HUMAN CAPITAL FORMATION AT LHC: SURVEY RESULTS

GELSOMINA CATALANO   CHIARA DEL BO   MASSIMO FLORIO

FRANCESCO GUALA

UNIMI UNIVERSITÀ DEGLI STUDI DI MILANO

ARE PREFERENCES FOR REAL?

CHOICE THEORY, FOLK PSYCHOLOGY,
DIPARTIMENTO DI ECONOMIA, MANAGEMENT E METODI QUANTITATIVI
AND THE HARD CASE FOR COMMONSENSIBLE REALISM
**Via Conservatorio 7
20122 Milano
tel. ++39 02 503 21501 (21522) - fax ++39 02 503 21450 (21505)
http://www.economia.unimi.it
E Mail: dipeco@unimi.it**

FRANCESCO GUALA

HUMAN CAPITAL FORMATION AT LHC: SURVEY RESULTS

Gelsomina Catalano, Chiara Del Bo, Massimo Florio

Department of Economics, Management and Quantitative Methods, University of Milan

Abstract

This note provides preliminary results from a survey of 384 fellows and students previously or currently working and studying at different experiments on particle accelerators at CERN. The aim of the survey was to understand the impact, in terms of both monetary and non-monetary outcomes, of a research and study period at CERN. The first results suggest that the majority of respondents, irrespective of their working status, report a positive impact of the period at CERN, and expect this effect to hold also with respect to future career and salary outcomes.

Keywords: human capital, expectations, salary premium.

JEL Codes: D61, D81, I23, O32

European Investment Bank · Institute

Introduction

The Large Hadron Collider (LHC) is a stimulating place which offers young students the opportunity to interact with other students and scientists from different countries. As an attempt to measure the human capital formation deriving from this interaction, an on-line survey has been launched to former and current students involved in the LHC activities[1]. The survey has been carried out between April and November 2014 and has been complemented with face-to-face questionnaires to students met at CERN and working on experiments and LHC in general[2]. Preliminary results deriving from these observation are shown in Part I of this note.

The survey has been structured with the aim to track the career paths of these students after the LHC experience and, as far as possible, to assess the marginal impact of such an experience on their professional achievements and in particular on monetary compensation. The expected career path and the desired compensation have been asked in the case of respondents which are still studying or are currently unemployed respectively. In particular, the following main research questions have been investigated through the survey:

- What is the impact of the LHC experience in terms of <u>skills acquired</u>?
- What is the impact of the LHC experience in terms of <u>salary and professional paths</u>?
- What would have been the '<u>alternative</u>' to LHC and which the consequences in terms of capacity to negotiate for salary, increase of salary in the long-term, difficulties (delays) to join an equivalent job position, etc.?

The full questionnaire is enclosed to this note (see Annex 1)[3]. Before the launch of the survey, the questionnaire has been tested with students involved in the LHC activities during two focus groups held on 11th of March 2014 at CERN.

In addition to the on-line survey and face-to-face questionnaires, a benchmark analysis was carried out to assess the differences in salaries due to the job position covered (e.g. physicist, professor, associate professor, etc.), the sector of employment (e.g. industry, research, academia, other), the level of education (e.g. with or without the PhD degree, etc.). For this purpose, different sources have been explored. Results of this analysis are shown in Part II of this note.

---

[1] The on-line survey has been firstly launched to CMS former and current students in collaboration with the team of CMS (Compact Muon Solenoid) experiment. In particular, the support in gathering contacts of former and current students involved in the CMS collaboration is gratefully acknowledged to TizianoCamporesi (CMS Spokesperson) and NicolettaBarzaghini (CMS Secretariat). Following this pilot test, the survey has been extended also to former and current students involved in other LHC collaborations.

[2] Interviews were carried out at CERN on June 2nd and 3rd, 2014, on October 13rd and 14th 2014, on March 11th and 13th 2015.

[3] It is worth noting that questionnaire was initially drafted for (former) students working at CMS collaboration. During the face-to-face interviews, it was adapted also to (former) students working at other LHC collaborations.

Part I –Results of the survey in a nutshell

Students, visiting researchers and permanent staff are both the workforce running experiments at CERN facilities and the beneficiaries of the research and scientific output produced. Do they benefit from their stay at CERN, in terms of productivity and research output, skills learned, career path and salary? Is the perceived actual and expected impact, if any, different depending on employment status? Are personal characteristics relevant in explaining the impact of a period at CERN? The present note presents the first results obtained by analyzing the answers provided by a sample of CERN fellows, students and staff, interviewed in 2014, both online and in person. While research is still ongoing, preliminary analyses suggest that the perceived impact, both on the respondents' current situation and in terms of future expectations, is positive, irrespective of current employment status. In detail, after presenting some general characteristics of the sample, results are presented on the impact on research output, career and salary expectations, and on the actual impact on current salaries. For outcome variables, with some degrees of variation, the actual and expected outcome is positive for the majority of respondents. Further research will explore in more detail the underlying mechanisms, with the aim of providing a clearer picture of the impact of human capital formation at large research infrastructures.

1. Sample overview

Results presented are based on the information gathered from 384 questionnaires,[4] completed between April and March 2015, 221 of which administered on the premises of CERN, while the remaining 163 were filled in online. Before going into details of results, it is worth noting that approximately 56% of respondents are working (as a post-doc or in other positions, hereafter working), while 44% are not (hereafter not-working), because still studying (40%) or because currently unemployed (4%).

**Figure 1: Share of respondents by current position**
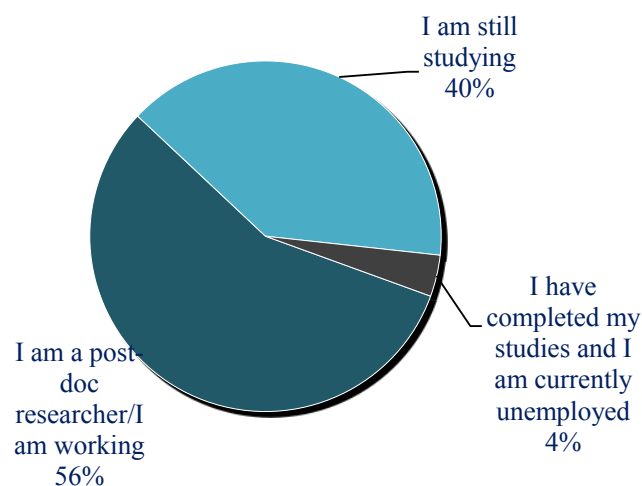
Participants in the survey are former or current students, CERN fellows and visiting researchers, studying and working on different experiments that are currently carried out at CERN. The distribution of participants to the survey among the different experiments is provided in Figure 2 below, from which the predominance of people working at CMS is evident (78%).

---

[4] Note that not all the questionnaires are complete, so the total number of answers may vary for each question considered.

Figure 2: Experiments (frequency and percent)

LHCb 27, Other 3, ALICE 19, ATLAS 84, CMS 251

LHCb 7%, Other 1%, ALICE 5%, ATLAS 22%, CMS 65%
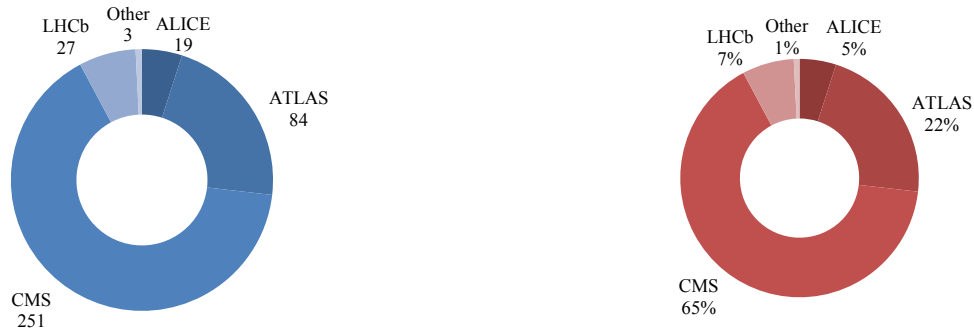
Looking at the profile of these respondents (see Figure 3 below), it is worth noting that 75% are male and mostly European, with an overall representation of 52 nationalities. Respondents from Italy and USA account for the largest share (overall 38% of respondents) followed by UK and Germany (8% respectively). In terms of age, the majority of respondents (43%) are in their thirties, followed by fellows and students in their twenties (38%).

Figure 3:Share of respondents by sex, year of birth and nationality

Female 25%, Male 75%
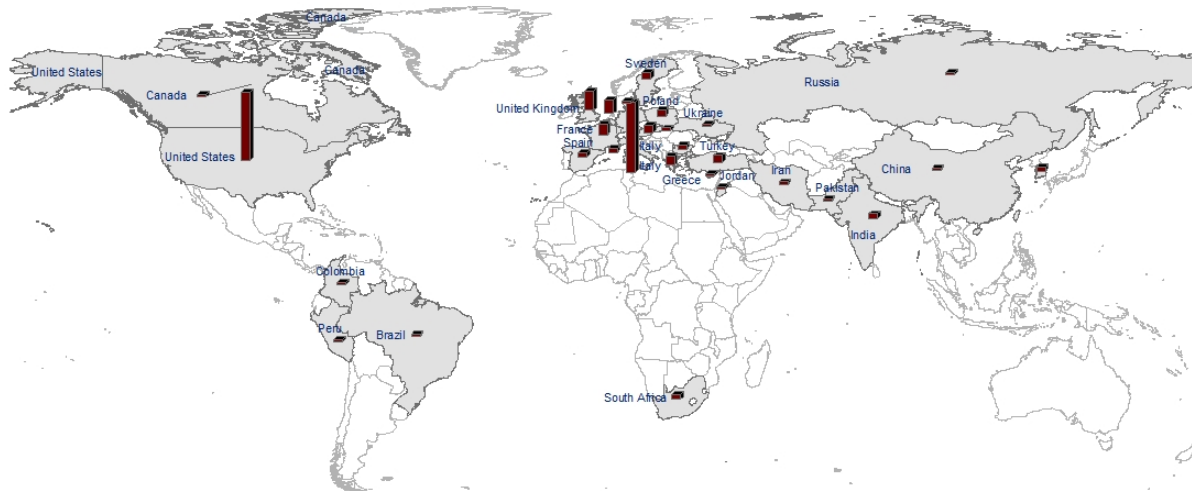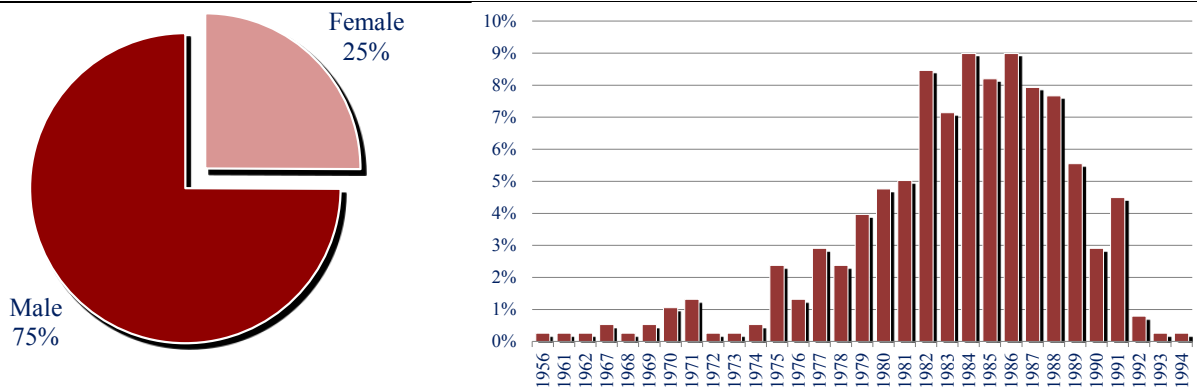
The largest share of respondents has got a PhD degree (68%), followed by 29% having a Master degree and 3% a Bachelor's degree or equivalent (see Figure 4 below). Applied or experimental physics is the most common academic background of respondents to the survey (85%) followed by engineering (6%), theoretical physics (6%) and computer science (2%). Most of the surveyed individuals hold a PhD in physics, as is evident from Table 1.

Figure 4: Share of respondents by educational degree and academic background
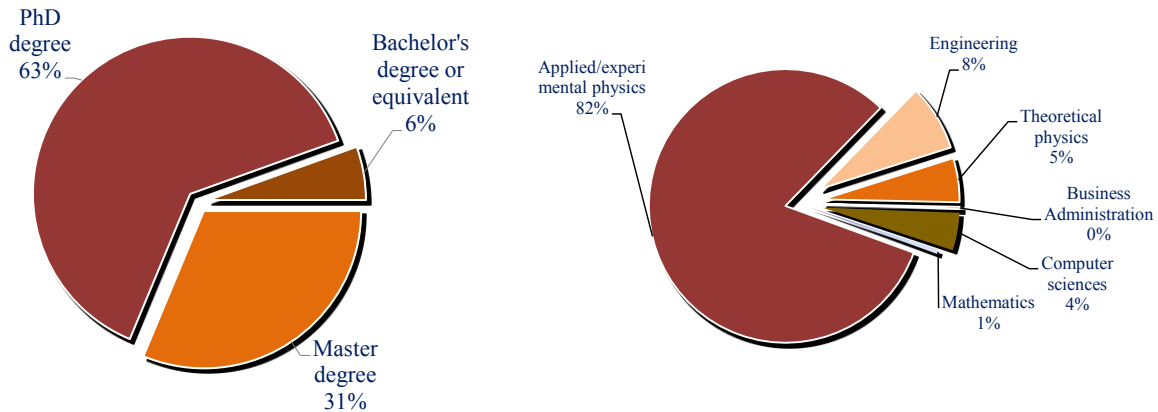
Table 1: Number of respondents by highest degree achieved and field

Degree/Field	Physics*	Engineering	Computer Science	Math	Business Administration
BA	8	3	5		
Master	64	19	6	1	1
PhD (completed)	179	1	4		
PhD (ongoing)	82	7	2	1	

2. *Impact of CERN research period on research output and skills*

Research activities such as those carried out at the various experiments hosted at CERN typically lead to significant output in terms of publications, patents and software applications. Are both students and working fellows contributing to the production of knowledge output? In the following Table 2 the number of papers (including working papers and preprints, conference proceedings, articles and chapter in books) and the number of patents[5,] software applications and multimedia applications are considered, distinguishing between respondents who can be classified as working or not (the latter including both students and the few currently unemployed).

Table 2: Research output and employment status (percent)

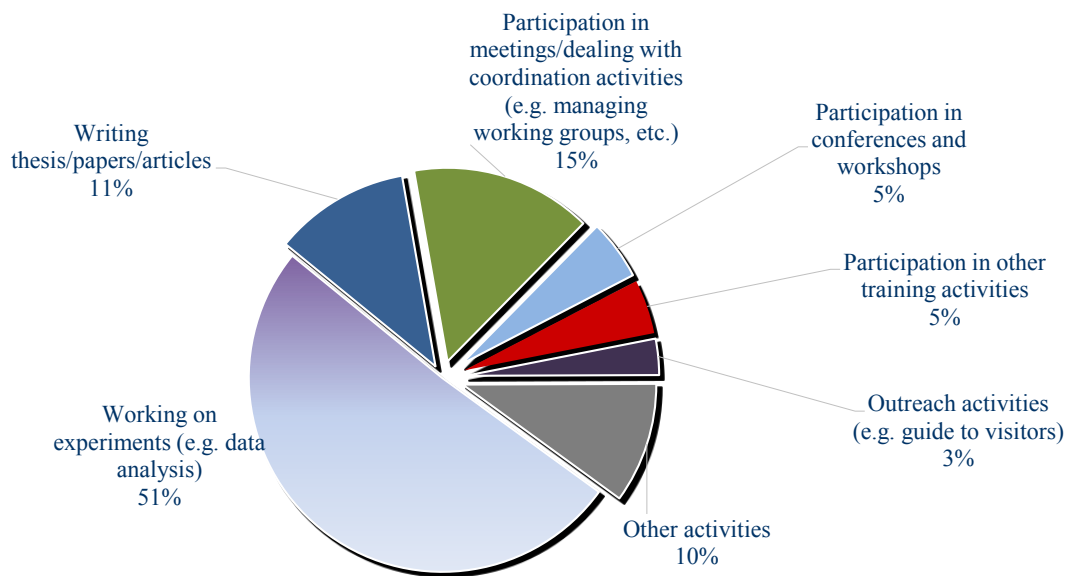|	Papers		Patents, software and multimedia	
	Working	Not-Working	Working	Not-Working
0	19	23	68	65
0-5	51	66	24	17
6-10	13	6	4	12
11-20	6	0	1	0
21-30	2	0	1	0
> 30	9	5	1	7
Total	*100*	*100*	*100*	*100*

Source: *Authors processing*

Note: *In each cell, the number represents the percent of respondents that have co-authored the number, as set out in each row, of research output, identified in the respective columns.*

In each cell the % of respondents quantifying their research output for the two categories is presented. Looking at papers, the highest percentage of respondents have co-authored from 1 to 5 papers, irrespective of their employment status. Similar conclusions can be drawn for patents, software and multimedia applications, although the majority of respondents have not produced this type of research output.

During their research period at one of the LHC's collaborations (CMS, ATLAS, ALICE, LHCb), respondents have spent most of their time in working on experiments (on average 51% of their time), in participating to meetings or dealing with coordination activities (15% of their time) and in writing paper, thesis or articles (11% of their time, see Figure 5 below). 26% of respondents have completed their research period while 74% are expected to complete it between 2014 and 2020.
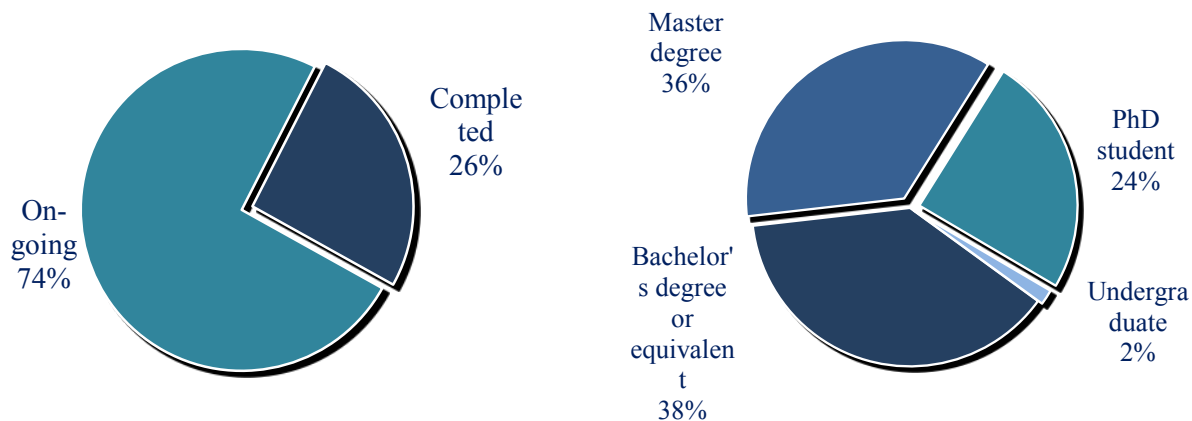
---

[5] Patents are very few, a result that might be related to the overall policy at CERN concerning patenting behavior.

Figure 5: Time spent by respondents during the research period at LHC

Participation in meetings/dealing with coordination activities (e.g. managing working groups, etc.) 15%

Participation in conferences and workshops 5%

Writing thesis/papers/articles 11%

Participation in other training activities 5%

Working on experiments (e.g. data analysis) 51%

Outreach activities (e.g. guide to visitors) 3%

Other activities 10%

Figure 6: Status of the research period at LHC and the academic background at the time they started it. Share of respondents

Completed 26%

On-going 74%

Master degree 36%

PhD student 24%

Bachelor's degree or equivalent 38%

Undergraduate 2%

In terms of skills acquired, respondents declared that technical and scientific skills and the problem-solving capacity are amongst the skills which have been mostly improved thanks to the LHC experience (see Figure 7 below).

Figure 7: Skills improved thanks to the LHC experience

Share of respondents

	Scientific skills	Technical skills	Communication skills	Problem-solving capacity	Team/project leadership	Developing, maintaining and using networks of collaborations	Independent thinking/critical analysis/creativity
Highly Decisive	50%	44%	29%	33%	20%	20%	31%
Decisive	36%	39%	44%	46%	33%	37%	39%
Moderately Decisive	12%	12%	20%	17%	31%	29%	21%
Poorly Decisive	2%	3%	5%	3%	13%	11%	6%
Not Decisive	1%	1%	2%	2%	2%	4%	3%
Total	100%	100%	100%	100%	100%	100%	100%

Average Judgement
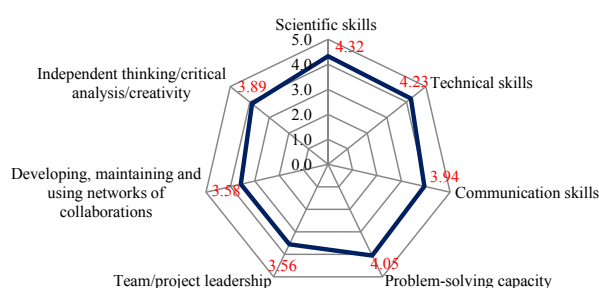
Highly Decisive	5
Decisive	4
Moderately Decisive	3
Poorly Decisive	2
Not Decisive	1

Source: Authors processing

Respondents were inquired about the factors enabling the decision of applying for a research period at LHC, the alternative to the LHC that they have considered as well as the number of activities they have joined at CERN. The aim of these questions was to properly understand and explain answers provided by respondents on the impact of LHC experience on their research activity and, moreover, on their professional career.
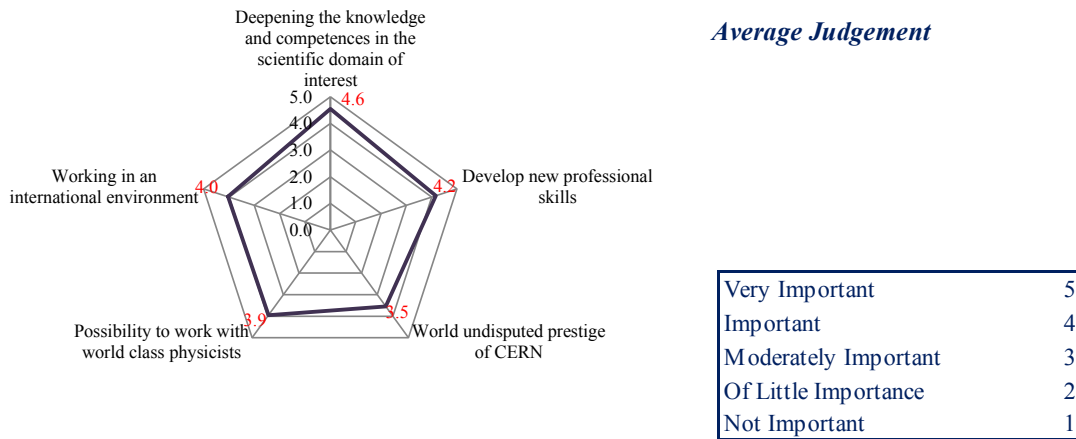
Evidence collected show that when they have applied for a research period at one of LHC's collaboration, respondents have mostly taken into account the following considerations: '*deepening the knowledge and competences in the scientific domain of interest*'; '*developing new professional skills*', '*working in an international environment*'; *possibility to work with world class physicists*' (see Figure 8 below).

When asked to indicate which was their *alternatives* to the LHC experience, respondents declared firstly that they would have applied for another research period on another experiment at CERN. The largest share of respondents declared that they would have applied for a research period at another international research institute (other than CERN) as a second alternative while they would have applied for a research period at a national research institute as a third alternative.

Figure 8: Factors enabling the decision of applying for a research period at LHC

Share of respondents

	Deepening the knowledge and competences in the scientific domain of interest	Develop new professional skills	World undisputed prestige of CERN	Possibility to work with world class physicists	Working in an international environment
Very Important	64%	41%	27%	37%	40%
Important	29%	40%	27%	34%	35%
Moderately Important	7%	15%	25%	20%	17%
Of Little Importance	1%	4%	17%	7%	6%
Not Important	0%	1%	4%	3%	2%
Total	100%	100%	100%	100%	100%

Average Judgement

Very Important	5
Important	4
Moderately Important	3
Of Little Importance	2
Not Important	1

Source: Authors processing

Table 3: Alternatives to LHC experience. Share of respondents

	I Alternative	II Alternative	III Alternative
I would have applied for a research period at another international research institute (other than CERN)	9%	**67%**	8%
I would have applied for a research period at another national research institute (other than CERN)	9%	12%	**57%**
I would have applied for a research period on another experiment at CERN	**67%**	2%	5%
I would have applied for an Internship in academia	6%	5%	6%
I would have applied for an Internship in the industry sector	4%	7%	12%
I would have applied for an Internship in the IT sector	2%	3%	8%
I would have applied for an Internship in the financial sector	1%	3%	4%
I would have applied for a job in academia	0%	0%	0%
I would have applied for a job in the industry sector	2%	0%	0%
I would have applied for a job in the IT sector	0%	0%	0%
I would have applied for a job in the financial sector	0%	1%	0%
Total	100%	100%	100%

Source: Authors processing

Figure 9: The experience at CERN. Share of respondents by number of collaborations joined
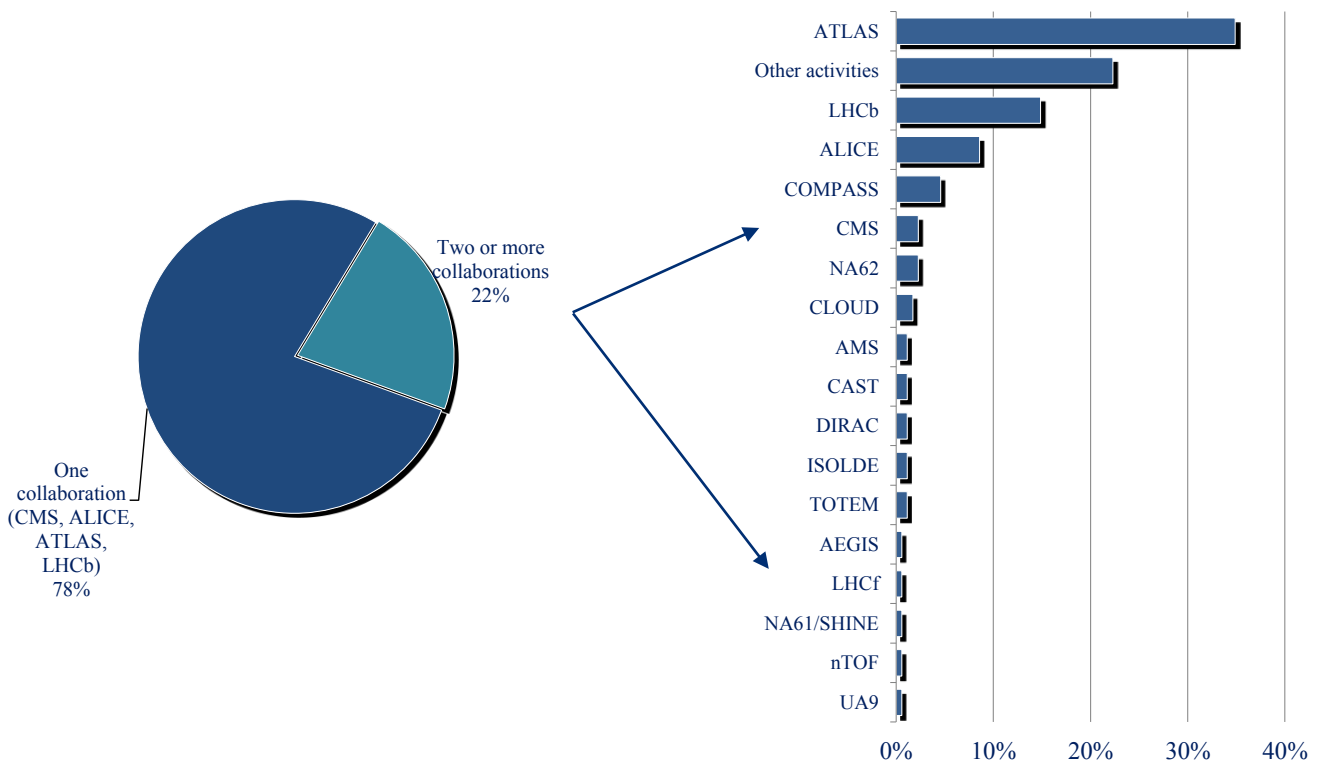
3. Impact of CERN research period on professional career: ex-ante versus ex-post evaluation

Respondents were asked to rate the importance of their research period at CERN, on a 1 to 5 scale, with respect to their professional career. Given that the sample includes both students and individuals who have completed their studies and are currently working (see Figure 1 for details on share of respondents by employment status), the information can be read in terms of ex-ante expectations and ex-post evaluations. Table below thus provides an overview of how respondents have rated their research experience at CERN based on their current employment status. Overall, respondents believe their research period at CERN is relevant or very relevant for their career. Comparing students versus workers, the former seem to be understating, ex-ante, the importance of the stay at CERN with respect to the latter, possibly suggesting that the actual impact of the research period might be greater than what is expected[6].

Table 4. Impact on career (percent)

	Impact on career	
	Working	Not-Working
Not relevant	3	2
Of little relevance	2	3
Moderately relevant	19	10
Relevant	29	38
Very relevant	47	46
Total	**100**	**100**

Source: Authors processing

Focusing on respondents which are still studying or are currently unemployed, it is worth noting that the largest share expects to have a professional experience at CERN or join a position in a research institution other than CERN or at university. Physicist, post-doc, researcher, data analysts and software engineer are the most cited positions which they are expected to cover.

Figure 10: Respondents who are currently studying/unemployed. Expectations about their professional career: sector, position and salary
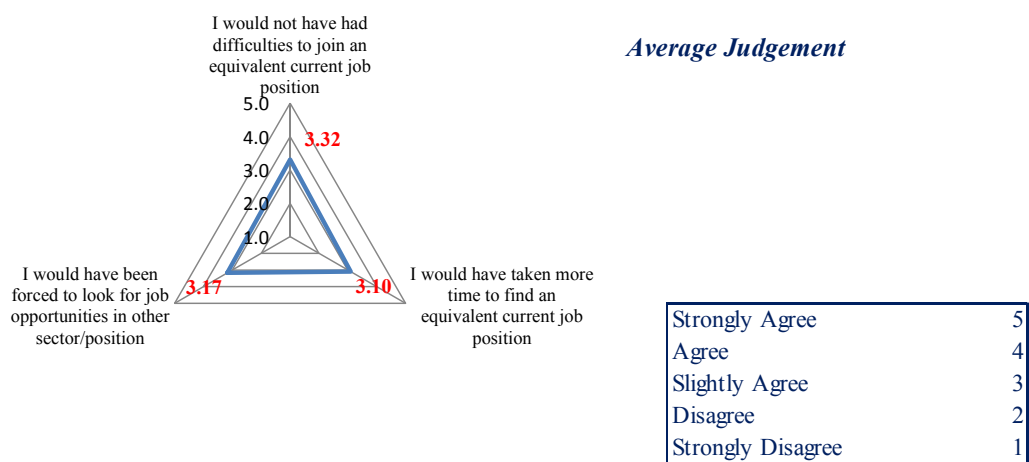

---
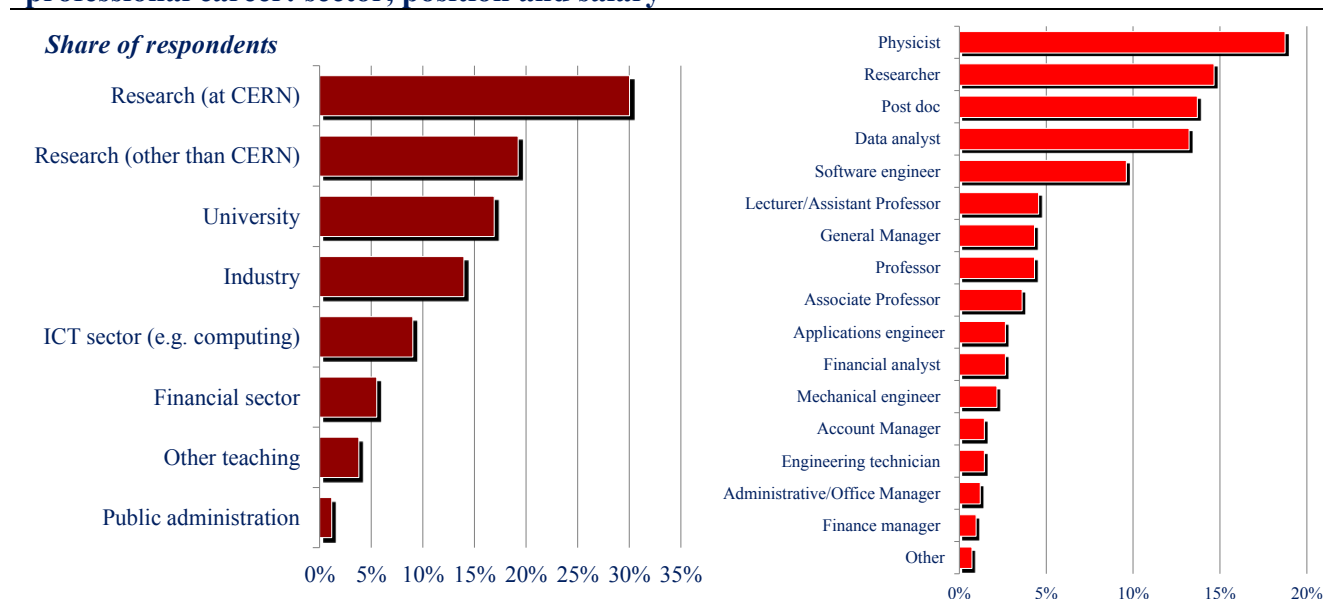
[6] Further research is however needed to confirm the validity of this result in a multivariate setting

If considering respondents which have already gained some professional experience, it is worth noting that the largest share agree that without the LHC experience they would have taken more time to find an equivalent current job position and they would have not received the same salary (see Figure 11). As their first professional experience, 56% of respondents from this group declared they were employed at CERN, by mostly covering the position of User and Fellow (67% and 20% respectively). The remaining 44% have mostly worked in the University, Industry sector, ICT sector, Research sector (institutions other than CERN) and Financial sector (see Figure 12). They have worked mostly as post-doc (21%), software engineering (21%), physicist (17%9 or data analyst (15%).

Figure 11: Respondents who are currently working. The impact of LHC experience on their professional path[7]

Share of respondents	I would not have had difficulties to join an equivalent current job position	I would have taken more time to find an equivalent current job position	I would have been forced to look for job opportunities in other sector/position
Strongly Agree	16%	8%	15%
Agree	30%	34%	30%
Slightly Agree	27%	24%	20%
Disagree	6%	9%	5%
Strongly Disagree	15%	21%	22%
Total	100%	100%	100%

Average Judgement

Strongly Agree	5
Agree	4
Slightly Agree	3
Disagree	2
Strongly Disagree	1

Source: Authors processing

48% of respondents declared that they have changed their employment as compared to their first professional experience (see Figure 13). Looking at the current employment of respondents, it is worth noting that university, industry, research (at CERN and other institutions) and Industry represent the main sector of current employment (see Figure 14).
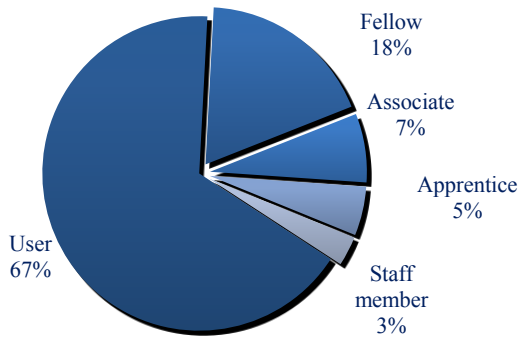
---

[7] The question was: *Thinking to the possibility you had not joined the LHC experience, please indicate the extent to which you agree with the following statements about your PROFESSIONAL PATH.*

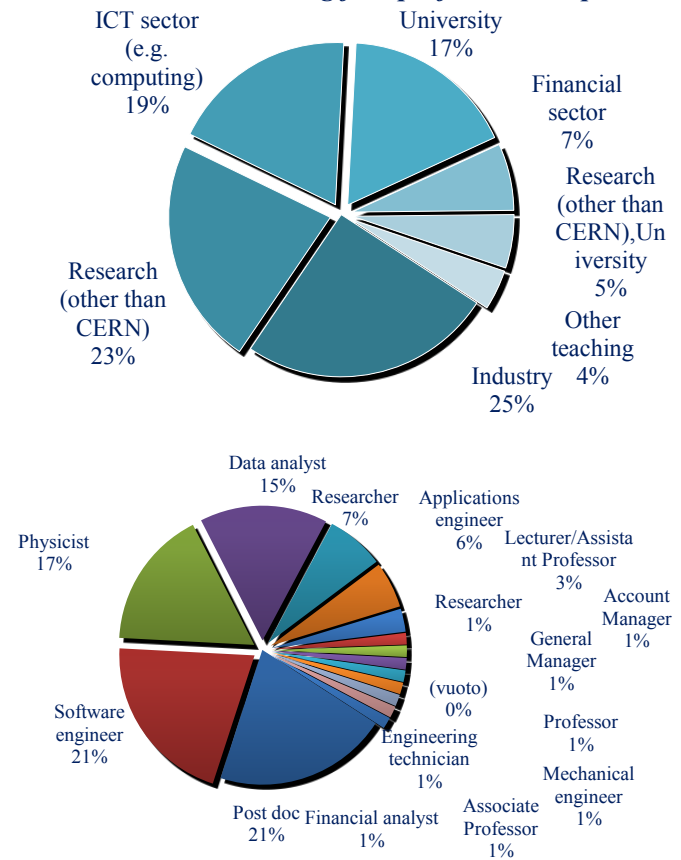**Figure 12: Respondents who are currently working. First career move**

With regard to your first professional experience, were you employed or associated at CERN?


Yes
56%

No
44%

Professional category at CERN

Fellow
18%

Associate
7%

Apprentice
5%

Staff member
3%

User
67%
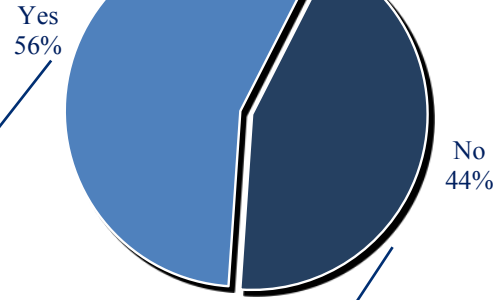
Sector and Position during first professional experience

ICT sector (e.g. computing) 19%

University 17%

Financial sector 7%

Research (other than CERN),University 5%

Other teaching 4%

Industry 25%

Research (other than CERN) 23%

Data analyst 15%

Researcher 7%

Applications engineer 6%

Lecturer/Assistant Professor 3%

Researcher 1%

Account Manager 1%

General Manager 1%

(vuoto) 0%

Professor 1%

Engineering technician 1%

Mechanical engineer 1%

Physicist 17%

Software engineer 21%

Post doc 21%

Financial analyst 1%

Associate Professor 1%

Figure 13: **Respondents who are currently working. Current employment vs First professional experience**

Is your current professional employment different from your first professional experience?
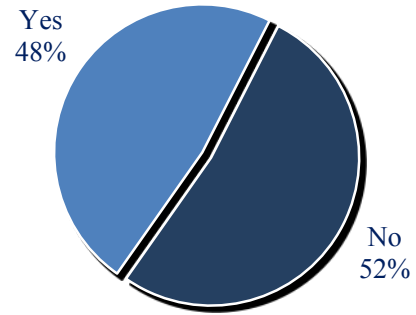
Figure 14: An overview of current employment (sector and position). Share of respondents
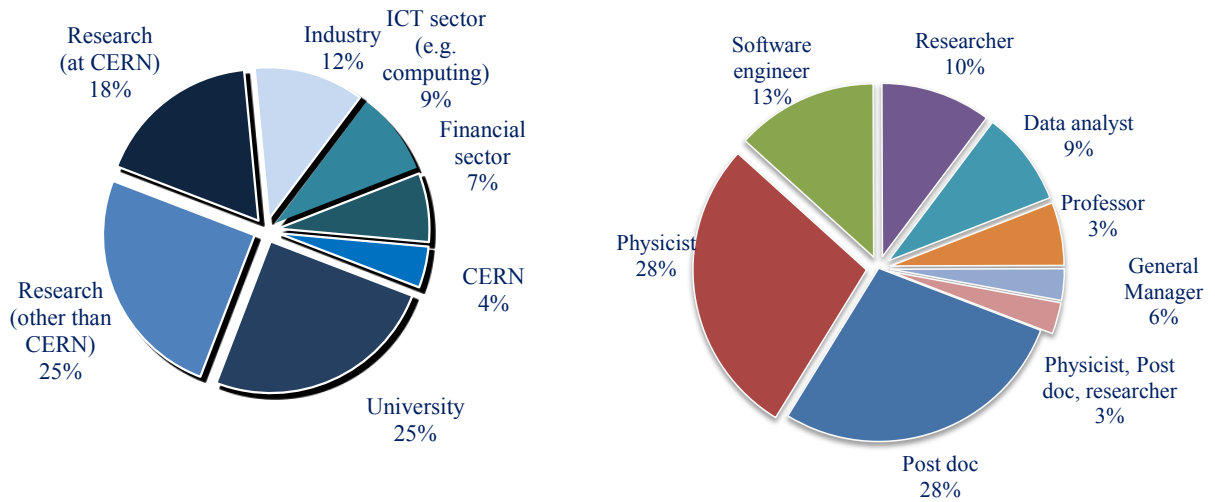
Looking at the future, it is worth pointing out that 43% of respondents are expected to change their employment. The most desired sector of employment are Research (both at CERN and other institutions), Industry, University and Financial sectors (see Figure 15).

Figure 15: **Respondents who are currently working. Expectations about their future professional career: sector and position**

Do you expect to remain in the same SECTOR and to play the same POSITION in the future?

Research…
Research (at…
Industry
University
Financial sector
ICT sector…
Other teaching
Public…
Other

0% 10% 20% 30%

Pie chart labels:
Associate Professor 8%
Software engineer 8%
Lecturer/Assistant Professor 7%
Financial analyst 6%
General Manager 4%
Post doc 5%
Other 2%
Finance manager 1%
Professor 9%
Account Manager 1%
Applications engineer 1%
Researcher 10%
Engineering technician 1%
Mechanical engineer 1%
Data analyst 14%
Physicist 19%
Administrative/ Office Manager 1%

.

4. *Impact of CERN research period on salary levels: ex-ante versus ex-post evaluation*

Respondents were asked to provide an estimate of the level of their future salaries. For students this amounts to the future entry level, mid-term and end of career salary, while for those currently employed only mid-term and end of career salaries are obviously considered. This information can be used to address two related issues. The first amounts to verifying whether the ex-ante expectations are mirrored in actual first job salaries. While it should be noted that we will be comparing different individuals at different career levels, and not the same individual along his path, the fact that most of the respondents are in the same or adjacent age cohorts and share the similar educational backgrounds, suggest that this interpretation of results is at least plausible. Results from the following table confirm this view, suggesting that ex-ante expectations on entry level salaries are extremely accurate, when compared with a group of peers.

Table 5: Expectations on salary levels (percent)

€	Salary Expectations	
	Working (first salary)	Not-Working (first salary)
< 30000	28	23
35000	25	24
45000	12	24
55000	14	10
65000	7	7
75000	6	6
85000	3	3
95000	2	3
125000	2	1
>150000	0	0
Total	*100*	*100*

The second issue is related to the process of expectation building and updating along the career path. If students and workers share the same expectation building process, given the similarity in their backgrounds and given that they share similar information sets on salary and career prospects, their expectations on end of career salaries should be similar. Once again, the distribution is rather similar, with a possible higher expectation of very high salaries of the employed with respect to the students and unemployed. Overall this confirms that the expectation-building process is not updated drastically once individuals enter the workforce officially.

Table 6: Expectations on future salaries before and after entering the job market (percent)

€	Salary Expectations	
	Working (end of career salary)	Not-Working (end of career salary)
< 30000	2	4
35000	2	5
45000	6	4
55000	12	20
65000	5	6
75000	14	12
85000	14	6
95000	11	17
125000	14	16
>150000	20	11
Total	*100*	*100*

Source: Authors processing

Figure 16: Average salary evolution: a comparison between the two groups of respondents (EUR)
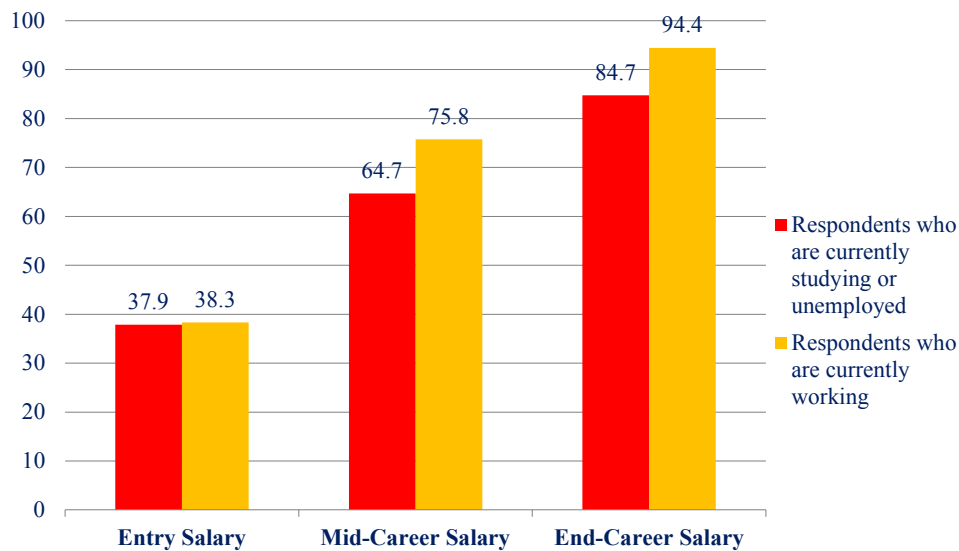
Source: Authors processing

5. *Impact of CERN research period on salary expectations: ex-ante versus ex-post evaluation*

When asked if the research stay will have a positive, non-zero, impact on their future salaries, the majority of students and currently unemployed (72%, Table 7, column 3) respond affirmatively. This percentage decreases however to 55% when we consider the currently employed evaluating their current salary (Table 9, column 1). A tentative reading of this preliminary result, to be validated by further research suggests that the positive salary premium, while present for the majority of the sample, irrespective of their current status, might be slightly overstated by younger respondents, which have not yet entered the labor market.

Table 7: Impact on salary expectations (percent)

	Impact on salary expectations		
	Working (current salary)	Working (future salary)	Not-Working
0	45	37	28
0-5%	13	13	13
6%-10%	11	13	20
11%-20%	12	14	20
21%-30%	6	7	11
> 30%	15	16	7
Total	*100*	*100*	*100*

Source: Authors processing

A related question investigates the expectations on the impact on future salaries for the currently employed (Table 7, column 2). Comparing this once again to expectations on future salaries by non-working respondents, the percentage of those that believe the research period will have no impact on future salaries decreases with respect to column 1, coming closer to the distribution of students. A possible interpretation of this result is related to a form of (positive) myopia regarding the prospect of future salary increases.

Figure below shows the average salary premium declared by respondents because of the LHC experience. It is worth pointing out that respondents who are currently working declared that their current salary is 9.5% higher than the salary earned by somebody else who has not benefitted from the LHC experience In the long-term, they expect that the difference in terms of salary will be around 10.9%. Interestingly, the expectations of the respondents not-working (which are still studying/unemployed) are quite similar. They expect that - thanks to the LHC experience - their salary will be 10.4% higher than the salary earned by somebody else who has not gained such an experience.

Figure 17: The impact of LHC experience on salary (%)[8]
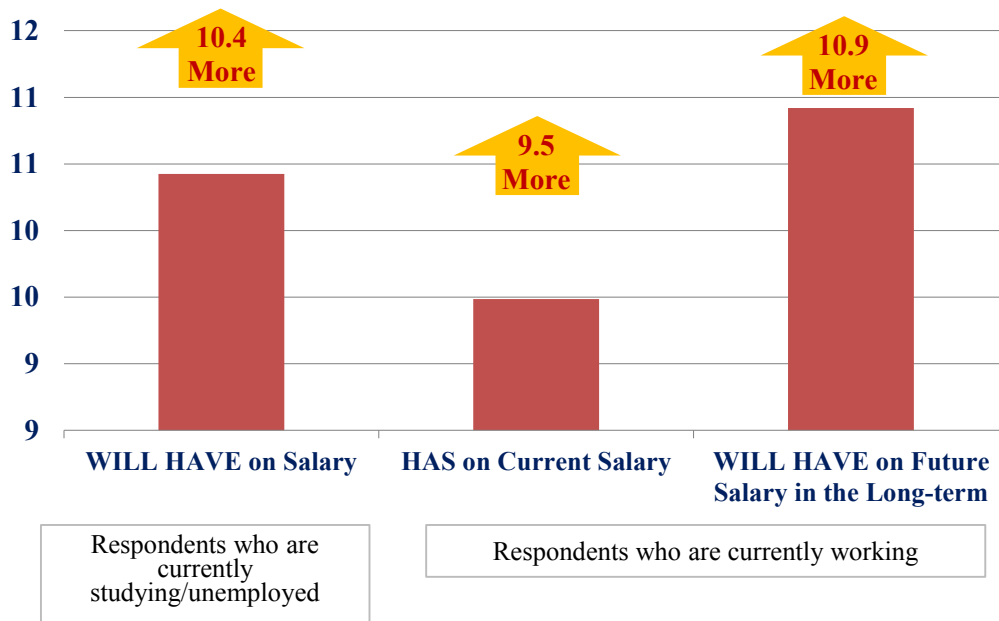
Source: Authors processing.

---

[8]Interviewees were asked to choose amongst ranges of percentage values (see Question C.2 andD.4 of the questionnaire). The values shown in the Figure were calculated as weighted average of the answers collected. In particular, the value was calculated for the two groups of respondents: those who are still studying/unemployed and those who are currently working. As for the second group, they were asked to indicate the percentage of salary increase both for the present and the future.

6. Conclusions

While the results presented in this note are still preliminary, a few concluding remarks can be put forward. Overall, the majority of respondents reports a positive impact of the research period at CERN, both on current and future outcomes, and irrespective of the fact that they are still students or have entered the workforce.

The respondents in particular evaluate the research period at CERN as very important for their future career path, with current students possibly overstating the potential impact with respect to those currently employed.

No difference can be instead detected when evaluating the expectations on future salary levels, suggesting that the respondents' information sets are accurate and common to students and workers alike.

Florio, Forte and Sirtori (2014)[9] relied on the results of this survey to estimate the salary premium enjoyed by students, fellows and post doc researchers for having spent a training period at the LHC. In compliance with a conservative approach, an average salary premium equal to 5% has been adopted[10] in the cost –benefit analysis of the LHC for the estimation of the human capital benefit. However, as showed above (see Figure 17) the premium is higher and is around 9.8% for current salary and exceed 10% for the future, irrespective of respondents' current work status.

---

9 Florio, M., Forte S. and Sirtori, E. (December 2014), *The socio-economic impact of the LHC: An exploratory cost-benefit analysis at the frontiers of science*, drafted in the frame of the research project 'Cost/Benefit Analysis in the Research, Development and Innovation Sector' sponsored by the EIB University Research Sponsorship programme (EIBURS).

10 Plus 1-3% as an additional job effect linked to the higher probability of accessing a better paid job outside academia.

Part 2 – Benchmark analysis

The aim of the benchmark analysis was to assess the differences in salaries on the basis of the sector of employment, university of origin, job positions and level of education (PhD degree). Results of this analysis has been compared to data gathered through the survey and taken into account in the evaluation of human capital benefit in the CBA of the LHC (See note on preliminary results of LHC social costs and benefits).

Figures below show some evidence gathered from Payscale[11]and U.S. Bureau of Labor Statistics. Additional sources are going to be explored in the next months.

Figure 18: Salary evolution by sectors
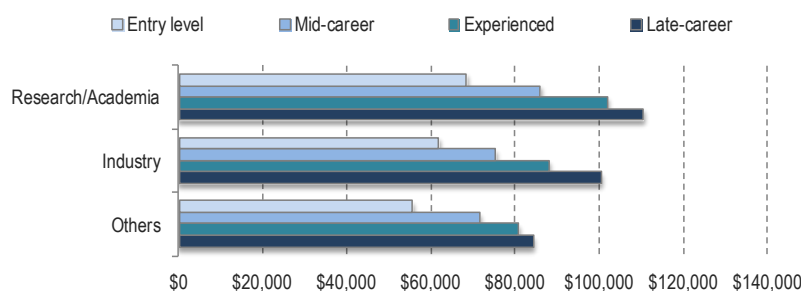
Source: Authors processing of PayScale data

Figure 19: Best Schools for Physical Science Majors in USA. Salary Ranges by University
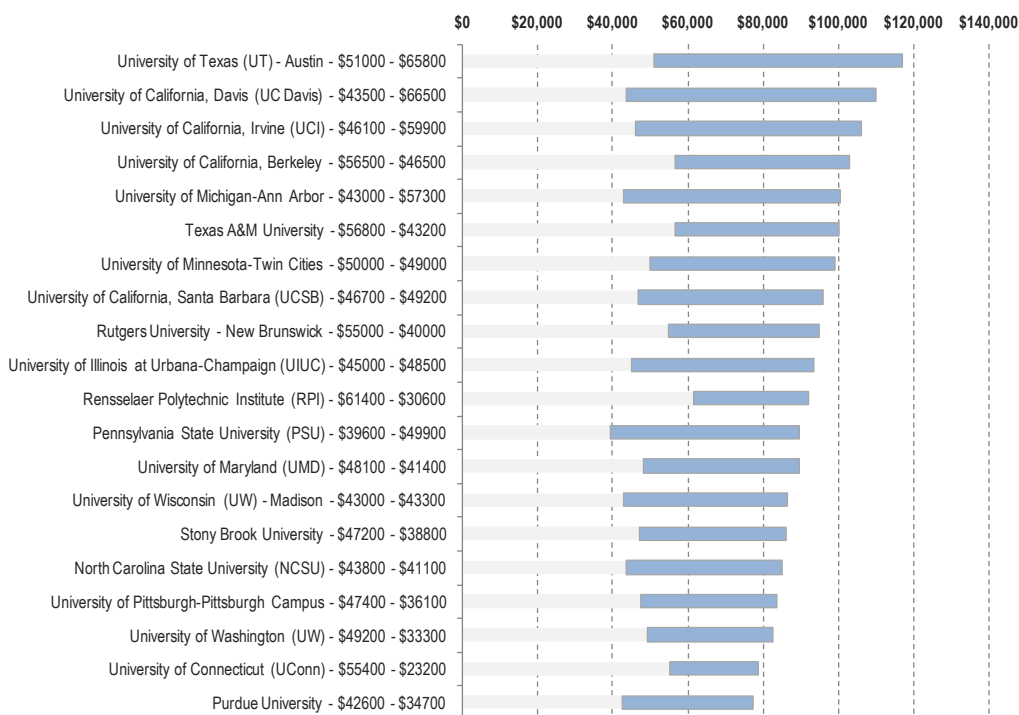
Source: PayScale

---

[11]Payscale is an online salary, benefits and compensation information company.

Figure 20: Employees with a Doctorate (PhD), Physics Degree. Salary Ranges by Job
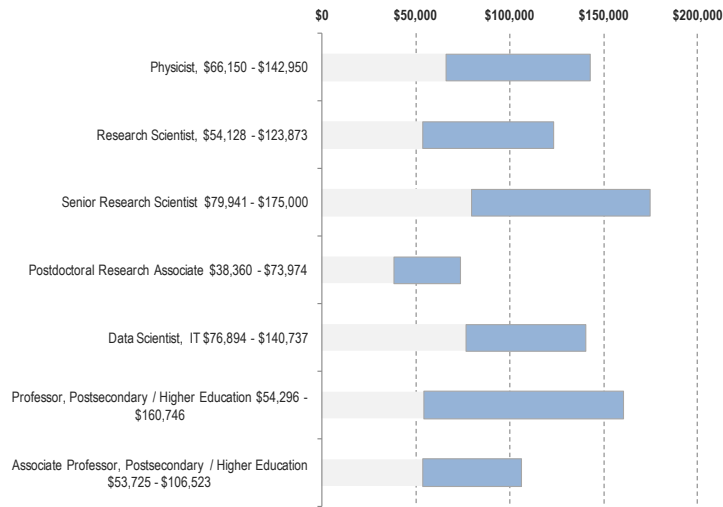
Source: PayScale

Figure 21: Physicists and Astronomers. Median annual wages, 2012
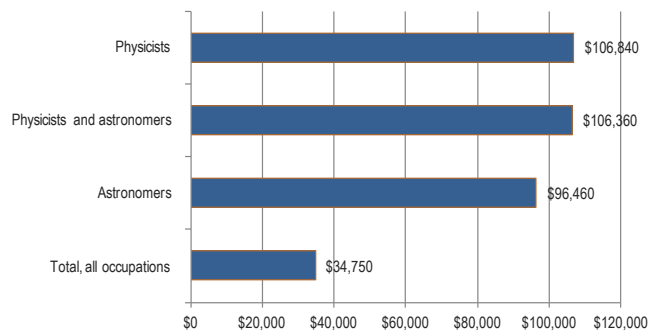
Source: U.S. Bureau of Labor Statistics, Occupational Employment Statistics
Note: All Occupations includes all occupations in the U.S. Economy

Figure 22: Occupations with job duties that are similar to those of physicists and astronomers. Median Pay (US$), 2012

Occupation	Median Pay
Physicists	$106,840
Physicists and astronomers	$106,360
Nuclear Engineers	$104,270
Aerospace Engineers	$103,720
Computer and Information Research Scientists	$102,190
Mathematicians	$101,360
Computer Hardware Engineers	$100,920
Astronomers	$96,460
Geoscientists	$90,890
Electrical and Electronics Engineers	$89,630
Biochemists and Biophysicists	$81,480
Mechanical Engineers	$80,580
Civil Engineers	$79,340
Chemists and Materials Scientists	$73,060
Postsecondary Teachers	$68,970

Source: Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook, 2014-15 Edition

Annex I – Questionnaire

PART A – PERSONAL INFORMATION			
A.1	*Are you:*	Male	Female
A.2	*Year of birth:*		
A.3	*Your nationality*		
A.4	*Your highest educational qualification*	Bachelor's degree or equivalent Master degree □ PhD student □ Other, please specify:	
A.5	*Please, indicate the institution where you have attained your highest educational degree*		
A.6	*Please, indicate the academic background of your highest educational degree*	□ Theoretical physics □ Applied/experimental physics □ Engineering □ Computer sciences □ Mathematics □ Life science □ Other, please specify:	
PART B – YOUR EXPERIENCE AT LHC			
In answering questions from B.0 to B.4, please refer to your first experience at LHC. If you have gained further experiences (e.g. working on two different experiments or other experiments not related to LHC, please indicate this information in question B.10 and specify your activity (e.g. fellow, postdoc, etc.)			
B.0	*Please, indicate on which of the following activities you have been working when you started your experience at LHC*	□ ATLAS experiment □ CMS experiment □ ALICE experiment □ LHCb experiment LHC machine HiLumi LHC LIU (Injector Upgrade) □ Other activities related to LHC, please specify	
B.1	*Start date of your research period at LHC*	Month: Year:	
B.2	*End date of your research period at LHC*	Month: Year: □ On-going → *Expected to be completed in:*	

B.3	***Please, indicate your educational qualification when you started your research period at LHC***	Bachelor's degree or equivalent Master degree □ PhD student □ Other, please specify					

B.4	***What is/was your university affiliation during the research period at LHC?***	

B.5	***Considering that your time spent at LHC is equal to 100%, please indicate the percentage dedicated to the following activities:*** *If the allocation of the time addressed to these activities has changed during your stay at LHC, please indicate an average percentage.*	Working on experiments (e.g. data analysis)
		Writing thesis/papers/articles
		Participation to meetings/dealing with coordination activities (e.g. managing working groups, etc.)
		Participation to conferences and workshops
		Participation to other training activities
		Outreach activities (e.g. guide to visitors)
		Other activities, please specify:

			1	2	3	4	5
B.6	***How do you rate the importance of the following considerations on your decision of applying for a research period at LHC?*** *Please, provide a rate from 1 (= not important) to 5 (= very important) to each of the following items by keeping in mind that they are not mutually exclusive:*	Deepening the knowledge and competences in the scientific domain of interest					
		Develop new professional skills					
		World undisputed prestige of CERN					
		Possibility to work with world class physicists					
		Working in an international environment					
		Other, please specify:					

			1	2	3	4	5
B.7	***To what extent the following skills have been improved thanks to the experience at LHC?*** *Please, provide a rate from 1 (= not decisive) to 5 (= very decisive) to each of the following items by keeping in mind that they are not mutually exclusive:*	Scientific skills					
		Technical skills					
		Communication skills					
		Problem-solving capacity					
		Team/project leadership					
		Developing, maintaining and using networks of collaborations					
		Independent thinking/critical analysis/creativity					
		Other skills, please specify:					

B.8	**Going back in time, shouldn't you had the opportunity to join the activity on LHC, what would you have done as an alternative?** *You can indicate more than one option*	□ I would have applied for a research period on another experiment at CERN □ I would have applied for a research period at another international research institute (other than CERN) □ I would have applied for a research period at another national research institute (other than CERN) □ I would have applied for a job in academia □ I would have applied for a job in the industry sector □ I would have applied for a job in the financial sector □ I would have applied for a job in the IT sector Other, please specify:	

B.9	**As of today, how many of the following have you authored/co-authored in relation to your research activity at LHC?** *Please, indicate the total number for each of the following items*	Working papers/preprints:	
		Articles in refereed journals:	
		Papers for conference proceedings:	
		Section/chapter in book:	
		Patent:	
		Software/application:	
		Multimedia products:	
		Other, please specify:	

B.10	**Please indicate to which of the following experiments or research projects (other than the one indicated in question B.0), carried out at CERN, you have contributed for a period of at least one month.**	ACE AEGIS ALICE ALPHA AMS ASACUSA ATLAS ATRAP AWAKE CAST CLOUD CMS COMPASS DIRAC	LHC machine HiLumi LHC LIU (Injector Upgrade) ISOLDE LHCb LHCf MOEDAL NA61/SHINE NA62 nTOF OSQAR TOTEM UA9
		Please specify your activity:	

B.11	**Please, indicate the total duration of your research period at CERN,** including the activity indicated in question B.0 and others experiments/activities, if any.	*Number of months*

YOUR CURRENT POSITION

	What is your current position?	I am still studying	**GO TO SECTION C**
		I have completed my studies and I am currently unemployed	**GO TO SECTION C**

		I am a post-doc researcher/I am working	GO TO SECTION D			

	PART C – YOUR EXPECTATIONS ABOUT YOUR PROFESSIONAL CAREER						
C.1	*Overall, to what extent do you expect that your experience at LHC will be relevant to your professional career? Please, provide an overall rate from 1 (= not relevant) to 5 (= very relevant).*	**1**	**2**	**3**	**4**	**5**
C.2	*We would like to understand the impact that do you expect your experience at LHC will have on your salary. Please, answer to the following question by possibly thinking to somebody who has not been accepted at your experiment or other experiments at CERN.*	*To which extent do you expect that your future salary will be higher than that earned by somebody else?* □ 0% □ up to 5% □ 5%, 10% □ 11% , 20% □ 21% , 30% □ more than 30%				
C.3	*Please indicate your expectations about the SECTOR of your professional experience immediately after completing the studies.* *In case you have completed your studies and you are currently unemployed, please indicate the SECTOR of your most desired professional experience* *You can indicate more than one option*	□ Research (at CERN) □ Research (other than CERN) □ University □ Other teaching Industry ICT sector (e.g. computing) Financial sector Public administration □ Other, please specify				
C.4	*Please indicate the POSITION expected to be covered during your professional experience immediately after completing the studies.* *In case you have completed your studies and you are currently unemployed, please indicate the POSITION of your most desired professional experience* *You can indicate more than one option*	□ General Manager □ Account Manager □ Administrative/Office Manager □ Finance manager □ Software engineer □ Mechanical engineers □ Applications engineers □ Engineering technician □ Financial analyst □ Data analyst □ Physicist □ Professor Associate Professor Lecturer/Assistant Professor Post doc Researcher Other, please specify				
C.5	**STARTING SALARY** *What is the approximate gross annual salary do you expect to earn during your first professional experience (desired experience if you are currently unemployed)?*	□ less than 30,000 EUR □ 30,000 – 40,000 EUR □ 41,000 - 50,000 EUR □ 51,000 - 60,000 EUR □ 61,000 - 70,000 EUR □ 71,000 - 80,000 EUR □ 81,000 - 90,000 EUR □ 91,000 - 100,000 EUR □ 101,000 - 150,000 EUR □ more than 150,000 EUR				

C.6	**MID-CAREER SALARY** ***What is the approximate <u>gross</u> annual salary do you expect to earn in the mid of your career (desired experience if you are currently unemployed)?*** *Please, note that mid-career salary is the salary that you expect to earn after 10 years of working experience*	□ less than 30,000 EUR □ 30,000 – 40,000 EUR □ 41,000 - 50,000 EUR □ 51,000 - 60,000 EUR □ 61,000 - 70,000 EUR □ 71,000 - 80,000 EUR □ 81,000 - 90,000 EUR □ 91,000 - 100,000 EUR □ 101,000 - 150,000 EUR □ more than 150,000 EUR
C.7	**END-CAREER SALARY** ***What is the approximate <u>gross</u> annual salary that you expect to earn at the end of your professional career?***	□ less than 30,000 EUR □ 30,000 – 40,000 EUR □ 41,000 - 50,000 EUR □ 51,000 - 60,000 EUR □ 61,000 - 70,000 EUR □ 71,000 - 80,000 EUR □ 81,000 - 90,000 EUR □ 91,000 - 100,000 EUR □ 101,000 - 150,000 EUR □ more than 150,000 EUR

PART D – YOUR PROFESSIONAL CAREER

THE IMPACT OF YOUR EXPERIENCE AT LHC ON YOUR PROFESSIONAL CAREER

D.1	***Overall, to what extent your experience at LHC has been relevant to your professional career?*** *Please, provide an overall rate from 1 (= not relevant) to 5 (= very relevant)*	1	2	3	4	5

			1	2	3	4	5
D.2	***Thinking to the possibility you had not joined the LHC, please indicate the extent to which you agree with the following statements about your PROFESSIONAL PATH.*** *Please, provide a rate from 1 (= strongly disagree) to 5 (= strongly agree) to each of the following items:*	*If I hadn't had the chance to join the LHC…*	1	2	3	4	5
		I would not have had difficulties to join an equivalent current job position					
		I would have taken more time to find an equivalent current job position					
		I would have been forced to look for job opportunities in other sectors outside the research sector					
		Other, please specify:					

			1	2	3	4	5
D.3	***Thinking to the possibility you had not joined the LHC, please indicate the extent to which you agree with the following statements about your SALARY.***	*If I hadn't had the chance to join the LHC …*	1	2	3	4	5
		I would have had a lower capacity to negotiate my salary and additional benefits with my employers					
		I would have received the same salary					
		I would have had few probabilities to increase my salary in the long-term					

		Other, please specify:

D.4	**We would like to understand the impact of your experience at LHC on your salary.** *Please, answer to the following question by possibly thinking to somebody who has not been accepted at your experiment or other experiments at CERN.*	***Thinking about that, to which extent is your CURRENT SALARY higher than that earned by somebody else.*** □ 0% □ up to 5% □ 5%, 10% □ 11% , 20% □ 21% , 30% □ more than 30% ***Looking at your professional career in the long-term, to which extent, do you expect, your FUTURE SALARY will be higher than that earned by somebody else.*** □ 0% □ up to 5% □ 5%, 10% □ 11% , 20% □ 21% , 30% □ more than 30%

FIRST CAREER MOVE

D.5	**Please, indicate the year of start of your professional career**	*List of Years*	
D.6	**Please, indicate the country of your first professional experience**	*List of Countries*	
D.7	**With regard to your first professional experience, were you employed or associated at CERN?**	□ YES	**GO TO QUESTION D.7.1**
		□ NO	**GO TO QUESTION D.8**
D.7.1	**Please, specify your professional category at CERN**	Staff member Apprentice Fellow User Associate Other, please specify **GO TO QUESTION D.10**	
D.8	**Please indicate the <u>SECTOR</u> of your first professional experience**	□ Research (<u>other than CERN</u>) □ University □Other teaching Industry ICT sector (e.g. computing) Financial sector Public administration □ Other, please specify	

D.9	*Please indicate the __POSITION__ covered during your first professional experience*	□ General Manager
		□ Account Manager
		□ Administrative/Office Manager
		□ Finance manager
		□ Software engineer
		□ Mechanical engineers
		□ Applications engineers
		□ Engineering technician
		□ Financial analyst
		□ Data analyst
		□ Physicist
		□ Professor
		  Associate Professor
		  Lecturer/Assistant Professor
		  Post doc
		  Researcher
		  Other, please specify

D.10	*What was the approximate __gross__ annual salary earned during your first professional experience?*	□ less than 30,000 EUR □ 30,000 – 40,000 EUR □ 41,000 - 50,000 EUR □ 51,000 - 60,000 EUR □ 61,000 - 70,000 EUR □ 71,000 - 80,000 EUR □ 81,000 - 90,000 EUR □ 91,000 - 100,000 EUR □ *more than* 100,000 EUR

YOUR CURRENT PROFESSIONAL EMPLOYMENT

D.11	*Is your current professional employment different from your first professional experience?*	□ YES **GO TO QUESTION D.12** □ NO **GO TO QUESTION D.15**

D.12	*Please indicate the __SECTOR__ of your current experience*	□ Research (other than CERN)
		□ University
		□ Other teaching
		  Industry
		  ICT sector (e.g. computing)
		  Financial sector
		  Public administration
		□ Other, please specify

D.13	*Please indicate the __POSITION__ covered during your current professional experience*	□ General Manager □ Account Manager □ Administrative/Office Manager □ Finance manager □ Software engineer □ Mechanical engineers □ Applications engineers □ Engineering technician □ Financial analyst □ Data analyst □ Physicist □ Professor

		Associate Professor Lecturer/Assistant Professor Post doc Researcher Other, please specify
D.14	**What is the approximate <u>gross</u> annual salary earned during your current professional experience?**	□ less than 30,000 EUR □ 30,000 – 40,000 EUR □ 41,000 - 50,000 EUR □ 51,000 - 60,000 EUR □ 61,000 - 70,000 EUR □ 71,000 - 80,000 EUR □ 81,000 - 90,000 EUR □ 91,000 - 100,000 EUR □ 101,000 - 150,000 EUR □ more than 150,000 EUR
YOUR EXPECTATIONS ABOUT THE FUTURE		
D.15	**Do you expect to remain in the same <u>SECTOR</u> and to play the same <u>POSITION</u> in the future?**	□ YES **GO TO QUESTION D.18** □ NO **GO TO QUESTION D.16**
D.16	**Please indicate the expected <u>SECTOR</u> of your future career** *You can indicate more than one option*	□ Research (<u>at CERN</u>) □ Research (<u>other than CERN</u>) □ University □ Other teaching Industry ICT sector (e.g. computing) Financial sector Public administration □ Other, please specify
D.17	**Please indicate the expected <u>POSITION</u> of your future career** *You can indicate more than one option*	□ General Manager □ Account Manager □ Administrative/Office Manager □ Finance manager □ Software engineer □ Mechanical engineers □ Applications engineers □ Engineering technician □ Financial analyst □ Data analyst □ Physicist □ Professor Associate Professor Lecturer/Assistant Professor Post doc Researcher Other, please specify
D.18	**MID-CAREER SALARY** **What is the approximate <u>gross</u> annual salary do you expect to earn in the mid of your career?**	□ less than 30,000 EUR □ 30,000 – 40,000 EUR □ 41,000 - 50,000 EUR □ 51,000 - 60,000 EUR

D.19		
	Please, note that mid-career salary is the salary that you expect to earn after 10 years of working experience	□ 61,000 - 70,000 EUR □ 71,000 - 80,000 EUR □ 81,000 - 90,000 EUR □ 91,000 - 100,000 EUR □ 101,000 - 150,000 EUR □ more than 150,000 EUR
D.19	**END-CAREER SALARY** **What is the approximate <u>gross</u> annual salary that you expect to earn at the end of your professional career?**	□ less than 30,000 EUR □ 30,000 – 40,000 EUR □ 41,000 - 50,000 EUR □ 51,000 - 60,000 EUR □ 61,000 - 70,000 EUR □ 71,000 - 80,000 EUR □ 81,000 - 90,000 EUR □ 91,000 - 100,000 EUR □ 101,000 - 150,000 EUR □ more than 150,000 EUR

During the preparation of the questionnaire the following sources have been taken into account:

- Anderson et all (2013), Snowmass 2013 Young Physicists Science and Career Survey Report
- Auriol L., M. Schaapar and B. Felix (2012), 'Mapping careers and mobility of doctorate holders: draft guidelines, model questionnaire and indicators, third edition, OECD Science, Technology and Industry Working Papers 2012/07, OECD publishing.
- Camporesi, T. (2001), *High-energy physics as a career springboard*, European Journal of Physics.
- Centre for Education Statistics (2008), ' Survey of earned doctorates: July 1, 2007 to June 30, 2008', Statistics Canada.
- Exit questionnaire for Tech and Doct Students - provided by CERN- Human Resources department
- Fellow Exit questionnaire – provided by CERN- Human Resources department
- http://www.payscale.com/mypayscale.aspx
- ISTAT (2009), L'indagine sui dottorati di ricerca: un'esperienza pilota.
- OPAL statistics on number and whereabouts of PhD's and fellows etc. (1983 - 2004)
- Questionnaire to PHD students from Università degli Studi di Milano (UNIMI), Nucleo di Valutazione
- Seamus Hegarty (2012), Impact on researchers of the Marie Curie actions at CERN, Human Resources Department, CERN
- The National Opinion Research Center and the University of Chicago (2012), ' Survey of earned doctorates 2011-2012'.
- The National Opinion Research Center and the University of Chicago (2010), ' Survey of Doctorate Recipients'.