Generational Professional Career Evolution of Professionals in Computer Science in Costa Rica: A Gender Study

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Abstract

The career evolution of professionals in Computer Science has been studied very little, especially in Latin America. In a previous study (LAWWCC 2016) we reported results of an exploratory study that aimed to characterize the professional development model of people that studied Computer Sciences in Costa Rica. It reflects the roles and the industrial sectors with which they began their professional career and in which they report are currently working. No important gender differences were depicted in it amongst men and women, since they report similar choices regarding their professional evolution. As a result, some valid concerns were raised regarding the question: do these results represent the female (and male) behavior in all professional career stages? In this study, results, obtained from an online survey responded by 611 professionals in Computer Sciences, are now shown by generations. Professionals are grouped in four generational categories: Baby Boomers, Generation X, Young and Mature Millennials. The main finding is that the professional evolution, with respect to the role and sector in which they perform, revels different behaviors for professionals of different generations. It also reflects that male career evolution shows more role and industry changes than that of female professionals.

Keywords: Professional Career, Gender, Generations

1 Introduction

The professionalization of Computer Science in Costa Rica began a little over forty years ago. Since then, thousands of professionals have integrated into the labor market and have been working in very diverse jobs, adjusting their working roles to the needs of society and changes in technology. However, there is very little information available on how professionals develop in this field and what their contribution to society is.

The Chamber of Information and Communication Technologies (CAMTIC) carried a study focusing on the market needs of professionals in the Costa Rican labor market and not on the professional career of our computer scientists [1]. Studies carried by the National Council of Rectors (CONARE) and universities, for example [2], aim to evaluate employability (i.e., potential of graduates to enter and remain in the labor market and their satisfaction level). These studies do not delve into the migration of professionals between industry sectors or in gender aspects. Moreover, these studies do not contemplate the long-term trajectory of professionals.

In [3], the professional development model of men and women who studied Computer Sciences or Informatics in Costa Rica, in terms of types of work with which they began their professional career and in which they are currently working is reported. Its main finding is that male and female professional evolutions are similar, that means no significant gender differences were found. However, differences among generations were not studied. In this study, professional career migrations were reported totalized for women and for men.

Models of professional development are useful both to generate theoretical knowledge as well as to produce some knowledge to allow universities and industry to attract and retain talent to the area. This is very important for the information and telecommunication technology (ICT) industry which always complains about employee offer being shorter than employer demand.

In our study we try to determine whether there are differences in the professional career evolution between men and women and between different generations. A generation is an identifiable group of people that shares birth years (hence age) and are defined by significant life events at critical developmental stages [4]. Members of a generation share certain thoughts, values, and behaviors because of these shared events. Furthermore, values, reactions, and behaviors presumably differ across different generations [4]. Literature, based mainly on US and global events, has defined some generations which have been accepted at least in the Occidental culture.

Generations are defined by determinant events which affect the whole population. However, some specific ICT events may impact ICT professional careers as well. In our study we try to incorporate both types of events to group Costa Rican ICT professionals in four different categories. Emigration and immigration to industrial sectors and among professional roles are described for these four generational groups.

This paper is an extension of the paper titled "Professional Career of Women Graduates in Computing in Costa Rica: a Generational Study", presented at the IX Latin American Women in Computing Congress in 2017. The structure of this paper is as follows. Section 2 presents related work. Section 3 describes the methodology followed and Section 4 the results. Finally, Section 5 presents the conclusions.

2 Related Work

In this section some effort is given to define and typify what professional careers are. Also, generations are defined and categorized. Finally, studies about the Costa Rican ICT work market are summarized.

2.1 Professional career

According to [5], the expression professional career relates to different stages a person goes through after finishing her/his college education and/or getting into the work market. The professional career comprises not only the tasks and responsibilities associated with the job, but also social and economic aspects.

In [6], three career stages are mentioned: entry, middle, and ending. The entry stage refers to the first job. This is a socialization period in which tasks executed in job positions typically are technical and specific and people get used to the organization technology. During the entry stage, worker´s superiors may identify an employee´s potential. In the middle career, job positions have a wider scope and more depth, which means that tasks are less technical and specific. Development of social skills and technical competencies becomes more important in the middle stage. Finally, in the ending stage, the person has reached a high degree of specialization in technical or managerial skills and competencies.

In the Engineering field, in which Computer Science is included, the professional career of a person may take one of two paths: the technical or the managerial [6]. The path to follow will depend on skills and competencies that each person is able to develop, opportunities that employers offer, and decisions the person makes about her/his professional career.

According to [7], professionals in Computer Science start working on technical positions, move to project technical management, and finally shift to predominantly managerial jobs. As a person moves through this path, she/he gains and improves managerial skills and loses the technical ones. In [8], a gender study, authors concluded that technical and managerial competencies are mutually exclusive.

In [9], a third career path is introduced: the protean. This means that professionals in Computer Science and Information Technology may "move from an IT job to a non-IT job in their career path" [9].

2.2 Generations

As stated earlier, generations are identifiable groups of people that share birth years and are defined by significant historic, social, or technological events. Currently, in companies and institutions, three generations coexist in the working environment: Baby Boomers, Generation X and Generation Y. Members of the Generation X are known as X-ers. Generation Y members are also known as millennials.

There is not only one date of birth range definition for each of these generations [4]. Moreover, characteristics of one generation in one global region can be absent on natives of other geographical regions, or can show up, some years later. As stated, according to [4], different authors define different limits for the initial and the ending years of each generation. This is natural since there is no exact date when events impact human behavior. We will summarize generations' definitions which are relevant to our study.

2.2.1 Baby boomers or Boomers

According to [4], most sources identify Baby Boomers as people born between 1943 and 1965. They also highlight that the U.S. Census Bureau defines Baby Boomers as individuals born between 1946 and 1964 [4].

Baby Boomers were raised to respect authority figures, but as they witnessed their antecessors, learned not to "trust anyone over 30" [10], and protesting against power characterized their formative years. They grew up in an era of "prosperity and optimism and bolstered by the sense that they are a special generation capable of changing the world, have equated work with self-worth, contribution and personal fulfillment" [11]. Baby Boomers have been characterized as individuals who believe that hard work and sacrifice are the price to pay for success [4].

2.2.2 Generation X or X-ers

In the case of the Generation X, [4] states that the U.S. Census Bureau defined this segment of the population as consisting of individuals born between 1968 and 1979. However, the upper limit of birth for Generation X in some cases has been as high as 1982, while the lower limit has been as low as 1963 [10].

Members of Generation X grew up in a period of financial, familiar, and societal insecurity. They grew up with a stagnant job market, corporate downsizing, and limited wage mobility. They are the first individuals predicted to earn less than their parents did [4]. They have grown up in homes where both parents work, and they aspire, more than previous generations, to achieve a balance between work and life [12]. They are not overly loyal to their employers although they have strong feelings of loyalty towards their family and friends [10]. They value continuous learning and skill development [13].

2.2.3 Generation Y or Millenials

According to [4], the lower limit for Generation Y may be as low as 1978, while the upper limit may be as high as 2002, depending on the reporting source. Moreover, the definition of this generation presents high heterogeneity amongst sources.

Members of generation Y, or millennials, have been shaped by dramatic technological advances [4]. One of the most frequently reported characteristics of this generation is their comfort with technology [14]. They value team work and collective action [15], and are adaptable to change [12]. Furthermore, they seek flexibility [16], are independent, desire a more balanced life [17], and are the most educated generation. They have been characterized as demanding [16] and as the most confident generation [18].

2.3 Studies about the Costa Rican ICT work market

The evolution of professional career of professionals in Computer Science in Costa Rica has been studied very little. In [1], emphasis is set on the identification of variables related to human resources which are important for the information and communication technology (ICT) sector growth. This study describes industry needs in a context of qualified staff shortages and government policies that should support the industry, but does not analyze the professional career of people graduated on this discipline.

In [19], authors present the state of the software industry in Costa Rica in 2008. The software industry is not the only one in which professionals in Computer Science work, but it absorbs a high percentage of graduates on this field. Therefore, we think this study can contribute to understand some aspects which could affect the professional career of people who design and develop software, such as:

- There is staff shortage in the field of software development.
- Employers prefer hiring professionals graduated from public universities.
- The number of professionals in Computer Science has dramatically increased since 1997 due to the high number of students in private universities.
- 73% of the companies are micro or small companies. This can represent a constraint for professional growth because such companies offer few career development possibilities.

- Reaching a master degree makes finding a job easier.
- 74% of people working in the software industry do not speak English fluently.
- 77% of the companies invest less than $10.000 per year on employee training.

In [20], the authors updated results obtained in [19]. This study shows the evolution of the Costa Rican software sector from 2008 to 2013. Some aspects that could affect the professional career of people who design and develop software presented in this study are:

- The number of registered companies dedicated to software development grew from 109 in 2008 to 127 in 2013. However, only 34 companies (27%) survived and the rest (73%) were created during this period. This means there is a great company mortality which can create job instability to professionals in Computer Science.
- The size of micro and large companies has grown, but the number of small and medium companies has decreased.
- The software development field is dominated by men.
- 95% of company owners are men and 68% of these owners studied Computer Science.
- The number of professionals in Computer Science between 20 and 29 years old has increased from 8.6 for each one thousand inhabitants in 2006 to 13.1 in 2011.

Some of these conditions define the opportunities and challenges that professionals in Computer Science face in the country.

In [3], authors characterize the professional development model of men and women who studied Computer Sciences or Informatics in Costa Rica, in terms of types of work with which they begin their professional career and in which they report are currently working. The main finding of this work was that male and female professional evolutions have similar behaviors. However, differences among generations were not determined.

Most literature reviewed is mainly centered in the situation of the industry, but it does not deepen in the career of professionals in Computer Science. Even more, there is no gender study showing generational differences. Hopefully, results presented on this paper will contribute to increase the knowledge about professional career evolution, as lived by different generations.

3 Methodology

3.1 Study Goal

The goal of our analysis was to identify how the professional career from different generations has changed in Costa Rica. To understand concepts related to professional career, the first step we followed was a literature review. Based on it, we built a questionnaire and evaluated its legibility and precision by making some researchers of the ICT Research Center of the University of Costa Rica respond to it and give us feedback.

3.2 Tools and Instruments

We used Lime Survey to implement the questionnaire to distribute it digitally, and to reach as much people as possible. We contacted the Costa Rican Association of Computer Science Professionals to be able to use its contact channels as distribution means. We sent the questionnaire to professors of other universities and ask them to distribute it among their graduated students to access non-associated professionals. We also used our personal social networks and e-mail contacts for reaching more possible participants.

Answering the questionnaire was volunteer and anonymous. The sampling method was non probabilistic by convenience with snowballing. Since it was impossible to know previously how many people would respond, we decided up front that the questionnaire would be available on line until we reached 500 answers. Finally, we received 611 answers from October 2015 till January 2016; however, only 603 were complete and used on this study. We consider it is a large sample size taking into account that Costa Rica is a small country.

Based on the literature review and on our assessment of Costa Rican socio technological events, participants were divided in four groups: Young Millennials (20-29 years old), Mature Millennials (30-35 years old), Generation X (36-50 years old), and Baby Boomers (51-62 years old). The socio technical events previously mentioned refer to the use of mainframes, the introduction of microcomputers, the advent of Internet, and the mass consume of mobile applications.

3.2 Questionnaire

Questions asked in the questionnaire were:

- Did you get a bachelor’s degree on Computer Science?

- Sex / Age
- Graduation year and university
- Have you worked in the field of Computer Science?
- If you have worked in the field of Computer Science, have you ever left the labor market? Why?
- Number of years you have been working
- Number of employers you have worked for
- Industrial sector of your first job
- Role you played on the first working place
- Industrial sector of your current job
- Role you play on your current working place
- Obstacles you have faced during the development of your professional career.
- Reasons that have guided decisions related to your professional career development
- Which is your contribution to the society?
- Do you partially or totally own a company?
- If you own a company, was it a good decision? Which is the contribution of your company to the society?
- With your current experience, if you had to choose a field of study, would you choose Computer Science again?
- Degree of satisfaction with your professional career

3.4 Limitations and Alternatives

The main limitation of this study was its sample selection due to the difficulty of accessing stratified groups that were more representative of the population. Nevertheless, we consider the sample size acceptable, considering that Costa Rica is a small country.

The survey was voluntarily answered. Therefore, there could be a sample bias, especially regarding the participants' professional satisfaction and their circumstances when they made career path decisions.

Regarding the instruments, the questionnaire did not address family composition that could be used to analyze the results further. Furthermore, questions regarding educational opportunities (e.g., scholarships) were not included. This could have been used to analyze the paths taken by the participants.

Due to the questions included in the survey, addressing more in-depth reasons for the decisions described in the results of this study was not possible. An alternative to overcome this is to conduct interviews that would allow a detailed analysis of the results of this study.

4 Results

In this section, survey respondents are characterized, and their responses are presented.

4.1 Demographic Data

The questionnaire was answered by 611 professionals in Computer Science with at least a bachelor degree, 166 women and 445 men. Female participants were 166 (27.2%) and male participants were 445 (72.8%). The number of male and female participants in the sample is not balanced, but it reflects very accurately the gender distribution in Computer Science in our country[21].

Average age of the 166 female participants was 36. Ages range from 22 to 62 years old. Only 161 of the 166 participant women developed a professional career on Computer Science. Most of the questions were answered only by these 161 women, who, according to their age, were classified in four generation groups: **Baby Boomers** (51- 62 years old): 23 participants, **Generation X** (36 – 50 years old): 47 participants, **Mature Millennials** (30 – 35 years old): 50 participants, and **Young Millennials** (20 to 29 years old): 41 participants. The frequency of participants by graduation year can be seen on Figure 1.

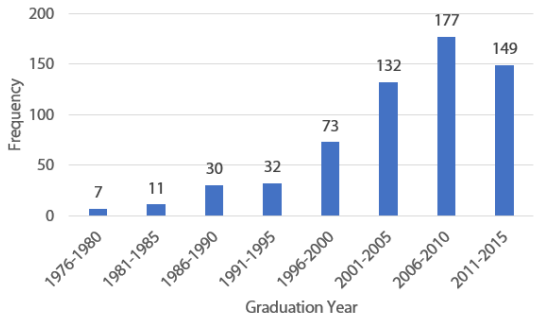

Figure 1: Frequency of participants by graduation year, n=611

Although male participants were 445, but only 437 developed a professional career on Computer Science and answered most of the questions. Their average age was 34. Ages range from 22 to 56 years old. They were also classified in the same generation groups: **Baby Boomers** (51- 62 years old): 28 participants, **Generation X** (36 – 50 years old): 132 participants, **Mature Millennials** (30 – 35 years old): 133 participants, and **Young Millennials** (20 to 29 years old): 144 participants.

Baby Boomers are the smallest group, which is understandable because the number of professionals in Computer Science was low when the professionalization of the field began in the seventies.

4.2 Professional Career Evolution

The career of professionals in Computer Science is determined by their own decisions, goals, and skills and by opportunities and obstacles in the labor market. Female and male motivations in their respective career paths are described. Since participants have worked from one to 42 years, it is possible that their answer to which reasons guide their decisions is mainly influenced by the most recent events, especially for those who have been longer in the labor market and have changed employer or role several times.

The three main reasons that female participants reported as guiding their elections of professional career are:

- Opportunities of professional growth (50.3%)
- Income (47.2%)
- Employment stability (42.9%)

Reasons such as having a flexible working schedule, retribution to the society of part of what they have received from it, balance of working and family life, study possibilities (time and financial aid from the employer), travel possibilities, and freedom to decide what they want to do within their working framework are not reported as important by female participants.

The three main reasons that male participants reported as guiding their elections of professional career are:

- Income (61.6%)
- Opportunities of professional growth (55.8%)
- Possibility of working in the field that mostly matters to me (34.8%)

Reasons such as retribution to the society part of what they have received from it, balance of working and family life, study possibilities (time and financial aid from the employer), travel possibilities, and freedom to decide what they want to do within their working framework are not reported as important by male participants.

Table 1 shows reasons that guide the elections of professional career of men and women by generation. Colored cells indicate there is a significant difference between men´s and women´s answers.

Female Young Millennials are the generation more interested in finding opportunities of professional growth and in increasing their income. This generation is less interested in employment stability. This is understandable since they are very young and are familiarized with current technologies, which makes it easy for them to find a new job. Female Mature Millennials report income as the most frequent reason guiding their decisions. This generation is still young and is updated in technology, but they start to show higher interest on employment stability. Female Generation X is guided by employment stability and opportunities of professional growth. This is a generation of women which may face difficulties finding a new job because the fast rhythm of technology change makes it harder for them to keep updated in new tools. Female Baby Boomers are not particularly guided by any of the three reported reasons. Employment stability is a slightly higher motivating force for them but not significantly.

All male generations are more interested in increasing their income and in finding opportunities of professional growth. Male Young Millennials is the generation less interested in the *possibility of working in the*

field that mostly matters to them. Male Mature Millennials report income as the most frequent reason guiding their decisions. This generation is still young and is updated in technology, but they start to show higher interest on employment stability. Male Generation X is guided by income and opportunities of professional growth, but employment stability becomes an important reason. Male Baby Boomers are guided by the three reported reasons. Employment stability is not as important.

Table 1: Reasons guiding elections of professional career. Percentage is relative to the number of participants in each generation. Respondents were allowed to select more than one category; thus percentages do not add to 100%.

Reason guiding professional career decisions	**Baby Boomers**		**Generation X**		**Mature Millennials**		**Young Millennials**	
	Men	***Women***	***Men***	***Women***	***Men***	***Women***	***Men***	***Women***
Opportunities of professional growth	**64.3%**	34.8%	51.5%	46.8%	51.9%	48.0%	61.8%	**65.9%**
Income	57.1%	34.8%	**63.6%**	34.0%	**57.9%**	**52.0%**	**63.9%**	63.4%
Possibility of working in the field that mostly matters to me	50.0%	34.8%	34.1%	31.9%	39.8%	32.0%	27.8%	26.8%
Employment stability	28.6%	**39.1%**	37.1%	**51.1%**	35.3%	44.0%	23.6%	34.1%
Search of satisfaction with tasks done	17.9%	30.4%	15.9%	10.6%	21.8%	6.0%	12.5%	19.5%
Possibility of balance of working and personal life	10.7%	13.0%	14.4%	25.5%	6.0%	16.0%	8.3%	4.9%
Flexible working schedule	7.1%	4.3%	12.1%	4.3%	21.1%	22.0%	31.9%	29.3%

As seen on Table 1, differences between men and women in reasons guiding elections of professional career becomes larger as professionals become older. Each generation found different conditions when entering the labor market. Since then, both the market and professionals have evolved. New working roles and sectors have emerged. As professionals become older, their lives have also changed, and new responsibilities have arisen, but gender roles may influence the goals of men and women in such a way that priorities become different for both sexes. Young Millennials, the generation in which smaller gender differences are present, are young people free of responsibilities who can prioritize according to their likes and dislikes, with less social and family pressures.

Table 2: Obstacles reported by participants. Percentage is relative to the number of participants in each generation

	Baby Boomers		**Generation X**		**Mature Millennials**		**Young Millennials**	
Obstacle	***Men***	***Women***	***Men***	***Women***	***Men***	***Women***	***Men***	***Women***
Favoritism towards other people	**25.0%**	8.7%	24.2%	21.3%	16.5%	20.0%	13.9%	9.8%
Lack of acknowledgement of my skills from my superiors	21.4%	17.4%	**36.4%**	23.4%	**32.3%**	**26.0%**	34.7%	22.0%
My inability to communicate in other languages	14.3%	13.0%	22.7%	19.1%	21.8%	**26.0%**	18.1%	19.5%
Time required for attending my family needs	10.7%	**26.1%**	25.0%	23.4%	12.8%	8.0%	10.4%	12.2%
Lack of training opportunities	7.1%	8.7%	31.8%	**31.9%**	30.8%	22.0%	**41.7%**	**34.1%**
Very small companies that offer no career development possibilities	3.6%	0.0%	24.4%	10.6%	30.8%	20.0%	29.9%	24.4%
Discrimination due to my gender	0.0%	8.7%	0.8%	25.5%	0.8%	26.0%	0.0%	7.3%

Both female and male professionals report facing obstacles in the professional career development. The three obstacles in the professional career more frequently reported by female participants are:

- Lack of training opportunities (26.1%)
- Lack of acknowledgement of my skills from my superiors (23%)
- Inability to communicate in other languages (20.5%)

Two of the three main obstacles that female participants reported are exogenous, but the third one is endogenous.

The three main obstacles in their professional career that male participants reported are exogenous. They are:

- Lack of acknowledgement of my skills from my superiors (33.6%)
- Lack of training opportunities (33.2%)
- Very small companies that offer no career development possibilities (26.8%)

These results are consistent with some of the aspects highlighted in [19]. Table 2 shows the obstacles in the professional career development more frequently reported by gender and generation.

When referring to women, in general, female Baby Boomers report the lowest rate of obstacles. It is very likely that this generation has reached their personal and professional goals, and when they are asked about obstacles, they have not faced any for a long time. One of each four women between 30 and 50 years old (Mature Millennials and Generation X) reports that they have faced discrimination due to their gender. Female Young Millennials and Baby Boomers do not seem to be very affected by this obstacle. Small companies that do not offer career development possibilities affect more Young and Mature Millennials. Female X-ers and Mature Millennials are the generations more frequently reporting favoritism toward other people as an obstacle. For female Baby Boomers, time required for attending family needs seems to be the most present concern. On the other hand, lack of training opportunities is the obstacle more frequently reported by both female Generation X and Young Millennials. Female Mature Millennials seem to be facing their professional life confronting more obstacles.

When talking about men, in general, male Baby Boomers report the lowest rate of obstacles. Male X-ers and Mature Millennials report lack of acknowledgement of their skills from superior as the most frequent obstacle. Lack of training opportunities is the one more frequently reported by male Young Millennials. The small size of the companies is an important obstacle for Millennials. One of each four men in male X-ers and Baby Boomers has faced favoritism towards other people. In general, men do not report discrimination due to their gender.

According to Table 2, in general, men report a higher rate of obstacles than women. Female professionals of all generations face more frequently discrimination due to their gender. This is the only obstacle in which women from all generations surpass men. X-ers and female Baby Boomers report time required for attending family needs more frequently than the other generations. Baby Boomers are the generation reporting the lowest rate of obstacles; Mature Millennials are the ones with more significant differences between men and women, which may be related to the fact that men give more importance to income as a reason guiding professional career decisions. Working on very small companies that offer no career development possibilities seems to affect more men than women. Moreover, female and male Baby Boomers do not consider it is an obstacle for them. Finally, most obstacles are exogenous because they are caused by other persons, but the inability to communicate in other languages is endogenous and can be overcome. Speaking a foreign language is a personal decision; however, professionals from all generations report this obstacle.

On the following sections we try to characterize the evolution of the professional career of the participants.

4.3 Sector Evolution

Baby Boomers generation got into the work market between 1975 and 1985, which means they started working in organizations using mainframes. Generation X started working between 1986 and 1999, when microcomputers had invaded the Costa Rican industry. Mature Millennials started working between 2000 and 2006, when organizations had already found out that Internet was a valuable tool. Finally, Young Millennials started working between 2007 and 2015, a period in which mobile applications gained importance. This evolution in the computer market is visible in the evolution of industrial sectors professionals have worked on.

Changes in the industry affected all generations and new opportunities emerged. Professionals had the chance to shift to new sectors and roles. Table 3 shows the average number of years working, the number of employers, and the average number of years professionals have worked for one employer. The number of employers is slightly lower for women of all generations but the number of years working too. Younger generations show a higher rate of employer shifts, which also translates into a lower number of years with each employer. This may mean that participants´ reasons guiding career decisions involve moving to another employer or a way to overcome obstacles. Shifting employer may mean moving to another industrial sector and/or role.

Table 3: Number of employers and average number of years with one employer by generation and sex

	Baby Boomers		Generation X		Mature Millennials		Young Millennials	
	Men	**Women**	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**
Average number of years working	26.0	23.56	17.37	16.78	9.38	9.42	4.50	3.46
Number of employers	3.46	3.04	3.58	3.02	3.14	2.94	2.13	1.80
Average number of years with one employer	7.51	7.74	4.86	5.56	2.99	3.20	2.12	1.92

Figures 2, 3, 4 and 5 show the evolution for the four generations of industrial sectors in which professionals work. In each figure, the left axis shows the first sector in which professionals worked, and the right axis shows the current sector. Figures include information of those who have changed employer at least once and those who have not.

Female Baby Boomers (Figure 2) started working in the public (34.8%), higher education (21.7%), software development (13%), and finance (8.7%) sectors. The public sector (central government and related institutions), public universities and banks were the first adopting computers in Costa Rica. These organizations were the only ones which could afford the cost of mainframes. Nine out of 23 female Baby Boomers (47.8%) shifted to other sectors during their working lives, but they have mostly stayed in the same sectors they started working in. Currently, the public sector is still the most frequently reported (34.8%) by them, followed by higher education (26.1%). These two sectors offer employment stability, one of the three main reasons that female participants report as guiding their professional career decisions. None of the Baby Boomer women reports to be currently working in the software development sector.

Men in the Baby Boomer generation entered to a wider variety of entrance sectors than women, including commerce, health, and IT related services. Like women, male Baby Boomers (Figure 2) also started working in higher education (25%), public sector (21.4%), and software development (17.9%). The first two sectors are also the most frequently reported as current sectors. The software development sector is the one which decreases more significantly to 7.1%. Seventeen out of 28 male Baby Boomers (60.7%) shifted to other sectors; a few of them moved to sectors which were not among the entrance ones.

With the introduction of microcomputers, more organizations were able to invest on computers. This situation promoted the creation of a private software development sector, which has gradually become the most important entrance sector for professionals, as seen on figures 3, 4, and 5.

Figures 2, 3, 4, and 5 are not to scale. They represent the number of professionals in each sector, but for legibility purposes they were adapted. This adaption was necessary to contrast male and female evolution.

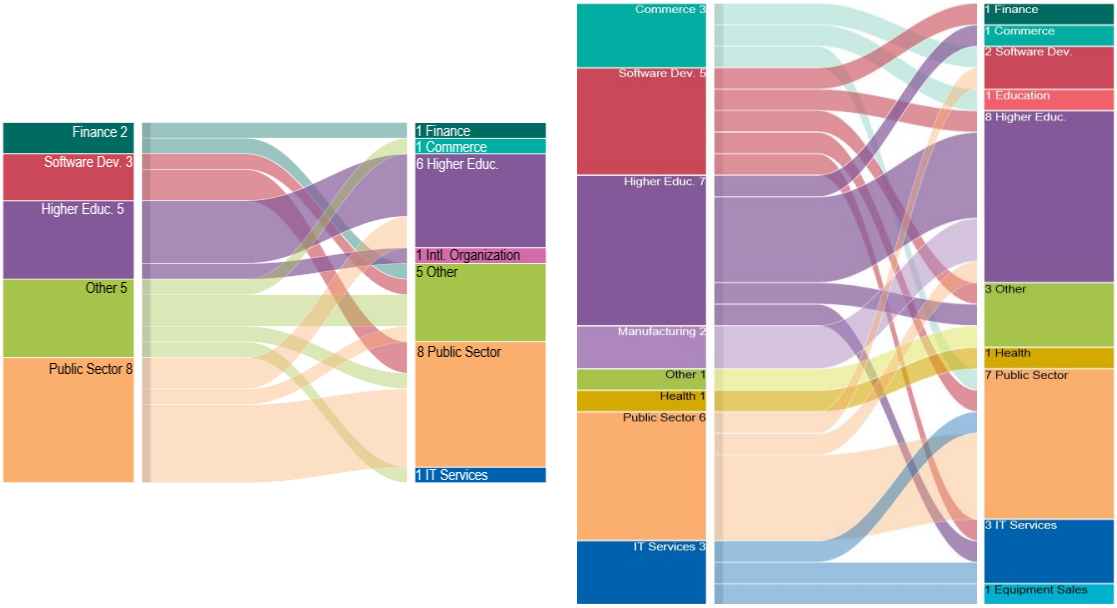

Figure 2: Left: Sector evolution of female Baby Boomers. Right: Sector evolution of male Baby Boomers. Figure not to scale.

Figure 3, corresponding to X-ers, shows that women started working in a wider variety of entrance sectors than female Baby Boomers. Commerce, international organizations, education (primary and high school), and IT related services emerged as new entrance sectors for women. The software development sector (36.2%) is the most frequently reported entrance sector by the female X-ers, followed by the public sector (31.9%). It is noticeable that the public sector (second in importance as entrance sector) has become the most frequently reported current sector (53.2%). All women who entered to the public sector remain on it.

Once again, it seems women are looking for job stability. The public sector fed with professionals who started working in the software development sector. Only one of the seventeen female X-ers who started working in the software development sector remains on it. This sector is reported only by 6.47% of participants as their current one. All women who started working in education moved to other sectors, very likely looking for higher income.

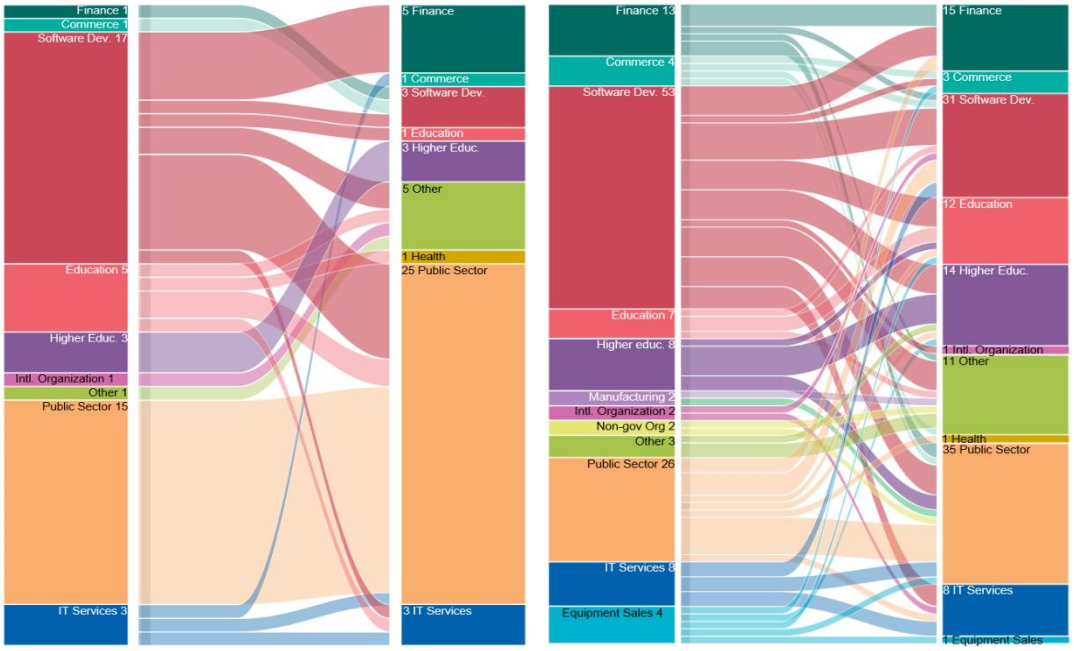

Figure 3: Left: Sector evolution of female X-ers. Right: Sector evolution of male X-ers. Figure not to scale.

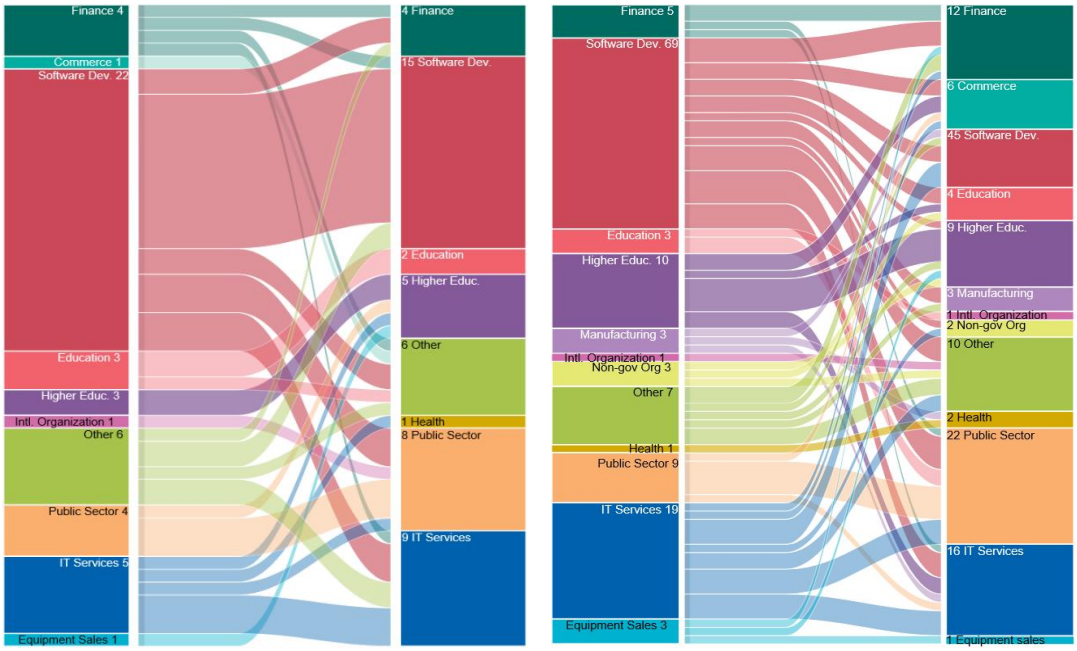

Figure 4: Left: Sector evolution of female Mature Millennials. Right: Sector evolution of male Mature Millennials. Figure not to scale.

Male X-ers reported as more frequent entrance sectors software development (40.2%) and public sector (19.7%). Only 23.5% report software development as current sector; the public sector is the largest current sector, reaching 26.5%. Sectors such as higher education and education grew significantly. It seems male X-ers are also looking for job stability.

The most important entrance sector for female Mature Millennials (Figure 4) is software development (44%), followed by IT related services (10%), public sector (8%), and finance (8%). Regarding the current sector, software development (30%) is the most frequently reported, but IT related services sector (18%), public sector (16%), and higher education (10%) have almost doubled. Most women who entered to the public sector remain on it.

Male Mature Millennials report software development (51.9%) as the most frequent entrance sector, followed by IT related services (14.3%), higher education (7.5%) and public sector (6.8%). Regarding the current sector, 33.8% reported software development, 16.5% public sector, and 12.1% IT related services. Software development is the sector that has decreased more significantly for both male and female participants of this generation.

Male Mature Millenials show a great dynamism related to sector shifting. Figure 4 shows that women of the same generation are more stable.

As shown on Figure 5, most female Young Millennials (68.3%) reported software development as their entrance sector, followed by IT related services (9.8%) and public sector (7.3%). Regarding the current sector, 65.9% indicated they still work in software development, 12.2% in IT related services, and 7.3% in public sector. Male Young Millennials also reported software development (66.7%) as the most important entrance sector, followed by IT related services (9.8%) and public sector (6%). Currently 56.3% work in software development, 9.8% in public sector, and 6.8% in IT related services.

Despite male Young Millennials started working only few years ago, they show a great dynamism related to sector shifting. Figure 5 shows, once again, that women are more stable than men. Those who entered in the public sector remain on it; it seems that stability offered by this sector is valuable for them.

It is noticeable that the public sector lost importance as entrance sector for Millennials and software development has become the most frequently reported. However, Mature Millennials have already started to shift from this sector. Despite the high percentage of professionals who have moved to another sector, the public sector generates less emigration. This is common to the four generations.

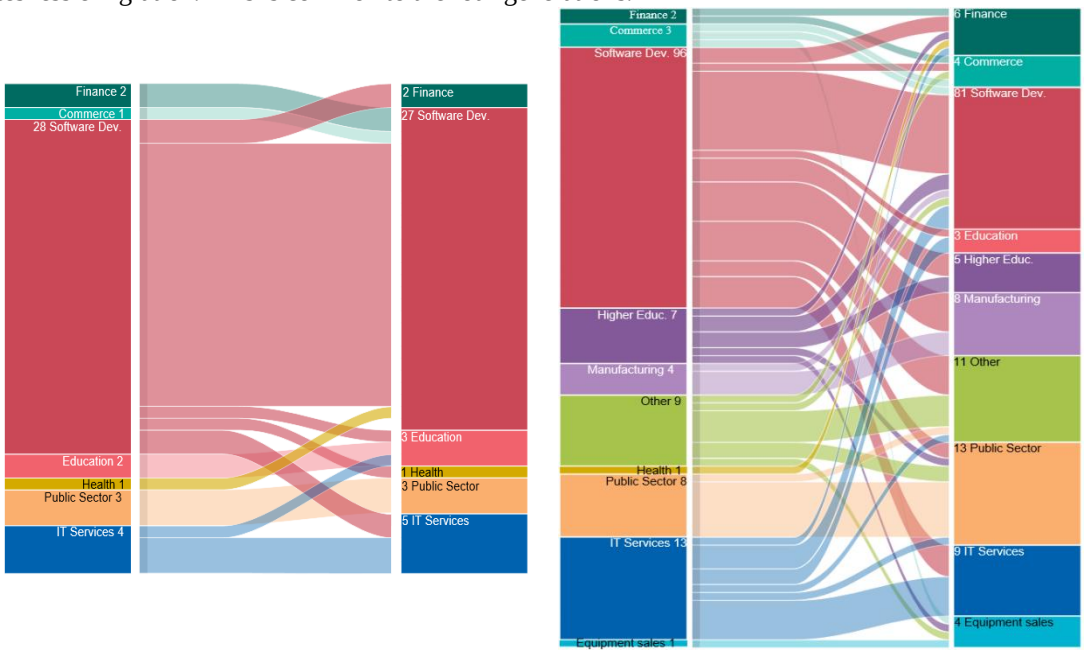

Figure 5: Left: Sector evolution of female Young Millennials. Right: Sector evolution of male Young Millennials. Figure not to scale.

The following facts can be derived from Figures 2, 3, 4 and 5:

- Men of all generations show more mobility among sectors than women.
- Male and female Baby Boomers seem the most stable.
- Software development is the most important entrance sector for both men and women of all generations, except for Baby Boomers.

- Software development sector is the most frequently reported as entrance sector, but mobility to other sectors is very high. This means that companies in this sector must constantly be seeking for new employees, which frequently are recently graduated from college.
- IT related services was not an entrance option for Baby Boomers and Gen X, but it is for both Mature and Young Millenials. This fact reflects a change in the labor market due to the establishment of companies dedicated to provide IT related services, such as call centers and corporative services.
- Public sector grows for all generations and for men and women. It is especially important for Baby Boomers and Gen X. Very likely those who have moved to this sector were looking for stability.

4.4 Role Evolution

Figures 6, 7, 8, and 9 show the evolution of roles played by professionals of the four generations: Baby Boomers, Generation X, Mature Millennials, and Young Millennials, respectively. Figures include information of professionals who have changed role at least once and those who have not. The left axis shows the first role played in the first working place by professional women, and the right axis shows the current role. Figures 6, 7, 8, and 9 are not to scale. They represent the number of professionals in each role, but for legibility purposes they were adapted. This adaption was necessary to contrast male and female evolution in a graphic way.

In Figure 6, for Baby Boomers, the role of Programmer is the most popular entrance role for women, however, a better paid position, Analyst, is the most popular entrance role for men. In fact, only two women and no men remain as programmers for this generation. Similarly, the Analyst role also shrinks. Baby Boomers, both male and female, have shifted for better paid or less technical positions. In fact, presence as Project Manager increases for both genders, and the Chief or Administrative Unit grows for women, and Manager appears for men.

Interestingly, the Other category is significant as entry role for this generation and increases for both female and male Baby Boomers.

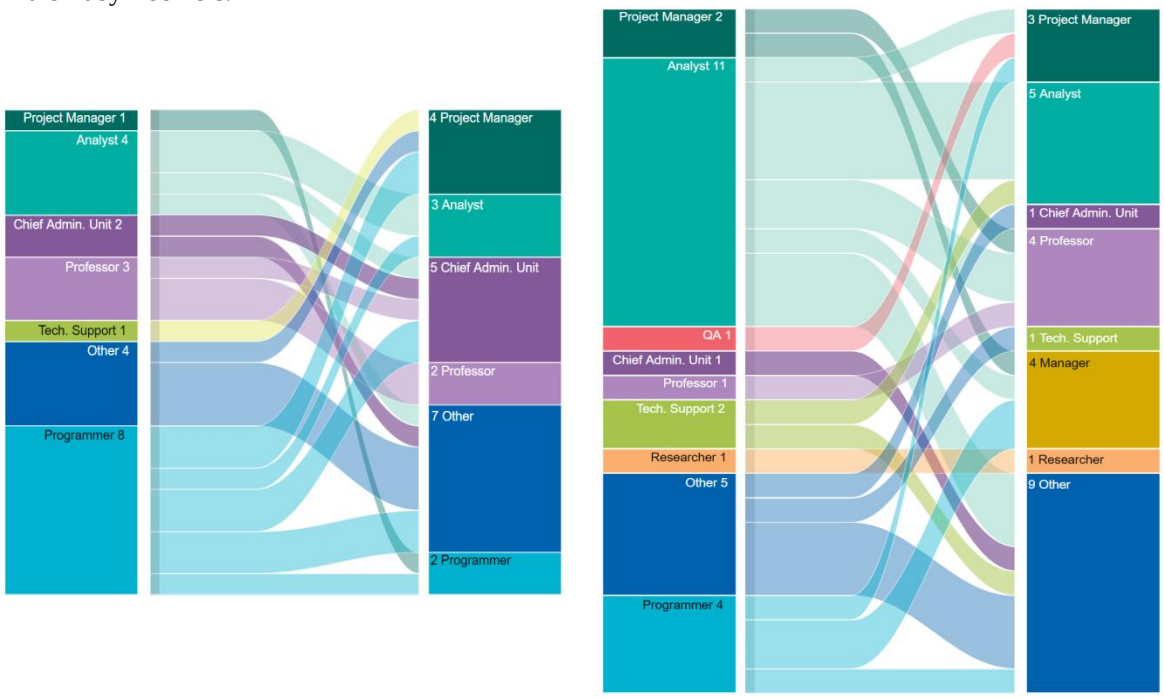

Figure 6: Left: Role evolution of female Baby Boomers. Right: Role evolution of male Baby Boomers. Figure not to scale.

In Figure 7, a swift in most popular entrance roles for X-er can be seen. The role of Programmer is the most popular entrance role for men; meanwhile, Analyst is the most popular entrance role for women. For both, the role of Programmer decreases significantly for this generation. Overtime, the Analyst role also shrinks for X-er females but not for X-er males. For this generation, Technical Support is also a very popular entrance role and its popularity decreases only a little for both genders. Similar to Baby Boomers, both male and female presence as Project Manager increases for this generation between entrance role and actual role. Some more sophisticated technical positions appear as actual roles for the members of this generation; such as Quality Assurance (QA) for women, and QA and Architect (referring to Software Architect) for men. Architect seems a very popular actual position for X-er men, not for X-er women. The Other category also increases for both males and females.

Figure 7: Left: Role evolution of female X-ers. Right: Role evolution of male X-ers. Figure not to scale.

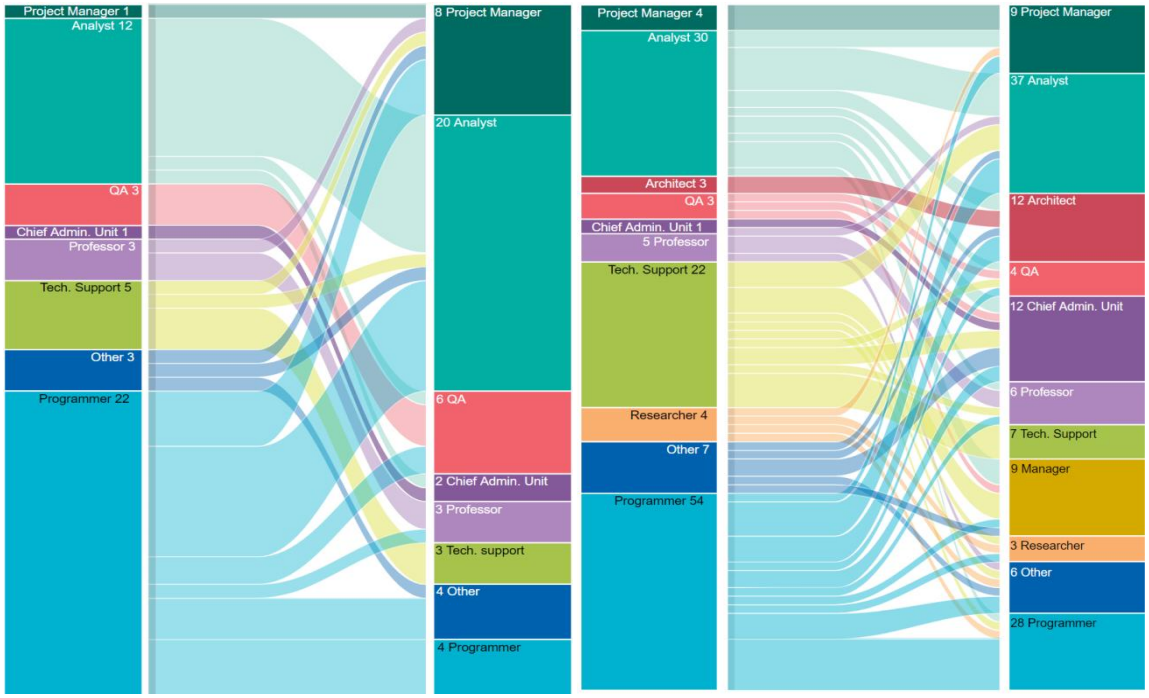

Figure 8: Left: Role evolution of female Mature Millennials. Right: Role evolution of male Mature Millennials. Figure not to scale.

Figure 9: Left: Role evolution of female Young Millennials. Right: Role evolution of male Young Millennials. Figure not to scale.

Programmer is the most popular entrance role for Mature Millennials, both women and men as depicted by Figure 8. In fact, almost half of the Mature Millennials respondents enter the labor market as Programmers, mainly for the Software development industry. Analyst and Technical Support are the next more important entrance roles reported. The Analyst popularity increases for both, but relatively more for women; meanwhile, Technical Support decreases very significantly for both. Similar to Baby Boomers, both male and female presence as Project Manager increases for this generation, between entrance role and actual role. Sophisticated technical positions such as QA for women, and QA and Architect (referring to Software Architect) for men, are more present than for the previous generation. This can be due to more complex software development done by the Costa Rican industry. More men and women of this generation have been able to go up though the administrative hierarchy; as Chief Administrative Unit or Manager, which puts in evidence that it takes women a longer time than men to achieve this within companies. The Other category is weak for both males and females.

Figure 9 shows that Programmer also is the most popular entrance role for Young Millennials, both for women and for men. In fact, Programmer is clearly the labor market entry door. More than half of Young Millennials start working as Programmers, mainly for the Software development industry. Analyst is the next more important entrance role reported. Technical Support decreases very significantly for both for this generation, giving space to Quality Assurance (QA). Male and female presence as Project Managers or Chief of Administrative Unit is scarce for this generation, since they have very little working experience. Over time, the role of Programmer decreases slightly, giving opportunity for both women and men to go up in the business hierarchy, to analyst or QA. Surprisingly, a high percentage of males exit from Technical Support in this generation.

The following facts can be derived from Figures 6, 7, 8, and 9 as analyzed together. The role of Programmer is the most frequently reported as first role both for Young Millennials, Mature Millennials, and Baby Boomers. Analyst/software engineer is the role most frequently reported by X-ers, followed by programmer. Younger generations (Mature and Young Millennials) reported Programmer as first role more frequently than older generations. This is congruent with what is shown on figures 2, 3, 4, and 5, in which the software development sector gradually becomes more important.

The role Analyst/software engineer is the second most frequently reported as first role in the other three generations: Young Millennials, Mature Millennials, and Baby Boomers. Female Young Millennials are the only ones who do not report the role Professor as entry role. Some Millennials reported the role quality assurance as first role. This fact reflects a change in the practice of software engineering in Costa Rica. In the late nineties of the twentieth century, software development companies started to introduce the practice of quality assurance in the process.

As expected, few professionals from all generations reported managerial roles (Director/Chief of administrative unit, Manager, and Project manager) as entrance role. These roles require the development of skills which are not common in recently graduated professionals.

Figures 6, 7, 8, and 9 show a high dynamism in role changes. The role that gets significantly smaller for all generations is Programmer. In fact, only 23% of female programmers and 28% male programmers are older than 30 years old. This shows that programmer is an entrance role. The role Analyst/software engineering gains importance as current role for Young and Mature Millennials. For older generations, this role is still one of the more frequently current roles, but it loses importance.

Managerial roles (Director/Chief of administrative unit and Manager) gain participation in older generations. These roles require developing skills that are not present in younger people. Project manager is not mentioned by female Baby Boomers as current role (Figure 6), but it is by Generation X and Mature Millennials, as shown on figures 7 and 8, respectively. This role requires knowledge and training generally not taught at a bachelor's degree on Computer Science.

Quality assurance (QA) is a role not played by Baby Boomers, except for one male as entrance role. The other three former generations reported this role as current job. This is a technical job which requires some degree of specialization and additional training. The topic of quality assurance started gaining importance in Costa Rica during the last five years of the twentieth century. This can explain why Baby Boomers did not introduce in this role.

Young Millennials have moved to technical roles which they also reported as entrance roles (Figure 9). Analyst/software engineering and QA are the current roles that have gained more importance for this generation. The other three generations show three facts:

- Baby Boomers (Figure 6), X-ers (Figure 7) and Mature Millennials (Figure 8) show great dynamism. More than 50% in these three generations have shifted from their entrance role to a different role.
- Men exhibit more dynamism that women in all generations.
- Professionals have shifted to roles that were not among the first roles they reported. The role Other becomes more frequent as generations get older. They also start playing less technical or more specialized roles, which is consistent with what [6] describes.

4.5 Entrepreneurship

Only eight women participating in this research (5%) own, partially or totally, a company. All of them think it was a good decision to be entrepreneurs. These women are between 27 and 49 years old. Motivations of women for shifting from employees to entrepreneurs are professional growth (50%), independence (25%), and flexibility (25%). Female entrepreneurs reported that the contributions of their companies to the society are a positive impact in people life quality (62.50%) and the development of innovative products (37.5%).

Fifty men (11.4%) own, partially or totally, a company. Only one of them thinks becoming an entrepreneur was not a good idea. These men, between 23 and 58 years old, were motivated by professional growth (44%), independence (28%), and desire of innovating (14%). Male entrepreneurs reported that the contributions of their companies to the society are income generation (66%), the development of innovative products (50%), and generation of employment opportunities (42%).

A relatively very low percentage of professionals have decided to change an employee career for an entrepreneurial one. This is an aspect that requires more study in order to determine what motivates this decision and why only few women and men take this professional path.

4.6 Degree of Satisfaction with the Professional Career

To the question of *how you feel respect to your professional career*, 62.7% of women answered they feel very satisfied and 31.1% satisfied. By generation, percentages are as follows:

- Baby Boomers: 69.6% very satisfied and 26% satisfied
- Generation X: 63.8% very satisfied and 27.7% satisfied
- Mature Millennials: 56% very satisfied and 34% satisfied
- Young Millennials: 65.9% very satisfied and 34.1% satisfied

To the same question, 59.3% of men answered they feel very satisfied and 33.8% satisfied. By generation, percentages are as follows:

- Baby Boomers: 67.9% very satisfied and 25% satisfied
- Generation X: 62.8% very satisfied and 31.6% satisfied

- Mature Millennials: 59.4% very satisfied and 32.3% satisfied
- Young Millennials: 57.2% very satisfied and 39.6% satisfied

Percentages of satisfaction of men and women are very similar. The only worth reporting difference is the degree of satisfaction of Young Millennials, were men are a little less satisfied than women.

We did not ask why they reach the degree of satisfaction they answer, but we think it may be related to the ways professionals think they contribute to the society. Women reported that they generate:

- Products and services which improve people life quality (49%)
- Access to information (39.1%)
- Better services provided to citizens by public institutions (36.7%)
- New knowledge and technologies useful for the society (26.7%)

On the other hand, men indicated that they contribute to society with:

- Products and services which improve people life quality (61.1%)
- Access to information (38.4%)
- Wealth generation for private companies (38.2%)
- Better services provided to citizens by public institutions (35.5%)

Men and women share three of their more important contributions to society. Notice that the nature of these contributions is social, except wealth generation for private companies. Most professionals feel they do something useful for the society. This may contribute to the degree of satisfaction they report.

The difference in the frequency the main contribution is reported is noticeably higher for men. Table 4 shows the ways of contribution to society reported by participants.

Table 3: Contribution to society by generation and sex.

	Baby Boomers		**Generation X**		**Mature Millennials**		**Young Millennials**	
Contribution	***Men***	***Women***	***Men***	***Women***	***Men***	***Women***	***Men***	***Women***
Better services provided to citizens by public institutions	**67.9%**	**52.2%**	47.7%	**55.3%**	31.6%	32.0%	21.5%	12.2%
Products and services which improve people life quality	60.7%	43.5%	**61.4%**	40.4%	**63.2%**	52.0%	**59.0%**	**58.5%**
Academic education of professionals needed by the society	50.0%	30.4%	34.8%	19.1%	29.3%	22.0%	22.9%	14.6%
Access to information	46.4%	34.8%	46.2%	51.1%	27.8%	32.0%	39.6%	36.6%
Generation of new knowledge and technologies useful for the society	32.1%	34.8%	32.6%	23.4%	29.3%	26.0%	31.3%	26.8%
Wealth generation for private companies	25.0%	0.0%	31.1%	21.3%	41.4%	28.0%	44.4%	26.8%
More transparency for decision making	25.0%	17.4%	22.0%	29.8%	18.8%	16.0%	13.9%	9.8%
Security for people and their assets	25.0%	21.7%	22.0%	14.9%	18.8%	8.0%	14.6%	9.8%
Tax payment	7.1%	8.7%	25.0%	8.5%	32.3%	20.0%	27.1%	12.2%
Attraction of foreign investment	0.0%	4.3%	22.7%	4.3%	34.6%	26.0%	31.3%	29.3%

As seen on Table 4, men report higher levels of contribution that women despite both genders play the same roles in organizations. For both sexes, the contribution *better services provided to citizens by public institutions* gets more importance as generations are older, which is consistent with the public sector becoming more important

as current sector, as professionals become more mature. Only 26.7% of women and 31.1% of men report that they generate *new knowledge and technologies useful for the society* in a field of creation of technological tools. This may mean that the Costa Rican industry does not offer many opportunities to work on research and development. Additionally, the contribution *security for people and their assets* is reported by 12.4% of women and 18.3% of men. These are very low percentages in a field in which security must be a priority to professionals creating information technologies.

To the question whether they would choose to study Computer Science based on their current experience, 77% of women and 88.5% of men answered *yes*. When analyzed by generation, we got the following percentages:

- Baby Boomers: 52.2% of women and 71.4% of men
- Generation X: 83% of women and 86.3% of men
- Mature Millennials: 72.0% of women and 90.2% of men
- Young Millennials: 90.2% of women and 92.3% of men

It is noticeable that younger generations are more willing to choose to study Computer Science again based on their current experience. If more than 90% of Baby Boomers and X-ers are very satisfied or satisfied with their professional career, why are so many of them unwilling to choose to study Computer Science? Professionals in older generations know themselves better and could have discovered other study fields that are also interesting to them. Additionally, keeping updated in Computer Science is hard, due to the rapid rhythm of technology change. Therefore, Baby Boomers and X-ers may be exhausted. They may also have found obstacles that they think would not exist in other fields.

5 Conclusions

Results reflect significant differences on the professional career evolution among different generations. For example, reasons guiding their elections of professional career vary between generations. Older generations give more importance to employment stability, whereas younger generations guide their decisions mostly by opportunities of professional development and income.

Moreover, representatives of different generations face different challenges and express different concerns. For Baby Boomers, lack of acknowledgement of skills from superiors seems to be the most present concern. On the other hand, lack of training opportunities is the obstacle most frequently reported by both Generation X and Young Millennials. Mature Millennials seem to be facing their professional life confronting more heterogeneous obstacles than the previous generations. In general, men report higher rates of obstacles than women. Female of all generations reported more frequently discrimination due to their gender.

Evolution in ICT is visible in the evolution of industrial sectors professionals have worked on. Baby Boomers generation started working in organizations using mainframes; X-ers when microcomputers had invaded the Costa Rican industry; Mature Millennials after the advent of Internet, and Young Millennials when mobile applications became popular. As a result, the public sector and the higher education sector were critical for ICT in the early years, and Baby Boomers started working, and remain working, mainly in these sectors. The software development sector became very relevant for the next generations, both men and women.

Emigration from other sectors to the public sector can be highlighted. This phenomenon is stronger for women than for men. Employment stability and limited working hours can be some of the motives to emigrate. Emigration to other industrial sectors may be due to opportunities for professional growth or better income offers.

Role differences also exist among generations. The role of programmer is the most frequently reported as first role by Young Millennials, Mature Millennials, and Baby Boomers. Analyst/software engineer is the role most frequently reported by X-ers, followed by Programmer. Younger generations (Mature and Young millennials) reported Programmer as first role more frequently than older generations. However, this role gets significantly smaller over time for all generations. This shows that the role of programmer is an entrance role. The role Analyst/software engineering gains importance as current role for Young and Mature Millennials. For older generations, this role is still one of the more frequently current roles but it loses importance. Managerial roles (Director/Chief of administrative unit and manager) gain participation in older generations.

The findings show interesting differences on generational groups related to reasons guiding preferences on professional careers and security in their decisions. Older generations show a higher participation in teaching. Their reasons for deciding to work as teachers are not related to economic factors but to personal satisfaction and social reasons. Entrepreneurship, independently of the generation they belong to, is still low, which is consistent with the literature review. It is lower for females than males. It is not clear why this happens, but it may be that becoming an entrepreneur is not consistent with the reasons guiding professional career decisions.

ICT industry in Costa Rica has faced scarcity of professionals. As a consequence, professionals are highly demanded, and they are able to migrate from one position to another relatively easily. Baby Boomers, X-ers and

Mature Millennials show greater role dynamism and Young Milleniums, who are only starting their careers. More than 50% of participants in these three generations have shifted from their entrance role to a different role. It is interesting to highlight that male figures exhibit more dynamism that female behavior in all generations. More research on this situation is necessary to determine its causes.

It is very interesting to draw attention to the fact that most professionals of both genders, independent of their generation, are very satisfied or satisfied with their professional career. This is an important conclusion that can be used to attract more women to the ICT field. In fact, percentages of satisfaction of men and women are very similar. The only aspect worth highlighting is the degree of satisfaction of Young Millennials, where men are a little less satisfied than women. Women in all generations, including the Young Millenniums generation, are still a small minority. More research is needed to understand and reverse this phenomenon.

Acknowledgements

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