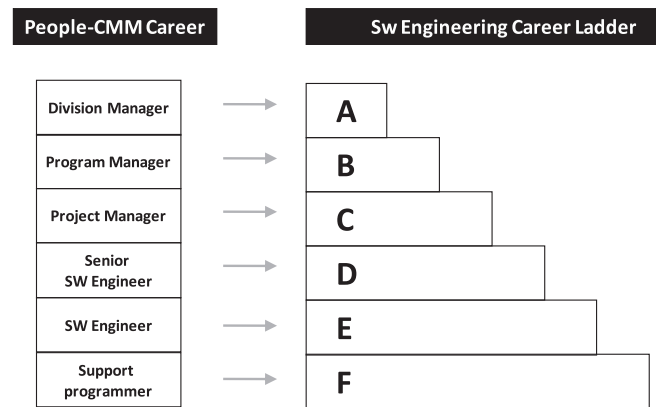

Fig. 1. Software engineering career ladder.

Table 1
Technical and Generic Competence level per role.

| Generic/tech.	Competence	A	B	C	D	E	F	G
Generic	Capacity for analysis and synthesis	4	4	4	4	3	2	2
Generic	Organization and planning	4	4	4	3	3	2	2
Generic	Oral and written communication in mother tongue	4	4	4	3	3	2	2
Generic	Problem solving	4	4	4	4	3	3	2
Generic	Decision-making	4	4	4	3	2	2	1
Generic	Critical thinking	4	4	4	4	3	3	2
Generic	Team work	4	4	4	4	4	3	3
Generic	Interpersonal skills	4	4	4	3	2	2	2
Generic	Ability to work on an interdisciplinary team	4	4	4	3	3	3	2
Generic	Information management	4	4	4	4	3	2	2
Generic	Ability to work in an international context	4	4	3	3	2	2	1
Generic	Ethical commitment	4	4	4	3	3	3	3
Generic	Environmental sensibility	4	3	2	2	2	2	2
Generic	Adaptation/flexibility	4	4	4	4	3	3	2
Generic	Creativity	4	4	3	4	3	3	2
Generic	Leadership	4	4	4	3	2	2	1
Generic	Understanding of other cultures and customs	4	4	3	2	2	2	1
Generic	Ability to work in an autonomous way	3	3	3	3	3	3	3
Generic	Initiative and enterprise	4	4	3	3	3	2	2
Generic	Quality concern	4	4	4	4	4	3	2
Technical	Software requirements	1	2	3	4	3	2	1
Technical	Software design	1	2	3	4	4	3	2
Technical	Software construction	1	1	2	3	4	4	3
Technical	Software testing	1	2	3	4	4	3	2
Technical	Software maintenance	1	2	3	4	4	3	2
Technical	Software configuration management	1	2	3	4	3	2	2
Technical	Software quality	1	3	4	4	3	2	2
Technical	Software engineering management	3	4	4	3	3	2	1
Technical	Software engineering tools and methods	1	2	4	4	3	2	2
Technical	Software engineering process	2	3	4	4	3	2	1

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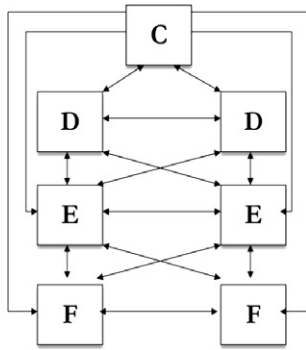
Fig. 2. Team structure.

Barnard, Eloff, Van der Poll, & Motah, 2005), but also for a wider range of organizational contexts, including all knowledge workers (Rimbau Gilabert, Miyar Cruz, & López de Pedro, 2009).

The identification of competences that match job requirements has become a major issue in human resources development. In any context, competences needs should be identified in terms of gaps, which inform whether deficiencies in competences exist and, at the same time, reduce managers' subjectivity and preference in identifying managerial competence needs (Wickramasinghe & De Zoyza, 2009). A gap arises when a competence possessed by an individual is below than what is required for the expert to perform the task efficiently (Agut & Grau, 2002). According to Latham (1988) a perceived gap could sometimes be an expression of preference but, in any case, this information is useful. In this sense, when an organization finds a competence gap, this circumstance could be tackled, for instance, by redesigning jobs (Naquin & Holton, 2003). In sum, the competence approach and, more precisely, the competence gap analysis is useful for both organizations and practitioners.

3. A career ladder for software practitioner

In the information technology/information systems world, there is a specific career path, which includes several positions: programmer, analyst, IT manager and, eventually, the chief information officer (CIO) (Lee, 2005). However, the software engineering career is much less established (Downey, 2010), no clear role definitions have been agreed (Downey, 2009). In spite of this, significant initiatives such as the People Capability Maturity Model (People CMM) (Curtis, Hefley, & Miller, 2009) point out the importance of establishing professional career structures defined, documented and driven by organizations. Recently, Colomo Palacios, Tovar Caro, García Crespo, and Gómez Berbís (2010) presented a career ladder for software professionals. This approach was based on an analysis, which focuses on extracting similarities between definitions for each professional profile from different sources such as industry practices (e.g. Curtis et al., 2009) and the technical literature (e.g. McConnell, 2003). The professional career is established starting from seven consecutive positions, giving concrete form to different levels of technical and general competences. Fig. 1 shows the seven steps of the People CMM career (Curtis et al., 2009) and the mappings to the software engineering technical career:

Once the software engineering career ladder is defined, the second step is to determine the set of competences, generic and technical, needed to perform the work in a competent way. The set of technical competences were extracted from the Software Engineering Body of Knowledge (SWEBOK) areas (Abran & Moore, 2004), while generic competences were adapted from the Spanish White book for university degrees in computer science (Casanovas, Colom, Morlán, Pont, & Ribera, 2004). Table 1 presents the standard level of generic and technical competences per role, which were extracted from two different sources: Colomo Palacios, Fernandes, et al. (2011) and Colomo Palacios et al. (2010).

Table 2
360-degree feedback results.

	C			D			E			F		
	N	Av	Sd	N	Av	Sd	N	Av	Sd	N	Av	Sd
Software requirements	6	3.5	0.8	24	3.2	0.6	38	2.8	0.6	31	2.2	0.9
Software design	6	2.8	0.8	24	3.2	1	38	3.2	0.6	31	2.5	0.5
Software construction	6	2.7	0.5	24	3.6	0.7	38	3.2	0.6	31	3	0.5
Software testing	6	2.3	0.8	24	3.2	0.7	38	2.7	0.6	31	2.3	0.6
Software maintenance	6	2.7	0.5	24	3	0.8	38	2.7	0.5	31	2.4	0.7
Software configuration management	6	2	0.9	24	2.4	0.8	38	2.2	0.7	31	1.8	0.5
Software quality	6	2.2	0.8	24	2.8	0.6	38	2.5	0.7	31	2	0.8
Software engineering management	6	3.2	0.8	24	2.6	0.8	38	2.3	0.7	31	1.6	0.7
Software engineering tools and methods	6	2	0.6	24	2.4	0.9	38	2.2	0.7	31	1.7	0.7
Software engineering process	6	1.3	0.5	24	1.5	0.5	38	1.4	0.5	31	1.2	0.5
Capacity for analysis and synthesis	6	3.7	0.5	24	3.4	0.8	38	3.2	0.7	31	2.9	0.6
Organization and planning	6	3.7	0.8	24	3.2	0.6	38	2.8	0.8	31	2.7	0.6
Oral and written communication in mother tongue	6	3.2	0.8	24	2.8	0.5	38	2.8	0.8	31	2.8	0.6
Information management	6	3.3	0.5	24	2.9	0.5	38	2.9	0.5	31	2.7	0.6
Problem solving	6	3.3	0.8	24	3	0.8	38	2.8	0.8	31	2.8	0.7
Decision-making	6	3.2	1	24	2.8	0.9	38	2.6	0.8	31	2.3	0.6
Team work	6	3.5	0.6	24	2.9	0.7	38	2.8	0.7	31	2.9	0.6
Ability to work on an interdisciplinary team	6	3.3	0.8	24	2.8	0.7	38	2.6	0.6	31	2.6	0.6
Ability to work in an international context	6	2.7	0.8	24	2.4	1	38	2.3	0.7	31	2.2	0.8
Interpersonal skills	6	2.7	0.8	24	2.9	0.8	38	2.7	0.7	31	3.2	0.6
Critical thinking	6	3.2	0.8	24	2.8	0.6	38	2.9	0.7	31	2.6	0.6
Ethical commitment	6	3.2	0.8	24	3.1	0.4	38	2.9	0.4	31	2.8	0.4
Ability to work in an autonomous way	6	2.8	0.8	24	3.1	0.7	38	3.2	0.5	31	3	0.6
Adaptation/flexibility	6	3.3	0.5	24	3	0.7	38	2.9	0.7	31	2.9	0.7
Creativity	6	3	0.9	24	3	0.8	38	2.7	0.5	31	2.9	0.7
Leadership	6	2.3	0.5	24	2.2	0.7	38	2.3	0.9	31	2.1	0.6
Understanding of other cultures and customs	6	2.7	0.8	24	2.6	0.5	38	2.5	0.6	31	2.5	0.6
Initiative and enterprise	6	2.5	0.6	24	2.5	0.6	38	2.6	0.8	31	2.5	0.5
Quality concern	6	2.7	0.8	24	3	0.4	38	2.7	0.7	31	2.5	0.6
Environmental sensibility	6	2	0.9	24	2.4	0.7	38	2.2	0.7	31	2.2	0.7

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The description of the scale (Likert type) for all competences is as follows:

1. Low level.
2. Medium level.
3. High level.
4. Very high level.

4. The study

4.1. Experimental design

Authors applied the competence evaluation analysis to a set of professional roles: C, D, E and F. The experimental groups were required to have personnel with a minimum work experience of 1 year. This restriction was set in order to allow that 360 degree evaluations had sufficient data. The 360 degree feedback obtains comprehensive evaluations by considering all those that may rea sonably comment on the performance of the individual evaluated, including self assessment, assessment from below (subordinates/ staff), assessment from peers or co workers as well as assessment from external agents (Church, 2000). In sum, authors opted for the 360 degree evaluation because of its good results (Wood & Payne, 1998) and previous use for IT personnel evaluation (Jiang, Klein, Roan, & Lin, 2001).

The groups' composition regarding work profiles presented a structure of seven professionals, which obey the hierarchical struc ture shown in Fig. 2.

With regard to evaluations, results from an individual were based on the following stakeholders:

- His or her supervisor.
- One or more subjects sharing the same professional role.
- One or more subordinates.

To provide a consensus in a single indicator, an overall measure was calculated using the following formula:

$$\text{C.Level} \quad ((\text{Avg. supervisor rate}) + (\text{Avg. peers rate}) + (\text{Avg. subordinates rate}))/3$$

This research instrument was pretested with 10 different prac titioners with similar characteristics as those in the sample. The objective of the pretest was to improve procedures and ensure the proper design and procedural implementation of the experi ment. The results from the pretest showed no particular bias.

4.2. Sample Description

The study was carried out over a period of three weeks. Partic ipants were obtained from those who responded positively to a personal invitation, the sample consisted of 22 subjects, 5 women (23%) and 17 men (77%), from three different Spanish software cor porations (a multinational IT consultancy corporation, a national IT consultancy corporation and a bank). The average age was 32.3. In average, subjects have 7.6 years of working experience. Subjects were classified on the previously mentioned roles, obtaining the following distribution: C (3), D (6), E(6) and F(7).

4.3. Threats to validity

Two threats to the validity exist: internal or external. With re spect to internal validity, the threat comes from the fact that the respondents may not have a comparable level of knowledge or expertise. Given that respondents were in all cases chosen because

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Table 3
Differences between evaluations and competence levels.

	C	D	E	F	Total
Software requirements	0.5	−0.8	−0.2	0.2	−0.3
Software design	−0.2	−0.8	−0.8	−0.5	−2.3
Software construction	0.7	0.6	−0.8	−1	−0.5
Software testing	−0.7	−0.8	−1.3	−0.7	−3.5
Software maintenance	−0.3	−1	−1.3	−0.6	−3.2
Software configuration Management	−1	−1.6	−0.8	−0.2	−3.6
Software quality	−1.8	−1.2	−0.5	0	−3.5
Software engineering management	−0.8	−0.4	−0.7	−0.4	−2.3
Software engineering tools and methods	−2	−1.6	−0.8	−0.3	−4.7
Software engineering process	−2.7	−2.5	−1.6	−0.8	−7.6
Total (technical competences)	−8.3	−10.1	−8.8	−4.3	−31.5
Capacity for analysis and synthesis	−0.3	−0.6	0.2	0.9	0.2
Organization and planning	−0.3	0.2	−0.2	0.7	0.4
Oral and written communication in mother tongue	−0.8	−0.2	−0.2	0.8	−0.4
Information management	−0.7	−1.1	−0.1	0.7	−1.2
Problem solving	−0.7	−1	−0.2	−0.2	−2.1
Decision−making	−0.8	−0.2	0.6	0.3	−0.1
Team work	−0.5	−1.1	−1.2	−0.1	−2.9
Ability to work on an interdisciplinary team	−0.7	−0.2	−0.4	−0.4	−1.7
Ability to work in an international context	−0.3	−0.6	0.3	0.2	−0.4
Interpersonal skills	−1.3	−0.1	0.7	1.2	0.5
Critical thinking	−0.8	−1.2	−0.1	−0.4	−2.5
Ethical commitment	−0.8	0.1	−0.1	−0.2	−1
Ability to work in an autonomous way	−0.2	0.1	0.2	0	0.1
Adaptation/flexibility	−0.7	−1	−0.1	−0.1	−1.9
Creativity	0	−1	−0.3	−0.1	−1.4
Leadership	−1.7	−0.8	0.3	0.1	−2.1
Understanding of other cultures and customs	−0.3	0.6	0.5	0.5	1.3
Initiative and enterprise	−0.5	−0.5	−0.4	0.5	−0.9
Quality concern	−1.3	−1	−1.3	−0.5	−4.1
Environmental sensibility	0	0.4	0.2	0.2	0.8
Total (generic competences)	−12.7	−9.2	−1.6	4.1	−19.4
Total by both type of competences	−21	−19.3	−10.4	−0.2	−50.9

of their expertise and experience, authors made sure that experts possessed a comparable level of knowledge and expertise.

Regarding external validity, authors assumed two possible threats. The first is the small number of respondents, which makes the generalization of results difficult. The second is the fact that the sample was not taken randomly. Even though these threats exist, the sampling method and the number of respondents may be acceptable given the exploratory nature of our study.

4.4. Results

Results from the 360 degree feedback are presented in table 2 for all the competences, including the number of responses per role (N), average rating (Av) and standard deviation (Sd).

With regard to technical competences, the role that presents more technical competences is "D", presenting an overall rating of 27.9 points, followed by "E" with 25.2, "C" with 24.7 and, finally, "F" with 20.7. Software Construction, Software Requirements and Software Design are the most valued technical competences. Only one case presents a standard deviation over 1 point "Software Design" (role D) with 1.02 points.

Regarding generic competences, the role that leads the list is "C" with 68.5 points, followed by "D" with 64.8, "E" with 62.5 and, finally, the "F" with 61.1 points. On the top of the generic competences' ranking is the "Capacity for Analysis and Synthesis" with 13.2 points, followed by "Organization and Capacity Planning". At the bottom of the list are "Environmental sensibility"

Table 4
Negative discrepancies by type of competence.

	C(3)			D(6)			E(6)			F(7)		
	N	DT	AvD	N	DT	AvD	N	DT	AvD	N	DT	AvD
Technical competences	15	25	8.33	40	62	10.33	43	48	8.00	33	31	4.43
Generic competences	27	35	11.67	65	74	12.33	35	37	6.17	20	20	2.86
Total	42	60	20	105	136	22.7	78	84	14	53	51	7.3

Table 5
Differences between self-evaluations and 360-degree evaluations.

	360	Self-evaluation
Technical competencies	98.5	95.8
Generic competencies	256.9	280.2
Total	355.4	376.0
Average	2.6	2.8

Table 6
Negative discrepancies by self-evaluations and 360° evaluations.

Competence	Self-evaluations			360° evaluations		
	N	AvD	TD	N	AvD	TD
Software requirements	8	1.12	9	7	1.0	7.16
Software design	15	1.27	19	10	1.1	11.29
Software construction	12	1.17	14	12	0.9	10.73
Software testing	16	1.19	19	16	1.1	17.87
Software maintenance	12	1.08	13	14	1.2	16.67
Software configuration management	13	1.46	19	12	1.4	16.28
Software quality	15	1.6	24	13	1.2	15.22
Software engineering management	10	1	10	11	1.0	10.77
Software engineering tools and methods	14	1.71	24	15	1.4	21.36
Software engineering process	20	2.05	41	21	1.8	37.93

and "Leadership" with 8.8 and 8.9 points, respectively. Similar to what occurs with the technical skills, only a case presents a standard deviation above the unit, "Working in an international context" (role D), with a score of 1.02 points.

To analyze the differences between standard competence levels and the evaluations (real data) table 3 is calculated. The role that presents the most significant negative competence gap is "C" with and overall gap of 21 points, followed by "D" with 19.3, "E" with 10.4 and "F" with 0.2. These gaps are rooted on the greater exigencies usually requested to higher levels. With respect to the competences, two technical competences, Software Engineering Process and Software Engineering Tools, present the greatest gaps, with 7.6 and 4.7 points, respectively. In general, technical competences present greater gaps, with none of the technical competences presenting positive gap. In contrast, positive gaps appeared for several generic competences such as Understanding of other cultures and customs, Environmental sensibility and Interpersonal skills.

Our first research question intends to respond whether software engineers present more deficiency in technical competences than generic competences. Adding total discrepancies for the case of 360 degree evaluations, 31.5 points and 19.4 points were obtained for the technical and generic competences, respectively. Therefore, technical competences present a greater percentage of negative discrepancy than generic competences for the case of 360 degree evaluations.

Our second research question is concerned with examining whether discrepancies differ along the software engineering career. Table 4 shows information related to negative discrepancies by professional role, indicating the number of respondents. Results showed that "F" profile, with 7 subjects, is the position with less negative discrepancies, presenting a total number of discrepancies of 51 and an average mean of discrepancies of 7.3 points. D profile is the one that presented the greatest number of discrepancies both in terms of technical and generic competences as well as in average. Thus, it can be concluded that subjects working in F positions present less negative discrepancies.

Table 5 shows the differences between self evaluations and 360 degree evaluations. It is important to notice the distinct number of cases between the two groups (3267 for the 360 degree evaluations and 726 for self evaluations) which indicates that additional analyses were needed. Our third research question is analyzing whether self evaluations are systematically above 360 degree evaluations for technical and generic competences. Descriptive statistics indicate that differences between both types of evaluations may exist. Although, according to the results obtained, differences only exist for the case of generic competences.

Furthermore, we explored whether discrepancies among technical competences existed. Table 6 shows that, for the 360 degree

evaluations, software construction competence is the technical competence that presented the fewest discrepancies on average, though the competence that had the fewest number of total discrepancies is software requirements with 7.16. With regard to self evaluations, the competence that presented fewer discrepancies on average (as well as by total number) was software requirements.

5. Conclusions

Personnel aspects have been recognized as the source of the main problems associated with software development projects. In this context, the management of human resources in software development projects is particularly critical. Inadequate verification of software engineers' competences is usually one of the main problems within software development projects. Another issue is the lack of an established career for software engineers, which adds difficulties to evaluate competences. These issues have not been sufficiently investigated and require further research. To address these gaps in the research, this paper presents a study conducted in the software industry to test competence gaps among software practitioners. More specifically, standard competence levels are compared with real competence levels from a set of software engineering organizations.

The results showed that the professional role that presents more technical competences is "D", followed by "E" and "C". Regarding generic competences, the role that leads the list is "C", followed by "D" and "E". These findings are coherent with the competence levels defined, since the D position is on the top of the technical competences pyramid, whereas C profile is on the top of the trapezoid formed by the generic competences. The implementation of the competence evaluation method has contributed to the knowledge of the subjects who took part in the experiment. Results from evaluations indicate that, for the generic competences but not for the technical competences, self evaluations are above those from superiors, peers and subordinates. This finding is in line with existing research and the literature refers to it as the leniency effect (Agut & Grau, 2002; Atwater & Brett, 2005). However, it cannot be concluded that subjects from higher hierarchical level give lower punctuations than those from lower levels.

Furthermore, regarding negative competence discrepancies, results corroborate that technical competences present a greater percentage of negative discrepancies than generic competences for the case of 360 degree evaluations. Despite this result, in software engineering, the human dimension sometimes has greater importance than the technical dimension (Constantine, 2001), since it is an activity based on intellectual and social interaction. In fact, there is abundant empirical literature which confirms that human aspects are the source of the main problems associated with software development projects (Hazzan & Hadar, 2008). In addition, results show that subjects from lower positions present less negative discrepancies than those from higher hierarchical levels both for technical and generic competences. The software engineering competence is the technical competence that presents the large number of negative discrepancies for all types of evaluations and, therefore, the one that requires more training. This circumstance may be explained due to the relatively recent research in software engineering, which started in the beginning of the 1990s. Contrary to what hypothesized, software construction was not the technical competence that presented the fewer number of negative discrepancies. The technical competence that presented the fewer number of negative discrepancies was software requirements.

Acknowledgements

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