Global Outlook on Forest Education (GOFE)
A Pilot Study Report

Editors:
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IUFRO
Interconnecting Forests, Science and People

International FORESTRY STUDENTS´ ASSOCIATION
IFSA

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GOFE is a part of the Joint IUFRO-IFSA Task Force on Forest Education (JTF)

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Foreword

Globalization demands that we understand the impact of forest education on the ability of those trained in forest science to manage large-scale, complex problems related to human interactions with forest ecosystems on an inter-continental scale. Past studies have demonstrated that, generally speaking, the education our students are receiving in forest discipline-specific areas is sufficient in the workplace, whereas that in non-discipline-specific or "general" areas is not. These findings have been obtained from traditional surveys of faculties and students in institutions of higher learning and of those who employ students having graduated from these institutions. Not uncommonly, respondents are asked to rate the importance of various desired competencies or learning outcomes and the degree to which these competencies or outcomes are being met. The results of these sorts of "gap analyses" commonly focus on identifying competencies that are considered of high importance and at the same time are rated as poorly developed in students and subsequently in the workplace. If well done, these studies are used to revise curricula that are better aligned with the desired outcomes in the academy and workplace.

What these past studies have not done is to analyse specific incidents or situations experienced by our graduates in the workplace, and from this determine which competencies emerge as most important in dealing with these incidents or situations, and in turn assessing how well these competencies are covered in curricula. In this particular study, this objective was accomplished by a modified form of Behavioural Event Interviews (BEI's) of 231 practicing professionals in nine countries on five major continents who received Bachelor's or higher degrees in forest science or related natural-resource disciplines from more than sixteen institutions. The results of this research, which are preliminary, support the findings from earlier studies of a traditional nature in that the competencies that emerged most frequently among these professionals in dealing with various situations that were considered both successes and failures by them were of a general nature and not-specific to their discipline. Included here were first and foremost those related to leadership and management (i.e., time management, responsibility, accuracy and diligence), followed by human relations (i.e., teamwork and social skills) and communication (especially with non-experts).

There were a number of additional components included in the original study design that unfortunately were not applied by all the participating institutions in the study, and thus the results cannot be generalized to the study population as a whole. In particular, the original study design called for identifying both high and average performing students and/or practicing professionals and ascertaining if there were differences in the competencies important to them relative to successes and failures in the workplace. However, not all investigators felt comfortable with identifying high and average performers, and thus did not do so. It seems like it would be worthwhile trying to make this distinction in future studies as it is basic to the BEI process in helping to identify competencies that "differentiate" high performers from average performers, and those that determine the "threshold" for adequate performance. For example, one institution that made this distinction reported that for high performers, the most frequently invoked competencies were associated with group and leadership skills, while those for average performers were related to individual, non-leadership skills.

Other components of the study which were not applied uniformly by all investigators included the incorporation of professionals educated in forest-science and those educated in related natural resource fields, and the level of education of individuals in the sample population (i.e., Bachelor's, Master's, Doctorate), and gaps between competencies identified as important using the BEI approach and the degree that these competencies are treated in current curricula in academic institutions. Thus, here again, comparisons cannot be made among all institutions and generalizations derived from these comparisons. Finally, I might mention that the majority of investigators in this study confined their sampling to graduates from a single institution in a given country and thus it is difficult to extrapolate to a country or continent as a whole.

In closing, despite the limitations noted above, I feel that the study is a good start toward understanding the competencies required of professionals responsible for managing our forests on a global scale, and certainly points the way toward the need for a more robust and comprehensive study using this new approach.

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Editors

List of abbreviations

BEI: Behavioural Event Interview

FS: Forest Sciences

GOFE: Global Outlook on Forest Education

IFSA: International Forestry Students' Association

JTF: Joint IUFRO-IFSA Task Force on Forest Education

IUFRO: International Union of Forest Research Organizations

LLL: Life Long Learning

MOOCs: Massive Open Access Online Courses

NR: Natural Resources

UH: University of Helsinki

Executive Summary

Forestry and forests are changing under several drivers such as globalization, climate change, political instability, aging societies, new technology, and a rising demand for greener economies. As a result, holistic and integrative approaches are required, such as increasing provision of ecosystem services and corporate social responsibility. All of these changes are expected to have considerable impacts on the forest education sector as well as several other service sectors. Within forest education there is an increasing demand for knowledge of social effects and generic skills, as well as e-learning and Life-Long Learning (LLL) approaches. Structurally, we are witnessing many traditional forestry programmes merging with other disciplines or even being terminated at some institutions.

The objective of this research project was to produce a scientifically based policy report on global forest education, concentrating mainly on university-level education. The specific objectives were: first, to analyse the working life competency needs of recent graduates; second, to conduct a comprehensive competencies gap analysis between what was included in the curriculum and competencies needed in the workplace.

The study followed the Behavioural Event Interview (BEI) methodology to explore the *threshold* and *differentiating* competencies in working life. Data consisted of recent graduate BEIs executed in nine different countries on five continents. Results showed that the most frequently observed threshold and differentiating competencies were related to generic skills such as leadership and management, human interactions, and communication. The subject-specific competencies were not frequently observed in BEIs and the variation was also high among countries. The fact that forest-specific skills were not among the most frequently mentioned threshold or differentiating skills suggests furthermore that graduates have been satisfactorily prepared in these skills for success in working life.

Results from the gap analysis of subject-specific and generic competencies reflect to some extent the results of the BEI analysis of the nine research groups. Generally speaking, forest education curricula in all studied countries should emphasize more generic competencies, such as leadership and management skills, social relations, and communication. However, many differences between countries are especially related to subject specific competencies. The most widely observed need was to increase the role of entrepreneurship, economics, and management.

This study focused on the current working life of the graduates from the forestry programs. In future studies, more emphasis should be put on competency needs for the future. Also the data could be more robust in terms of countries represented and the number of interviewees per country. Moreover, the competency requirements of different jobs in forest-related occupations can be very different. For this reason, a more comprehensive study with more homogenous working titles would be appropriate. Finally, good practices and models are needed to help inform how to integrate generic competencies into forest education curricula.

1. Background

IUFRO and IFSA have a long history of collaborative work and partnership on educational matters. Over the past years, the topic of forest education in international discussions has emerged as an important collaborative factor. In the Memorandum of Understanding (MoU) established in April 2002 and renewed in October 2014, IUFRO and IFSA have recognized that both networks represent a similar field of interest on a global level and have expressed their commitment to further enhance their cooperation on issues of mutual concern.

In recent years, changes of the forest-based sector combined with evolving societal demands, have led to new trends in forest education globally. These developments are reflected in the labour market as well as in the demands on students to accrue an ever greater diversity of experiences and skills. In addition, the institutional environments for forest-related research and education have changed.

Forest education is defined in this study as any education related to forests. The term includes for instance education on forestry, forest sciences, agroforestry, environmental sciences, land use, environmental management or any combination of these. Programmes educating about forests and focused on wood as a resource are being changed towards multidisciplinary programs, some of them concerning problems like climate change, for example. Independent forest programs exclusively addressing “forestry” are becoming rare. N.B. please note that we opted to use the term “forest education” in place of “forestry education” in this report because we are following previous IUFRO agreed upon formats.

Education related to forests takes place on various levels such as kindergarten, elementary school, high school, college or university, as well as formal, non-formal, informal education, continuing, professional development, and education for the general public. In this document and for this particular joint project, forest education refers mainly to the university level. Nevertheless, other types of education are not excluded by default. Therefore, the term “forestry students” used in this document relates to the definition of IFSA members as stated in the IFSA statutes: “IFSA’s global vision is for cooperation among students of forestry and related sciences, in order to broaden knowledge and understanding to achieve a sustainable future for our forests, and to provide a voice for youth in international forest policy processes” (IFSA Statutes, 2017).

Forest education has been insufficiently addressed in existing international efforts so far. Moreover, a widespread decrease in the number of students interested in enrolling in forestry programs has been identified, underlining the importance of this joint project.

All activities of the Joint IUFRO-IFSA Task Force (JTF) fit integrally into the following strategic directions of the IUFRO Strategy:

<u>Institutional goals</u>

Goal 1. Research excellence: strive for quality, relevance, and synergies
Objectives: “To facilitate mobility and exchange of scientists and students across IUFRO member organizations.”
The JTF will integrate students and academic partners from all levels of forest education in the discussion about relevant research issues on forest education across various regions of the world.

Goal 2. Network cooperation: increase communication, visibility, and outreach
Objectives: The JTF will enhance communication at all levels of forest education, for example vocational or university levels.

Goal 3. Policy impact: provide analyses, insights, and options
Objectives: "Strengthen education on forests"
The JTF will analyse and highlight the differences of access to the knowledge in the different regions and the diversity of forest education programs.

The objectives of the JTF are thus:

- To bring together perspectives and knowledge of students, educators and other stakeholders
- To encourage discussion on international education and capacity building
- To identify, compile and communicate the gaps and challenges for forest education, especially highlighting new fields of forest education
- To enhance forestry students' mobility and education opportunities

The GOFE research project was carried out within the working programme of the JTF, which activities have been divided into four work-packages (WPs), jointly developed and coordinated by IUFRO and IFSA representatives:

- WP1: Global Outlook on Forest Education (GOFE)
- WP2: Higher Forest Education interactive tool
- WP3: Trainings of forestry students
- WP4: Encouragement of students' involvement in IUFRO events and counterbalance of extracurricular students' activities

This paper is a final report of WP1 including a preliminary analysis of research results. Based on this report and other materials gathered during the past two years, scientific papers will be drafted.

2. Introduction

2.1. Rationale and objectives

There have been radical changes in the forest sector in past decades. These changes will most likely continue to affect the forest sector in the future. Some major drivers of changes in social, economic, and environmental issues are:

- Globalization of the economy
- Political changes
- Climate change
- Economic instability
- New technologies, such as Information Technology (IT), fibre based industry, energy industry, geographic information systems (GIS) and the energy industry
- Increasing demand for (vocational) education
- Aging societies
- Call for greener economies

Forestry and forest ecosystems are linked to all of these drivers and are coming under pressure because of them. Holistic and integrative approaches are needed in response. The drivers of change, mentioned above, also provide new opportunities for the forest sector, such as increasing needs for plantations to provide for bioenergy. The traditional use of forest resources has to be renewed as there is increasing demand, for example for packaging and tissue paper, while decreasing for newsprint (Hetemäki and Mery 2010, Katila et al. 2014).

One of the biggest anticipated changes in the education sector is that Information Technology, IT, will alter the ways people use services, and thereby alter supply chains and the business logics of these services. For instance, platforms like Airbnb and Uber are changing the way that accommodation and transport businesses run and new platforms are likely coming also for experts and freelancers, which would challenge the conventional rules of labour markets (Hakobyan 2017). New technology has already decreased and modified the demand for traditional professionals - including the forest sector. It has been predicted that in the next 20 years almost half of current professions will disappear (Frey and Osborne 2017). If this hypothesis becomes true for professions such as lawyers and medical doctors, why not forest professionals?

Major drivers in (higher) education and forest education have been (SILVA 2014):

- Consolidation of traditional forestry programmes with other disciplines or termination of forestry programmes
- Multidisciplinarity
- Increasing demand for social aspects of forests and generic skills component
- E-learning and blended learning
- Internationalization

One of the major drivers in (higher) education and forest education has been the increasing number of multidisciplinary study programs. More and more traditional forestry programs are being merged with other disciplines or even terminated at some institutions. Forest science content is frequently taught in programs where forest ecosystems are only one among others such as aquatic, wetland, range, mountain, and agricultural systems (SILVA 2014). Curricula can be here categorized as 1) *forest sciences* ***(FS)*** centred curricula based on and labelled with “forestry”, “forest sciences”, “forest management” or equivalent; and 2) *natural resources*

(NR) **study programs** based on and labelled with "natural resources management", "environmental science" or equivalent. With NR study programs we mean programs that treat all natural resources, such as wood, water, wildlife, recreation, and range, more or less equally.

It is fair to say that scientific research on forest education has not been extensively conducted. Research has, however, been carried out in some geographical areas and topics in a more intensive manner. To summarize, there has been research at least in the following three categories of studies:

- *Pedagogical methods*, such as problem based learning, e-learning and life-long learning (LLL)
- *Gap analysis,* where competency needs in the workplace have been compared with competencies provided by formal education
- *Student enrolment and graduate employability,* where the flows of incoming students and out coming graduates entering into the labour market have been monitored

Pedagogical methods and learning opportunities are now under drastic changes because of e-technology. Massive Open Access Online Courses (MOOCs) have been gaining in frequency since 2012. E-learning systems and the attitudes of younger generations have made it possible to develop teaching and learning methods via different Internet based platforms. Standiford (2015) presented an overview of distance learning and new models for forest education. The objective of distance learning and LLL is for continuous activity to increase knowledge, experiences, and competencies. Research centres and academic education institutes have a responsible role in the development and transfer of knowledge. These institutions need to promote and deliver qualified education and they have to guarantee practice-orientated training (BMWF 2012). It seems that LLL is one of the processes aiming at meeting the needs of a changing labour market (EHEA 2012).

Gap analysis can be actually seen as a large framework, covering the issues of competencies (depending on curriculum, learning methods, etc.) and working life needs. Gap analyses have been executed in the US for nearly 50 years. One of the major findings has been the fact that there is a need to have more training for *generic* competencies such as communication, ethics, teamwork and leadership (Barret 1953, Miller and Lewis 1999, Sample et al. 1999, 2015). Similar results have also been obtained from Europe (Schuck 2009) and South America (Arevalo et al. 2010). It seems that gap analysis of forest education and the studies of competencies in the working life of professionals have had little interaction. For instance, the classification of competencies into threshold or differentiating ones has not been applied (Campion et al. 2011). Furthermore, the methods of competency studies in other fields, e.g., behavioural event interviews, have not been applied in forest education studies (McClelland 1998).

Student enrolment and graduate employability are a set of long-term quantitative approaches to monitor education. Sharik et al. (2015) describes the national natural resource students' enrolment data collected in the US. The data, going back to the year 1980, consists of information on: field of study, gender and ethnicity/race. This information has made it possible to analyse long-term trends in enrolments, the major finding being that enrolment has been highly cyclical relative to other fields of study. Sharik et al. also present five factors behind these trends, i.e., (1) changing social values, (2) diversification of degree offerings beyond traditional forestry; (3) inflexible, science-based curricula associated with accreditation and certification; (4) a perceived lack of forestry jobs and low wages; and (5) limited attraction to forestry for women and minorities.

Data and studies similar to that obtained from the US (Sharik et al. 2015) are hard to find in other parts of the world. Ferguson (2012) presents some analysis of forestry students' enrolment in Australia, but presented no quantitative data in support of this assessment. Most likely, many studies on student enrolment and graduate employability are published in local languages and have thus not been available for more broad analytical endeavours.

All of the three topics above are critically important. The need for enrolment and employment data is evident. However, it seems that the establishing of a more effective international statistical system goes beyond the resources of the JTF, which is why this topic is not be the focus of this study.

The objective of this research is thus to produce a scientifically based policy report on global forest education mainly concerning university level education. The specific objectives are:

1. To study competencies needed in current working life
2. To conduct a comprehensive gap analysis between what was included in the curriculum and competencies in the workplace

A special sub-objective within the first and second objectives, and studied by some of the research teams, was to analyse whether competencies and learning outcomes from forest science (FS) -centred curricula are different than the ones from curricula more focused on natural resources (NR).

2.2. Frame of Reference

In order to provide a robust scientific analysis for meeting the aims of the study, a comprehensive theoretical framework is needed. The framework is constructed using these three separate theories or models (Figure 1):

1. Integrative Pedagogic Model (Heikkinen et al. 2011; Tynjälä, 2008; Tynjälä et al. 2014)
2. Constructive Alignment (Biggs 1996)
3. Competencies (Spencer and Spencer 1993; Campion et al. 2011; Rodriquez et al. 2002)

Integrative Pedagogic (IP) model, describing learning process and providing pedagogical principles for designing learning environments, is based on research concerning both expertise and different forms of intelligence (Hakkarainen et al. 2004). The basic idea of IP is that learning process and thus professional expertise is an integrated entity of theoretical, practical and self-regulative knowledge (Bereiter and Scardamalia 1993, Eraut 1994; Heikkinen et al. 2011, 2012, Tynjälä 2008). There are a number of processes linking these categories of knowledge. In a transformation process, conceptual or theoretical knowledge is converted and applied in practice. This can be said to be a typical focus for forest education. In an explication (conceptualization) process, practical knowledge or work experience is translated into theoretical concepts and models. The third element of the IP model – self-regulative knowledge – including metacognitive and reflective skills can be developed through reflection processes, which is not among the most prominent aspects of training in most forest curricula (Kettula 2012).

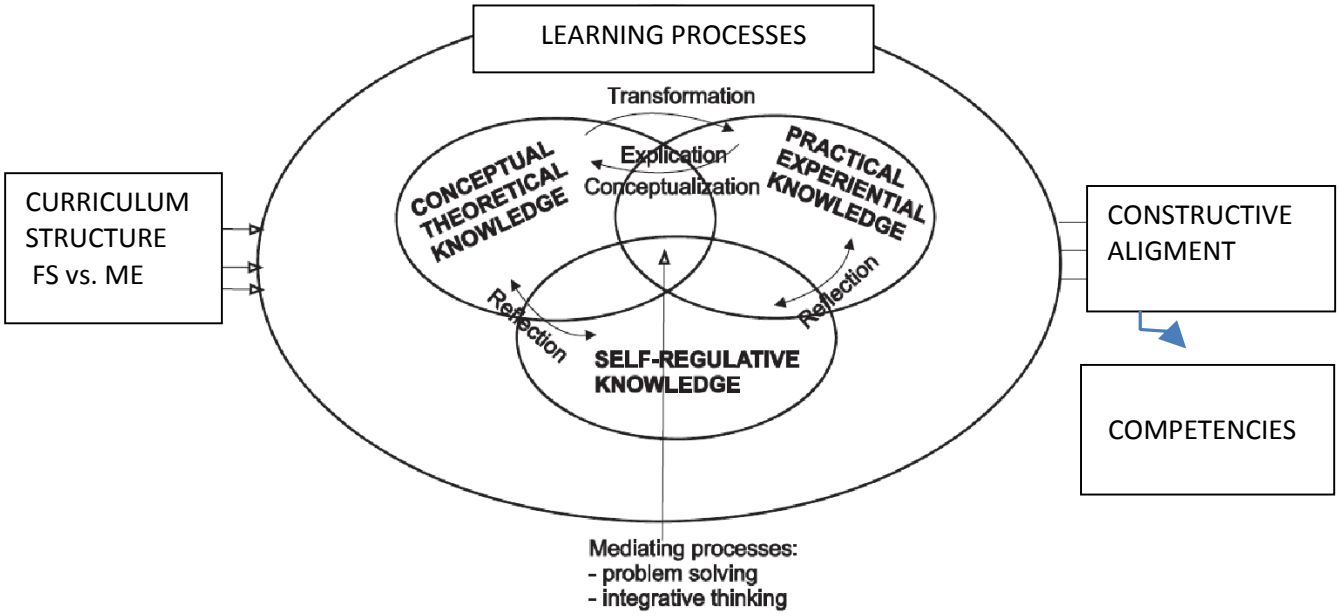

Figure 1: Framework of the study adapted from Integrative Pedagogics (IP) model by Tynjälä et al (2014)

The version of IP framework applied in this study (Tynjälä et al. 2014) was previously adopted also for a project on Technology-enhanced learning (TEL) in workplace competency development. The same model has been especially useful to develop and analyse modern e-learning methods (Tynjälä et al. 2014). These include topics such as computer supported collaborative learning (Goggins and Jahnke 2013), knowledge building and networked expertise (Hakkarainen et al., 2004), simulations, virtual worlds and game-like solutions (Krange et al. 2012), and social media in the workplace (Dabbagh and Kitsantas 2012, Fiehl 2012; see also Cheng et al. 2014).

One of the research questions was whether there are differences in learning outcomes between FS and NR curriculum. In order to study this question the structure of curriculum is explicitly added here into the IP model. The structure of curriculum can be described using the following items: general aims, visions and mission, models, intended learning outcomes, subject material and pedagogical methods.

Constructive alignment by Biggs (1996) is a way of thinking where all educational elements, aims of teaching, teaching and learning activities, and finally evaluation, should support intended learning outcomes, i.e. they have to be aligned. This concept derives from cognitive psychology and constructivist theory, where the linking learner's memory and earlier experiences with new material is seen as elementary. The teachers are responsible for making a deliberate alignment between aims of teaching and learning activities. They should make a conscious effort to provide the learner with a clearly specified goal, well-designed learning activities, and finally well-designed assessment criteria for giving feedback to the learner.

It can be stated that in the framework of this study (Figure 1), curriculum structure represents general aims of learning, which are further specified in teachers' actions within separate courses, or other elements of the curriculum such as thesis work or internships. Curriculum and course level aims depend on the country and university. In any case, in order to provide education, learning aims should be explicitly stated/documented in some form or another.

Hooghiemstra (1992) defined a *competency* as an underlying characteristic of an individual, which is causally related to effective or superior performance in a job. It is useful to separate two categories of competencies: first, *differentiating* competencies which separate low- and high-level performers, and second, *threshold* or essential competencies which indicate minimum or average requirements for performers (Campion et al. 2011). However, until now these categories have not been studied in the context of forest graduates. Campion et al. (2011) added the third category: future oriented competencies.

An important classification of competencies is based on the content of competencies. Several forest education studies have also used a classification of *technical (= subject specific*) and *generic or general (*= fundamental, cross-jobs, sometimes leadership) competencies (Miller and Lewis 1999, Sample et al. 1999, 2015, Schuck 2009).

Using competency libraries/dictionaries to name and recognize competencies is useful. The best examples of these are the Position Analysis Questionnaire (McCormick, Jeanneret, and Mecham, 1972) and the Occupational Information Network (O ∗NET) developed for the U.S. Department of Labor (Peterson et al. 2001). In the European Union there is a system of European Skills/Competencies qualifications and Occupations (ESCO) and European Qualifications Framework (EQF). The list of competencies analysed in this study can be found in the appendices.

Spencer & Spencer (1993) summarized the findings of 286 studies conducted in various types of organizations. The result is a competency dictionary for 21 competencies that distinguish superior from average performers in middle- to upper-level jobs (Spencer and Spencer 1993). One framework commonly used is the "Big Five" personality traits also known as the "Five Factor Model" (FFM). This model is based on early work in the 1930's and more widely accepted in the 1980's and 1990's (Goldberg 1993). Another common general competency model is the so-called "Great Eight" -model created by Bartram (2005). Several other competency models have been presented based on analyses of various fields, such as human resources management or business management. The rich competency literature is summarized by Campion et al. (2011) and Rodriquez et al. (2002).

3. Data and methods

According to Campion et al. (2011), working with competency models can be divided into three basic operations:

1. Analysing Competency Information (Identifying Competencies)
2. Organizing and Presenting Competency Information
3. Using Competency Information

In this study, the first two are divided into a theoretical study of competencies and interview studies. Results from those were then used to perform gap analysis, i.e., using the competency information. The study therefore applied two kinds of empirical methods. First, competencies were analysed using qualitative interviews of recent graduates. These interviews aimed to reveal threshold and differentiating competencies relevant to their current working life. Second, expert analyses were used to execute a gap analysis where existing study programs were contrasted with competency results from interviews (not all countries implemented this analysis type).

Differentiating and threshold competencies were analysed using the Behavioural Event Interview (BEI) methodology developed originally by McClelland (1973). The underlying notion with BEI is that it is easier for people to recognize those workers who are competent than what skills make them especially competent (McClelland 1998). As an analogy, one might say this equates to determining how good a car is. Engineers may compare the performance of each component and arrive at a somewhat objective measure. Yet the customer can more easily make the same conclusion by driving the car, rather than being told what parts are in it, which make it an outstanding one. Similarly, competency can be measured as a technical construct, but the BEI methodology aims at first recognising high performance and only afterwards determining which factors cause such an appraisal.

We applied a series of behavioural event interviews (BEI) to define – in cultural context – the actions that lead to have distinguishing competencies, both subject specific and generic ones. The BEI method entails an expert panel first classifying employees (recently students) into average and above average performers (McClelland 1973, McClelland 1998). This stage was discussed at length during the project formation and was found problematic in technical and sometimes ethical points of view. Therefore, in most series of interviews it was not applied.

The targeted interviewees were recent graduates, usually graduating from between 2011-2015, depending on the country and universities. The aim was to have at minimum of 15 interviews per study programme/university (Hooghiemstra 1992). The BEI method itself is based on critical incident technique, to obtain an as detailed picture as possible of interviewees' thoughts, actions, and attitudes. Those interviewed were asked to identify up to three professional successes and failures in their workplace and talk about them in story fashion, guided by the following questions: (1) What was the situation; what events led up to it? (2) What types of people were involved? (3) What did you think, feel, or want to do in the situation? (4) What did you actually do or say? (5) In retrospect, what might you have said or done differently? and (6) What was the outcome; what happened?

The interviews typically focused on three particular successes and three failures in workers' professional lives. The method relies heavily on the ability of the interviewer to estimate when sufficient information has been obtained, and to ask specific follow-up questions, if it is deemed

necessary. The appropriate level of detail is crucial in order for the subsequent coding of the interview data to be as reliable and consistent as possible.

BEI analysis also included the following quantitative questions/attributes:

- Status in labour market (working with permanent contract, working with fixed period contract, not in working life)
- Working experience (months)
- Status if not in working life (student, maternal leave or equivalent, unemployed)
- Estimate of working experience, even if part time job (months)
- Working experience related to own field during studies (months)
- Working experience other than those related to own field during studies (months)
- Working experience related to own field after graduation (months)
- Working experience not related to own field after graduation (months)
- Number work contracts during studies
- Number work contracts after graduation
- Working places (private, public)
- Working sector (industry, private forestry, public sector, education)
- Most important differentiating competencies (success cases), especially with high performance graduates if known
- Most important threshold competencies (failure cases)

Most series of interviews were done by students in a particular university did most series of interviews. Students did interviews as a part of thesis work or as a course assignment. Teachers provided supervision together with the coordinators of JTF. Other interviews were conducted by instructors or country report authors.

Interviews were coded using commonly agreed-upon competency codes (see Appendix). Competency codes were categorized into forest subject specific and generic competencies. Forest expertise included proficiency of different study lines. The subcategories corresponding to the generic competencies were related to:

- Human relationships
- Leadership and other generic competencies
- Communication
- Research
- General academic competencies

For each of the categories, individual competencies, such as negotiation or leadership, were defined. A total of 57 separate competencies were specified for the analysis.

After BEI interviews and analysing their results, a gap analysis was conducted to reveal how the competencies relevant to working life and the curriculum align. The idea of gap analysis is to find the differences (gap) between competency professional needs and competencies learned in education. Gap analysis is practically oriented; it is aimed to find development needs in curricula. These competency needs have been collected with several methodologies, such as surveys of experts, employers and other stakeholders (see e.g. Sample et al. 1999, 2015).

This is a qualitative stage where expert opinions, such as those from teachers, were used, if possible, through curriculum development seminars, stakeholder meetings etc.

The time schedule of the research was as follows:

1. Detailed research plan, April 2015 - October 2016
2. Recruitment of students and research partners, January - October 2016
3. Kick-off meeting, June 15, 2016
4. BEI Interviews, October 2016 - June 2017
5. GAP analysis March - June 2017

Resources needed for GOFE were mainly related to human resources, data collection, and organization of meetings and seminars, as well as communication. The main idea of executing the study was to conduct the study through research assistants' thesis work. Grants for research assistants were applied for mainly through local sources; partial funding was provided by the IUFRO president's fund. Funding for data collection and other resource needs was applied for through mostly regional and international donors, though most of the work done for this report was self-funded or on a voluntary basis.

4. Results

Detailed results are presented in country reports in the appendices (Appendix B-J). Each country report presents results of BEI interviews and curriculum analysis, as well as gap analysis based on those two. Results are classified into two broad categories of competencies: generic and subject-specific. Results are either from forest science (FS) centred curricula, curricula focusing on natural resources (NR), or both.

Please see Appendix for all nine country reports and a list of the coding competencies used.

4.1. Summary of Results

There were altogether 231 interviews conducted in nine different countries. The highest number of respondents came from Colombia (n=40) and the smallest from Austria (n=15), with the median number of respondents per country being 25 (Figure 2). Most of the total numbers of respondents were male (61%) (Table 1); however, the percentage of males varied by country, ranging from 40%-82% of the sample. The United States and China were the only countries where the majority of respondents were female. The earliest year of graduation was 1990 and the latest was 2014, with the average age of respondents being 29 years (Table 1).

The descriptive statistical figures in this section are not reliable estimates of all graduates in the respective countries. This is because the purpose of the study was to collect qualitative data about competencies, and not to survey quantitative, statistically reliable and descriptive data on graduates. That is why the sample sizes were small in all countries in this study. Methods for finding interview subjects also varied by country. The figures in the following material should be understood as background information, providing perspectives for qualitative results, therefore making it possible to roughly estimate the representativeness of the data. It is worth mentioning that in some countries the data has relatively high representativeness of the population of recent graduates. For example, in Finland the sample included about the 40% of the graduate population from the University of Helsinki (UH). UH population in turn represents around two thirds of the all forest science graduates in Finland.

Table 1: Demographic data of behavioural event interview (BEI) respondents from nine countries (N=231)

Total number of respondents	231
Sex	Male: 141 Female: 90
Mean age	29
Year of graduation range	1990-2014

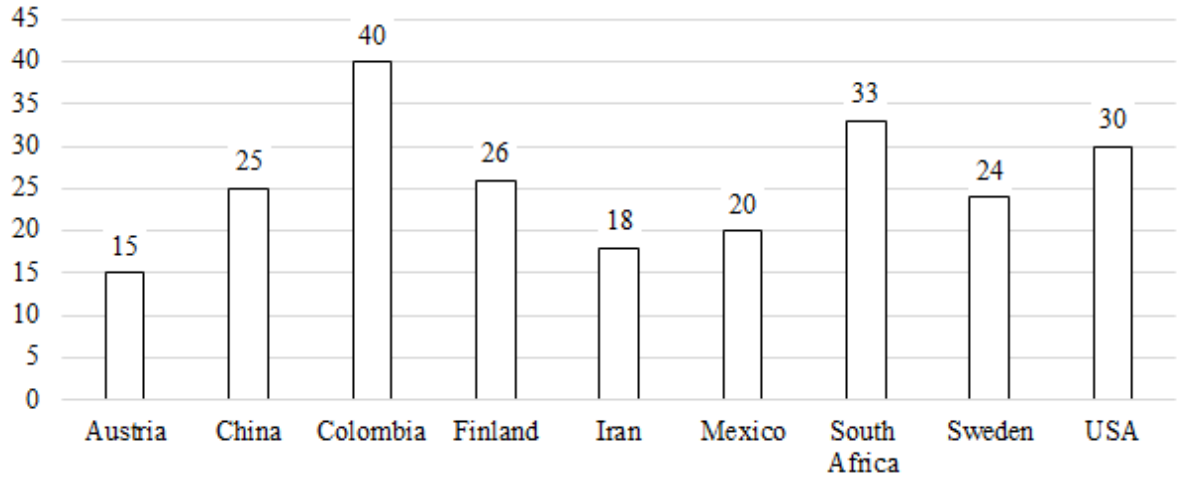

Figure 2: Number of behavioural event interview (BEI) respondents by country

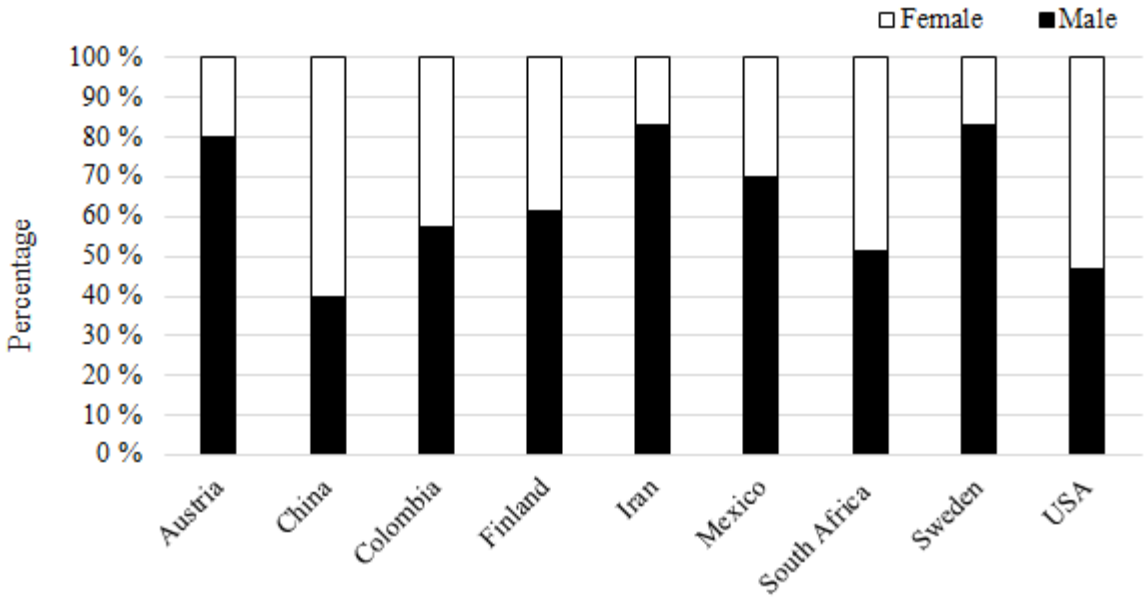

Figure 3: Proportion of male and female respondents by country

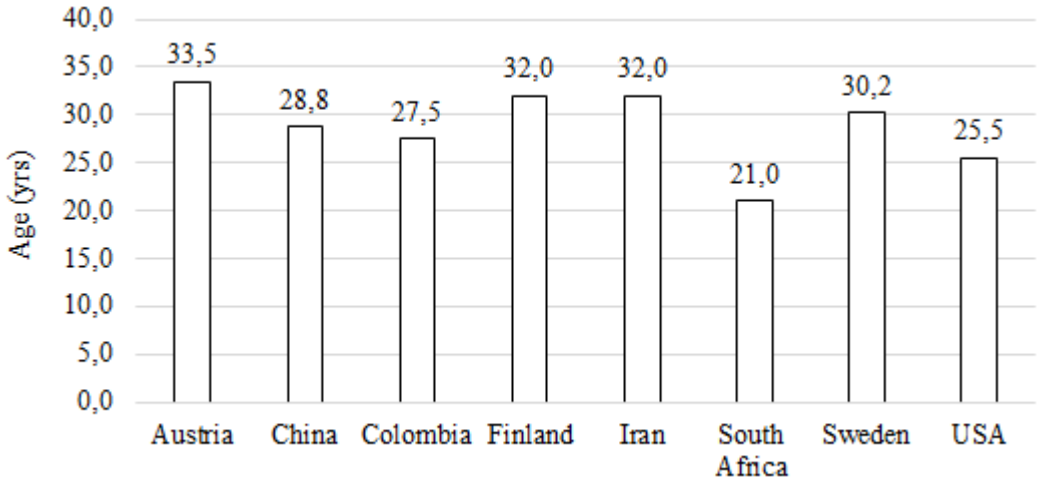

Figure 4: Average age of respondents by country (without Mexico)

Before graduation, i.e. during the enrolment in the program of forest education, respondents had been working either in forestry-related work or in other types of work places. The forest work experience was on average longer (15 months) than other work (10 months). However, relatively, the other work experience was longer during the studies compared to working experience after the studies. On average respondents had altogether 42 months of working experience after graduation, of which forest experience was greater (36 months compared to other work experience of only 6 months).

These results seem plausible because it is difficult to find a job in the forest sector prior to possessing a degree in forestry or related sciences. In most cases, forest-specific education is required in order to be allowed to work in the forest sector, often also for field workers (cutting trees, operating machines). Moreover, students' competencies are not necessarily enough for expert level work either. Many jobs in other sectors, such as the service sector (shops, restaurants), are easily available and more flexible for students.

Table 2: Average working experience (months), timing of work experience (during studies or after graduation) and type of work (forest-related work or other work)

The timing of work experience and type of work	Months (average)
The experience of forest work during the studies	15
Other work experience during the studies	10
The experience of forest work after graduation	36
Other work experience after graduation	6
The total amount of work experience (also part-time work)	67

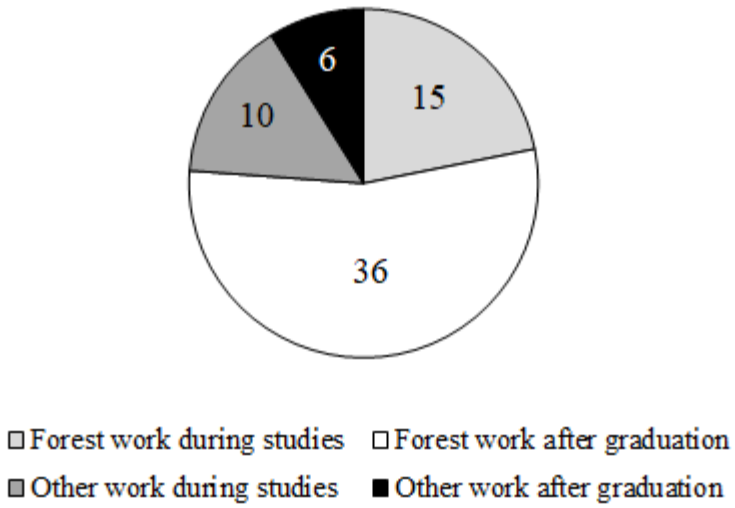

Figure 5: Average working experience (months), timing of work experience (during studies or after graduation), and type of work (forest-related work or other work)

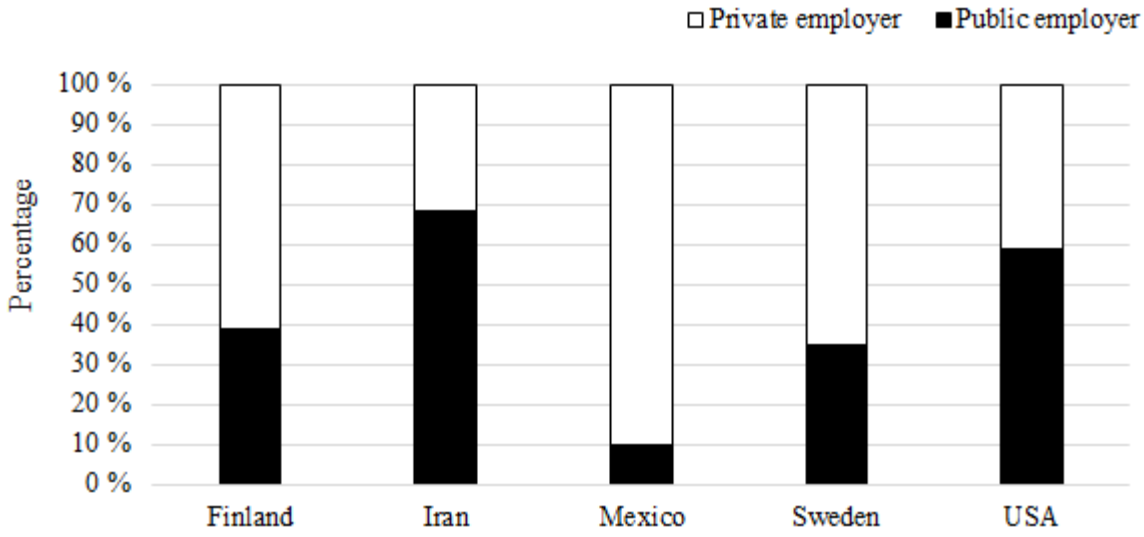

Figure 6: Proportions of private and public employment of respondents in Finland, Iran, Mexico, Sweden, and the United States

There were considerable differences in the graduates' employment in terms of private-public sector, as can be seen in Figure 6. Mexican graduates represented an extreme, around 90% of them working in private sector; whereas only around 30% of graduates in Iran were employed in the private sector. The rest of the countries were in between those extremes.

Most of the graduates had permanent contracts (Figure 7). In Austria, the share of permanent contracts was the highest, around 95%, with most countries being between 70-85%. The extreme was the United States where the proportion of permanent contracts was 35%, the rest being fixed term contracts. The length of the fixed term contracts was not asked, though many graduates mentioned they were in 1 to 3 year grant-based positions.

There was little variation in the data with respect to type of work contract (full- or part-time). The lowest proportion of part-time workers was in Finland (6%) and the highest in the United States (33%) (Figure 8). The interviewees were not asked about the length of fixed-term contracts.

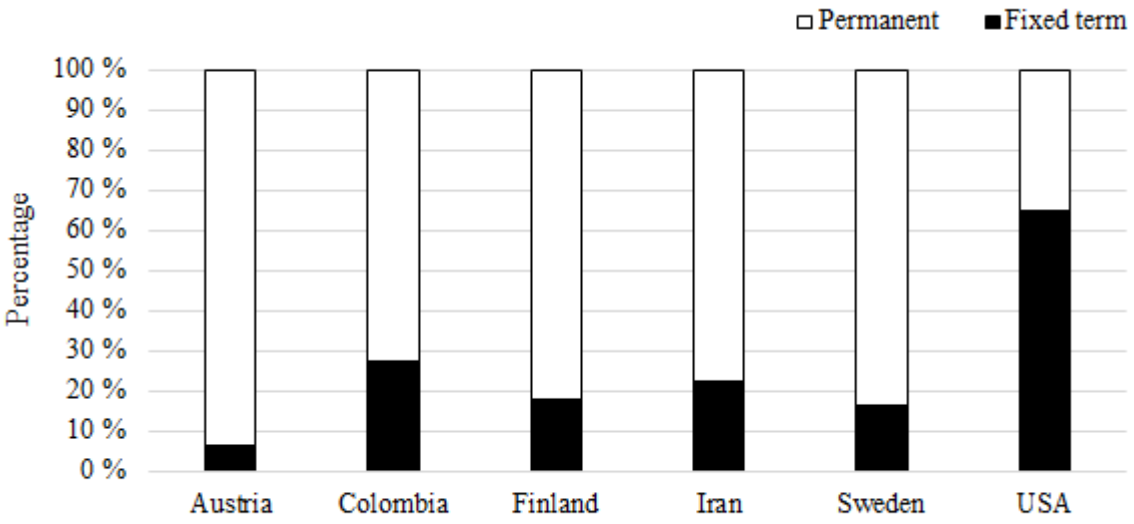

Figure 7: Proportion of current employment of graduates by contract type (permanent or fixed-term) in Austria, Colombia, Finland, Iran, Sweden, and the United States

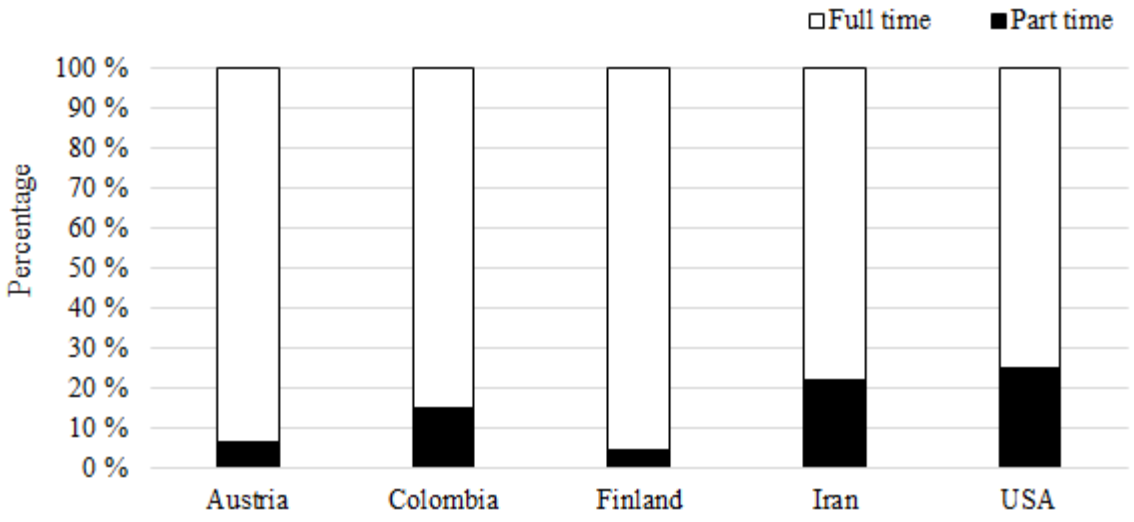

Figure 8: Proportion of full-time and part-time employment of graduates in Austria, Colombia, Finland, Iran, and the United States

4.2. BEI Results

The most frequently found competencies in BEI data represent differentiating and threshold competencies. Competencies were coded in the predetermined list that was based on previous studies in forest sector competencies (See the list of competencies in appendix). Competencies belonged to five categories (Table 3).

Table 3: Frequency of generic competencies in success and failure cases. Figures are frequencies summed across countries

Code	Competency category	Success*	Failure*
5.2.1.	Skills related to human relations	5	6
5.2.2.	Leadership and management	8	10
5.2.3.	Communication skills	3	2
5.2.4.	Research Skills	0	1
5.2.5.	General academic skills	1	0

* Numbers are produced as a result of aggregation across the summary tables from the country reports. Summary tables present the most frequent competencies in success and failure cases.

shows the aggregated frequencies of each generic competency categories. Frequencies are based on aggregation across the summary tables from each country report. Those summary tables show the most frequently (typically three) observed competencies in both success and failure cases. This meta-level information shows clearly which competencies are most frequently critical (*threshold*) competencies and which are crucial for success (*differentiating*).

The variation between frequencies of generic competencies was high. The most frequently observed competency was *leadership and management* with eight success and ten failure observations. Within this competency category the most frequent particular competency was time management with three success and five failure observations. All other elementary competencies had a maximum of 1-2 observations. The following is an example of management competencies, specifically time management:

> A success case: *"It was like a proud of all that. I was responsible for… responding to it (offer) in time. Of course I had a colleague with me…to help me with practicalities. However, the general responsibility for doing it in a right way in right time, it was mine."*
>
> A failure case: "*Well, this work is so free in terms of calendar and time allocation, so it is sometimes a challenge how time use and planning is working. Every now and then things accumulate and then between those moments there would be time to plan, if you just understand it then."*
>
> Source: Finland country report

The second most frequent competency category was human relations with five success and six failure observations. These observations were distributed evenly across all five elementary competencies: negotiation, teamwork and social, organization and coordination, education, training and supervision, and tolerance. An example of failure in negotiation comes from Austrian data:

> *"It was about a year ago when I had to organise this as the person in charge. It was the final meeting and it went not so well, because there were some differences between my college and the forest manager. I had clarified this to less extent, talked to less about this with the responsible persons."*
>
> Source: Austrian country report

The third most frequent competency category was communication with three success and two failure observations. This category consists of ten elementary competencies, however only *communication with non-experts* and *presentation* competencies had observations. An interview example of success in communication is as follows:

> *"(My job is) kind of more marketing, because my job kind of requires outreach, but you can't really help people if they don't know you exist or are there to help them. I guess I've kind of spent a lot of time looking at the demographics and doing kind of my own research on what's effective...but I've kind of keeping track of what's been working and what hasn't been working. So I'll mail out a flyer to a bunch of landowners and I actually get calls back, which it's kind of pricey because you've got to pay for postage and whatnot, but the demographic case studies show that people of*

this demographic like physical mail, they like to hold onto literature, so it's much more effective for me to send out than it is to maybe write a newspaper article that maybe gets seen once but doesn't really generate any kind of response. But at the same time I got to make sure that what I'm sending out is something they care about so if I say "hey, harvest your timber" that's probably not going to get the same response as saying "increase the wildlife benefits" or something like that, so that's kind of been a learning curve. I know I'm becoming more successful figuring out what works and what doesn't."

Source: US country report

The other two competency categories *research* and *general academic* competencies had only one observation across the country summary tables. The respective elementary competencies were *critical thinking* and *learning capability*.

Subject specific competencies varied greatly across countries. Some competencies such as Wildlife (5.1.c), Forest Resources Management (5.1.e), forestry expertise, and practical forest management were observed in the summary tables in country reports; however, they were all single observations and scattered in several country reports.

4.3. Gap analysis summary

The results of the gap analysis vary from country to country. As described in the section of BEI results there were no subject specific competencies that were observed in several countries. Moreover, competencies that need more emphasis in curricula differed location-wise, for example, measurement and inventories, environmental impact assessment and ecology of tropical forests in Colombia, and financial planning and budgeting in Iran.

The summary of country report gap analysis is presented in Table 4. Topics related to main gaps in subject specific and generic competencies reflect to some extent results from BEI analysis. That is, the most frequently observed competencies in BEI are on the general level those found relevant in gap analysis, such as leadership and management and communication. However, some differences do exist. In particular, results related to subject specific competencies seem to emphasis the role of entrepreneurship, economics and management.

Table 4: Summary of gap analyses

Country	**Main gaps, generic competencies**	**Main gaps, subject-specific competencies**
Austria	negotiation skills, legal affairs	wildlife management
China	communication skills, adaptability, ability to learn, teamwork, and negotiation, personal development	management and economics
Colombia	accuracy and diligence, new methods of learning	
Iran	teamwork skills	new (regional) forest management systems, afforestation
Finland	leadership and management	
Mexico	extra-curriculum activities	(entrepreneurship)
South Africa	leadership, oral presentation	economics and business
Sweden	communication, internship	economics
USA	communication, interdisciplinary interactions	

5. Conclusion

The aim of this Global Outlook on Forest Education (GOFE) pre-study was to explore the competencies, which have been crucial for recent forest and in some extent also to natural resources graduates. After these findings, the goal was to compare these competencies with those manifested in respective university curricula, i.e. gap analysis. There are several gap analyses in the previous literature, however GOFE is one the few that has been made with several continents using the same approach. The novelty of this study especially was the exploration method of competencies, Behavioural Event Interview (BEI), which has never been used before in the context of forest education.

Results from the BEI interviews showed that generic competencies were more often than subject specific competencies observed to be critical for graduates' "failures" in working life (*threshold competencies*). This result implicates two things. First, it shows that graduates attitudes, skills, and other elements of competencies related to specific subjects, such as silviculture or GIS, have an appropriate level of knowledge. There has not been a critical lack of these competencies in their working life. Second, the results show, that there has been a serious lack of skills related to generic competencies, so that graduates felt they were not able to fulfil their working duties. What is interesting in BEI results is that the very same generic competencies, leadership and management, human relations and communication, that were critical in graduates' working life failures were also observed to relate to their working life success stories. In a way, they were *differentiating* the performance in those cases from the average.

The results create a couple of questions and speculations. An uncertainty is whether those BEI results came from the same individuals. Was it that the very same graduates felt that they did not have, for example, enough communication skills in some cases and that in other cases they linked their success to proper communication? This is a question to be elaborated on in further research studies, building on the data gathered within this study. A speculation is, that even though we do not know the distribution of these *thresholds* and *differentiating* competencies among respondents, we might assume that there is a need for them in working life that makes those competencies even more relevant. Perhaps, time management as the most often observed leadership and management competency is a perfect example. It has been mentioned that it is not the ability to use a calendar or other tools for time management that are critical, but it is the ability to allocate your time to the most important tasks.

The results from the gap analysis are largely reflected in the results of the BEI studies. That is, those competencies, which were observed in BEI studies, seem to be underrepresented in curricula. This is not a self-evident result, and needs further detailed analysis, for instance, in terms of threshold and differentiating competencies. Results from BEI and gap analysis provided little emphasis on subject specific competencies. A detail worthy of note was that economics and management were subjects more often mentioned in gap analysis, rather than BEI results by country reports.

The notions above could be a product of some heterogeneity in study approaches among countries and regions. For instance, high and average performance differences were difficult to measure with the type of data gathered. This dimension has been crucial in earlier BEI studies where typically certain relatively strictly defined job competencies have been modelled. However, if the starting point would have been exclusively graduates from a certain university

program, the variation in occupations is considerably larger. In a few country cases, high and average performers were identified and some interesting results achieved. In general, this issue remains a challenge for future research. Finally, the method was also prone to a potential self-selection bias among respondents in terms of their competencies and working experiences.

How can we apply the current results? The results from BEI interviews can be used for training in both degree-based and LLL education. Direct quotations from the interviews are fruitful ingredients for motivating students and providing working-life relevant content for learning. The results of the gap analysis would be a good basis for further curriculum development, and they could provide a unique international reference point for forest university education.

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Appendix A. **Code List and Instructions**

Try to use the codes in the list below. If you do not find an appropriate code you are free to add your own code in this list.

3. Who was involved in the situation?

3.1.	number of participants
a	I was alone in the situation
b	There was another people in the situation
c	Situation had involved a number of individuals

3.2. Participant Groups

a	participants were colleagues
b	participants were customers
c	the participating teams had several

4. Feelings

a	positive emotion
b	negative emotion

5. Competency

Codes for subject-specific and generic competencies are both adapted from the following literature:

Arevalo, J., Pitkänen, S., Gritten, D., & Tahvanainen, L. 2010. Market-relevant competencies for professional foresters in European graduate education. International Forestry Review, 12(3), 200-208.

Schuck, A. 2009. Perspectives and limitations of Finnish higher forestry education in a unifying Europe. Dissertationes Forestales 78. 124 p. Available at http://www.metla.fi/dissertationes/df78.htm

5.1 Subject specific expertise
(Forest Expertise or Natural Resources expertise or something else non-generic skills)
Below are the codes for expertise and skills which are related to forest sciences or forestry know-how. For instance, enter code “5.1.g” in the column 2, if the interviewee talks about wood technology related issues. You can attach to the same situation several codes. Furthermore, mark the same code for each passage of text in an interview where the particular forest item is found.

Table 5: Code list

5.1.	**The forest sector know-how (GOFE minimum coding) See above more detailed IUFRO Global Forest Decimal Classification (GFDC)**
a	ecology, ecosystem biology and equivalent
b	ecosystem management and restoration
1	Waterland management
c	wildlife
d	forest pathology and mycology
e	forest resources management
f	forest technology and logistics
g	wood technology
h	ecology of tropical forests, management and use of
i	the forest industry marketing and management
j	commercial forest economics
k	forests in natural resource and environmental economics
l	another

5.2. Generic Skills

Here are codes for generic expertise and skills, which are not related to forest sciences or forestry know-how as such. For instance, enter code "5.2.2d" in the column 2, if the interviewee talks about leadership related issues. You can attach to the same situation several codes. Furthermore, mark the same code for each passage of text in an interview where the particular forest item is found.

5.2.	**General Skills**
5.2.1.	Skills related to human relations
a	negotiation
b	teamwork and social
c	organization and coordination
d	education, training and supervision
e	tolerance (to tolerate social discomfort)
f	another

5.2.2.	Skills related to leadership and management
a	knowledge of legislation
b	financial planning and budgeting
c	entrepreneurship
d	leadership
e	project management
f	time management
g	decision-making
h	responsibility
i	reliability
j	understanding of complex systems
k	resistance to pressure
l	initiative
m	subordinate
n	accuracy and diligence
o	another
5.2.3.	Communication skills
a	Information Technology (IT)
b	communication in mother language
c	communication in another local language
d	communication in English language
e	communication in any other foreign language
f	communication with non-experts
g	presentation

h	working in an international environment
i	oral communication
j	written communication
k	another
5.2.4.	Research Skills
a	information processing skills (including IT and statistical data analysis)
b	analysis and synthesis
c	critical thinking
d	methods (specific skills for example, laboratory or survey skills)
e	Another
5.2.5.	General academic skills
a	to apply knowledge in practice
b	metacognition
c	creativity
d	learning capability
e	ethical commitment
f	to work independently
g	to work in a multidisciplinary group
h	problem-solving
i	Another

Appendix B – J are country reports, conducted by local research teams within the GOFE project. The editorial team is not responsible for the accuracy of numbers and figures.

Appendix B. **Austria**

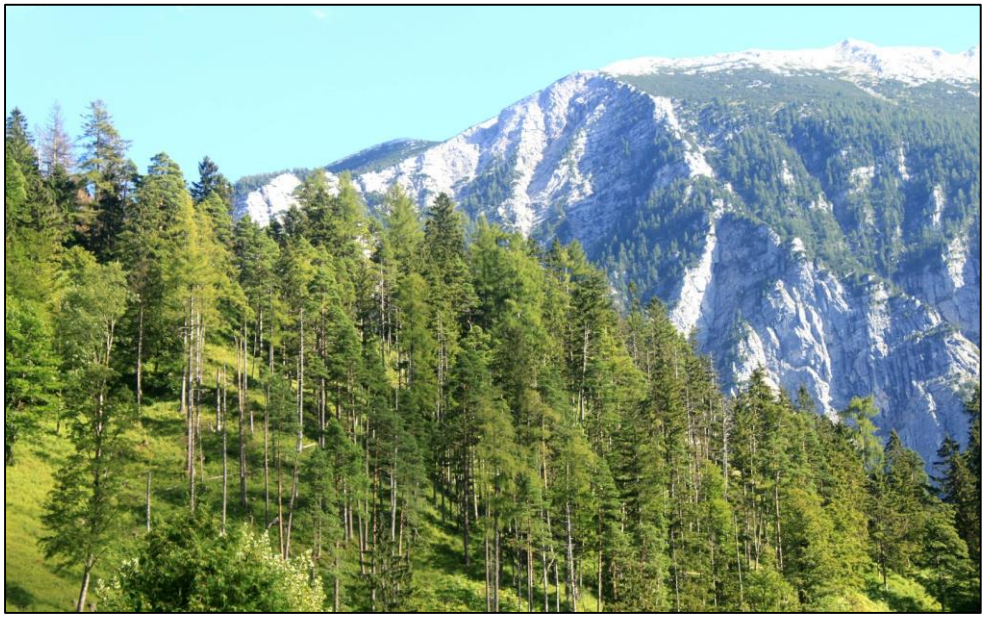

Figure 1 *Mountain forest at national park Gesäuse. Providing protection against erosion and avalanches. © IFSA LC BOKU*

Forestry University knowledge and needs on the job

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ABSTRACT

The Austrian landscape is covered more than forty per cent with forests. Forestry and the forest sector are therefore very important in the country to provide all necessary forest functions. The University of Life Sciences Vienna (BOKU) is the only university for forest education in Austria. Most of the high level leadership positions in the forest sector are occupied by BOKU graduates. Therefore, the curriculum has a very direct influence in how forests in Austria are cultivated and managed. In this work, 15 graduates from BOKU were interviewed with the Behavioural Event Interview (BEI) method about their forestry university knowledge and their general competencies they need on the job. Results were then compared with the knowledge provided from the BOKU curricula. Wildlife and forest resource management turned out to be the most important forest related competency. Responsibility, presentation, knowledge of legislation, teamwork and social, problem-solving, and negotiation are the most important general competencies. Oral presentations could be used more often as assessment tools to improve these competencies. There could be negotiation courses offered at the University, as other soft skills are offered. Some implications of wildlife and forest resource management, or knowledge of legislation, have more space in subjects' curriculum, with further surveying recommended.

1 INTRODUCTION

1.1. Background

Austria has about 3.99 million ha of forest area, which is about 48% of the country size. Seventy-two per cent are privately owned. About half of the private owned forestland is parcelled out, being smaller than 200 ha in size. About 15% of the forests, 510.000 ha, are owned by the Austrian Federal Forests. There are community managed forests (10% of forest land), communal forests (2%), and provincial forests (1% of total forest area) (BFW 2016).

Sixty-five percent of total land area in Austria is in the region of the Alps. This makes the landscape and the requirements for forest management very diverse. There are four functions the forests of Austria have to provide; these are welfare, economic use, protection and recreational use. Law regulates this and the intensity for providing these functions is dependent on various parameters. Wood production is the most important use of forests for sawmills, paper- and pulp production and many more. Forests larger than about one thousand ha must be managed by a state approved forester (§ 113 Abs. 2 ForstG), a person who has completed the technical forest school or equivalent, minimum 2 years of working experience and the state exam (§ 105 Abs. 8 1 ForstG).). Forestlands larger than 3.6 thousand ha, must be managed by a state approved forest academic (§ 113 Abs. 2 ForstG). This is a person with a MSc degree or higher in forestry, a minimum of 2 years working experience in a leading position, and having passed the state exam (§ 113 105 Abs. 8 1 ForstG).

1.1 History of forestry in Austria

Through the use by early cultures of hunters, fishermen and gatherers for crops and agricultural use, there was a decline in forest area in the foothills of the Alps. Later, the Roman period was marked by a significant agricultural expansion and many wood-intensive branches of economy. In the 16th century, urban settlements and intensive mining required more and more wood, thus leading to a massive deficiency. By the 18th and 19th centuries, demand for construction wood and firewood, as well as the use of leaf litter from trees, overwhelmed forests in such a way that catastrophes (such as avalanches and flooding) occurred much more frequently (BFW 2013). In 1817 Johann Heinrich Cotta made the first steps into forest sustainability in Europe with his famous book:”Anweisung zum Waldbau“(Instructions for Silviculture). By 1852, the first forest law was written that enshrined sustainability in Austrian forests. In the year 1975, all forests were made open to the public. For 50 years, the Austrian forest inventory program (ÖWI) has been the most important monitoring project implemented by the Austrian Research Centre of Forests.

1.2 Forest Education

In 18th century, forestry was only a skilled craft, as it wasn't until the 1770s that the first private forest institutes were opened. The first *public* forest institute opened in Mariabrunn in 1807 and the first institution of higher forest education in 1900 (Trzesniowski 2016).

Also in 1807, the first study program for forestry was opened at the mining academy in Schemnitz, Hungary. In the year 1867, the education language in Schemnitz was only in Hungarian; Mariabrunn had become the Monarchian forest academy one year earlier. In 1872, today's University of Life Sciences Vienna (later in the text BOKU, Universität für **Bo**den**ku**ltur Wien) was founded, with the study program for forestry opening in 1875. Starting with six semesters, the diploma for forest curricula has changed several times to include ten semesters and two study sections by 1973/74. In 2001, it was split into three study sections until 2003 when the curricula were adapted to the Bologna system (see e.g., http://ec.europa.eu/education/policy/higher-education/bologna-process_en). The architecture of all study programs was reorganized in this process into bachelor- and master programmes (Trzesniowski 2016). The University has its own body, but also belongs to the government's Ministry of Science, Research and Economics.

Today BOKU is still the only university in Austria to study forestry. There is one Bachelor's degree program and several Master's programs on or related to forestry. There is also one technical forest school and one for forest managers as well as two forest training centres operated by Austrian Research Centre of Forests.

2 DATA AND METHODS

All Behavioural Event Interview (BEI) participants had an ongoing employment contract at the time of the interview. All had graduated from BOKU. The interview participants (IP) were geographically split up across Austria. An expert panel or other ways to grade IP in average or outstanding ones could not be installed because of privacy rights and difficulties in finding IP. Interview participants were contacted via email to set up a time to interview.

Table 1: Demographic data of BEI Interview Participants in Austria, GOFE, 2017.

Total number of participants	15
Sex	12 males, 3 females
Age	Ø 33.5 years; from 29 to 39
Highest degree earned	13 MSc, 2 PhD
Year of graduation	Ø 2011; from 2007 – 2013
Graduation from another university?	3 with BSc
Public workers / Private workers	9 public / 6 private
Full time job / Part time job	14 Full time jobs, 1 Part time job
Permanent term job / fixed term contract	14 Permanent term jobs, 1 fixed term

***Figure 1**. Place of employment of interview participants in Austria, GOFE, 2017.*

An objective was to interview people in different positions and different jobs in the forest sector (Figure 1). Only graduates of the forestry study program (BSc) and/or forest science (MSc) were selected. To find IP for this work, an invitation mail was sent to all forest alumni at BOKU, graduated between 2004 and 2011. Because of only one response, the remaining IP were found using a snowball system (essentially, using a network) with help from the already interviewed IP. This was a very useful system and was responsible for twelve more IP. To get a balanced mix of IP in different positions and jobs, direct phone calls with companies, organisations, and institutions were also made. Interviews were carried out over the phone and dictaphone together or only with dictaphone. Interviews were then transcribed, anonymized, and coded according to GOFE guidelines. For a gap analysis, the curriculum of forestry (BSc) and forest science (MSc) from BOKU were analysed.

3 RESULTS

3.1 BEI analysis Quantitative Data

***Table 2**. The working experience period before and after graduation (# of months) of BEI participants in Austria, GOFE, 2017.*

	Working experience total, even if part time job	Working experience related to own field during studies	Working experience other than those related to own field during studies	Working experience related to own field after graduation	Working experience not related to own field after graduation
Per cent, that had a job in this category	100	93	33	100	6
Mean	87.13	11.3	3.4	71.6	0.4
Median	79	11	6	63	6

All IP total had an average of 5.1 working contracts during their studies and 1.8 contracts after graduation. All IP have an average of 87.1 months of general working experience, even with part time jobs. Ninety-three per cent of them have an average of 11.3 months working experience related to their own field (forestry) during their studies, while 33% had an average experience of 3.4 months working in a field other than forestry during their studies. All IP had, on average, 71.6 months of working experience in a forestry related field after graduation. The average year of graduation was 2011 or about 84 months before they were interviewed for this study. Only one IP had 6 months of working experience not related to their own field after graduation.

3.2 BEI Analysis Qualitative data

To illustrate the stories behind some of the most important competencies, here are three quotations from BEI data.

For presentation in a success case: “In my position, I have to set the allowable cut and I have to take all considerations into account beforehand. Then I just have to present the final results and not to give them the possibility to discuss it. In the beginning I did this wrong.“

For knowledge about legislation in a success case: “This was next to the border to [Name of country]. If a harmful organism like this appears, then this complex legal condition gets effective, which I told you about. Then this plant protection directive gets effective. It is implemented in the Austrian plant protection law. Here this harmful organism has to be reported to the European commission.”

For responsibility in failure cases: “It was about a year ago when I had to organise this as the person in charge. It was the final meeting and it went not so well, because there were some differences between my college and the forest manager. I had clarified this less, talked less about this with the responsible persons.”

***Table 3**. 3 Most frequently coded competencies in success and failures cases of BEI participants in Austria, GOFE, 2017.*

Important competencies (Success)	***Important competencies (Failures)***
Presentation (5.2.3.g)	*Responsibility (5.2.2.h)*
Knowledge of legislation (5.2.2.a)	*Negotiation (5.2.1.a)*
Teamwork and social (5.2.1.b)	*Problem-solving (5.2.5.h)*

The most frequently used general competencies in success cases were *presentation* (Communication), mentioned 26 times in 8 interviews, *knowledge of legislation,* mentioned 25 times in 9 interviews and *teamwork and social,* mentioned 24 times in 6 interviews (Table 3). Also, *accuracy and diligence*, *problem-solving*, *negotiation* and *responsibility* were used more often.
In failure cases *responsibility* mentioned 21 times in 11 interviews, *negotiation*, mentioned 20 times in 7 interviews and *problem-solving*, mentioned 19 times in 9 interviews turned out to be the most important generic competencies (Table 3). Also, *time management*, *accuracy and diligence*, *teamwork and social* and *metacognition* were used more often.

The most frequent forest sciences related competency in success cases was knowledge of *wildlife,* mentioned 32 times in 7 interviews. *Forest resources management*, *ecology*, *ecosystem biology and equivalent*, *ecosystem management and restoration* and *forest technology and logistics* were also often reported. For failure cases, *forest recourses management,* mentioned 20 times in 6 interviews and *forest technology and logistics* were the most frequent forest sector know-how competencies.

3.3 Gap Analysis

Competencies from the forest sector know-how, such as *wildlife* and *forest resources management* are treated in different subjects (Table 4). For *wildlife*, there is an entire master program at BOKU and consequently many optional subject courses on this topic. *Wildlife and forest resources management*, are mentioned in the general aims of the bachelor and master curriculum; *wildlife* as ecological patterns and in terms of biodiversity.

More evaluations with students have to be done to answer the question if it is necessary to broaden the subjects in *forest recourses management*. The same is true for *knowledge in legislation* as general competencies. In both topics there are additional, optional courses. For *presentation*, there is one introductory course, titled "research, presentation, reports" and several courses with obligatory presentations as well as final presentations for bachelor and master thesis defences. For *responsibility*, *problem-solving* or *negotiation*, there are currently no learning tools specifically in the materials and methods (Table 4). Responsibility is mentioned in the general aims of the curriculum in the way of managing a forest in a sustainable way and conservation of biodiversity and natural resources.

***Table 4**. Comparing competencies found in BEI analysis with curricula at BOKU.*

	Curricula (BSc and MSc) elements		
BEI Competencies (code)	***Aims***	***Material and methods***	***Assessment***
Knowledge of legislation (5.2.2.a), *Presentation (5.2.3.g),* *Teamwork and social (5.2.1.b),* *Responsibility (5.2.2.h),* *Negotiation (5.2.1.a),* *Problem-solving (5.2.5.h)*	*knowledge in legal subjects/forest law,* *conservation of biodiversity and natural recourses, sharing ideas, knowledge, solutions and communication skills are mentioned*	*lectures about forest and general law,* *Thesis presentation, scientific working lectures,* *Project presentation in lectures and excursions*	*written exams, oral exams, written assignments,* *oral presentation feedback, thesis presentation feedback, self-organised group assessment and reflecting the process of working in the group afterwards*
Wildlife (5.1.c), *Forest Resources Management (5.1.e)*	*Decision making in ecological questions, conservation of biodiversity, Sustainable forest management are mentioned,*	*wildlife, ecology, conservation and biodiversity lectures, lectures about forest resources management*	*written exams, oral exams, written assignments,* *oral presentation*

There are several assessment methods in the curriculum; the most important being written exams, oral exams, and working assignments throughout the semester. Additionally, group projects, oral presentations (with/without a poster), reports, or just attendance on excursions may be used as assessment. The assessment method can be changed by the instructor, but it is always fixed at the beginning of the course.

4 IMPLICATIONS

Knowledge in legal subjects could be expanded with more courses in forest curricula at BOKU if an evaluation confirms a lack of knowledge for most students leading to failure cases. Further evaluation would be necessary because of the small size of samples in this work. Courses in negotiation skills could be offered as they are offered currently for presentations or management experience. Both competencies could be also promoted more by bringing their importance in working life more into students' mind. To bring more presentations as an assessment method into forest curricula can also be an advantage for students.

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Appendix C. **China**

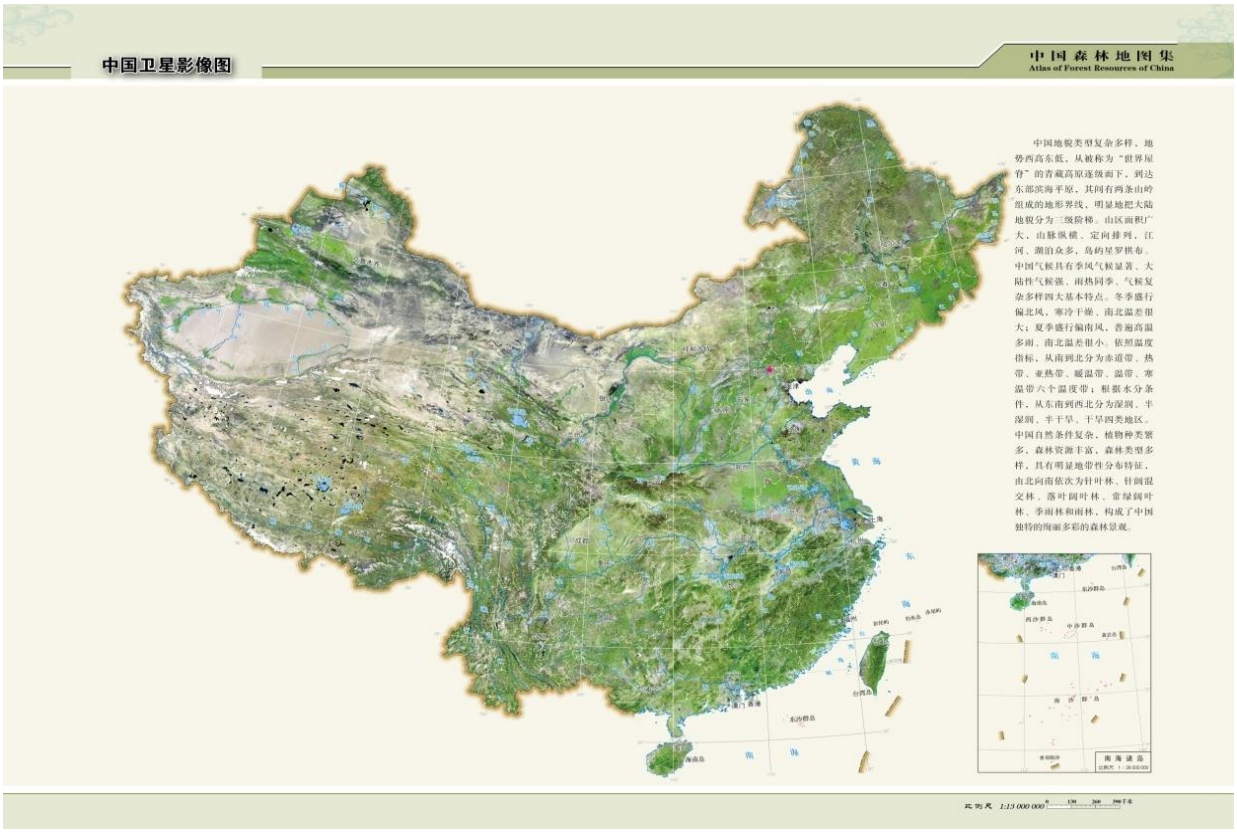

Figure 1. Chinese national forest inventory and satellite image map, eighth version.

-The Nanjing forestry University 2012-2013 Graduate Survey

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ABSTRACT

Twenty-five Nanjing forestry University graduates were interviewed with behavioural event interviews (BEI) to determine the influencing factors of success and failure, including important skills and personality traits. Commonly reported important generic skills are: communication skills and professional knowledge. Excellent performance and average performance comparisons between graduates found that there were no differences between the two groups concerning their skills influencing success, but significant differences were witnessed concerning their skills influencing failure. Concerning the influence of personality on both success and failure, there were significant differences detected between the excellent performance group and the average performance group. Therefore, we recommend to try to cultivate and improve students' communication skills; develop their professional skills (pay attention to developing their professional skills), adaptability, learning ability, team work ability and negotiation skills while focusing on their personality development. According to 438 valid statistical results, the ranking of university curriculum/courses on the basis of relevance to current work and contribution to professional competency is: Information Technology, Foreign Language, Management and Economics. The majority of interviewees acquire their professional competency through learning after work in means of self-study after work, either lifelong learning or learning-by-doing is most appreciated. As most of them choose to learn job-related knowledge and skills, general education and targeted online curriculum are thus highly recommended in establishing college curricula.

1. INTRODUCTION

1.1 Chinese forests

China's 8th national forestry inventory (2009 – 2013) (Figure 1) showed a total of 0.208 billion hectares of forest, covering 21.63% of the land area of China. The amount of forest growing stock is 15.137 billion m^3. In addition, there are also 0.069 billion hectares of plantations, with 2.483 billion m^3 of growing stock. However, China's forest coverage rate is far below the world average rate of 31%, forest area per capita is 1/4 of the global average level while growing stock per capital is only 1/7. Shortage of total forest resources, low quality and uneven distribution have not yet been changed fundamentally. Forest resources distribution is shown in Figure 1.

1.2. **Chinese Forestry education**

China has more than 10 forestry colleges, including Beijing Forestry University, Northeast Forestry University, Nanjing Forestry University, Central South University of Forestry and Technology, Zhejiang Agriculture and Forestry University, Southwest Forestry University, Northwest Sci-Tech University, Fujian Agriculture and Forestry University, Gansu Vocational & Technical College of Forestry, Shanxi Vocational & Technical College of Forestry, Jiangxi Environmental Engineering Vocational Institute, Fujian Vocational & Technical College of Forestry, Liaoning Vocational & Technical College of Forestry, and Heilongjiang Vocational & Technical College of Forestry. In recent years, the number of Chinese forestry education graduates have been relatively stable (Table 1). In the 2015 academic year, Chinese forestry education institutions graduated 7,280 masters and doctoral students (including Chinese forestry universities, research institutions, and other common forestry disciplines in institutions of higher learning and scientific research units, known as "graduate education in forestry"). Furthermore, in 2015 there were 47,400 bachelor students majoring in forestry graduated from universities, 41,500 from colleges (higher vocational education) and 60,800 from vocational schools (secondary vocational education). Meanwhile in the same year, from 78 forestry-related working fields, 33,200 people succeeded in passing the national vocational qualification test and obtained the professional skill certificate which is issued by the China's Ministry of human resources and social security.

Table 1. The number of graduates of forestry education institutions and research units in recent years in China.

Year	Number of graduates (persons)				Forestry industry employees through professional skills identification, number of obtained certificate of vocational qualification (person)
	Graduate students	Under-graduate students	Higher vocational education	In secondary vocational schools	
2014	7,379	40,739	37,702	67,712	57,643
2015	7,280	47,400	41,500	60,800	33,200

*data in the table are from the 'Annual Report on Forestry Development in China 2015' and 'Annual Report on Forestry Development in China 2016'.

With the support of 'One Belt One Road Initiative', the future of forestry education in China is promising. Problems in forestry education such as out-of-date international training for talents and few Sino-foreign joint education programs can be effectively solved through market-based education and further in-depth cooperation with many of the world's first-class universities or research institutions.

2. **Samples and Research Methods**

This report was compiled with forestry major related graduates from the Nanjing Forestry University (NFU) from the academic years 2012/2013 as research subjects. Nanjing Forestry University was founded in 1902 and as one of the three major forestry universities in China, and it is a good representation of Chinese forestry education.

Nanjing Forestry University is a multidisciplinary university, featuring forest sciences with national-wide competitive disciplines in Natural Resources Sciences, Ecology and Environmental Sciences. It consists of the Forest College, in addition to many other STEAM based Colleges (Science, Technology, Engineering, Art, and Math) and a graduate school. There are a total of 8 post-doctoral mobile stations, 7 first-level disciplines authorized to offer doctorate degrees, 39 second-level disciplines authorized to offer doctorate, 22 first-level disciplines with master's degrees, 93 master's of second-level disciplines authorized, 27 professional degrees authorized, and 74 undergraduate disciplines. Currently 2000 employees are working in NFU, including full-time teachers (1270 people), doctoral supervisors (181 people), and senior titles (640 people).

2.1. **BEI sample information**

This report focuses mainly on the behavioral event interview (BEI) and the questionnaire developed using the GOFE protocols. BEI interviewees originated from Nanjing Forestry University, from the graduation years 2012/2013 at the undergraduate or graduate level. Due to less availability of those willing to interview students, we could only invite enthusiastic head teachers and master student supervisors to personally call students to obtain effective interviewing. A total of 25 graduates were interviewed (11 outstanding, 14 average), with the sample all racial/ethnicity are Chinese Hans.

2.2 Questionnaire Information

According to the research objective of this project, drawing on Weng Qingxiong (2010) research results, we designed a Chinese version of GOFE survey. In 2013, Nanjing Forestry University graduated a total of 3,603 undergraduates. One forestry related major each was selected from Forest College, Chemical Engineering College, Material Science and Engineering College, Economic Management College, Civil Engineering College, Landscape Garden College, Art Design College, Furniture and Industrial Design College, Light Science and Engineering College, Humanities College in order to find the ideal interviewees. Correspondingly the majors are forest chemistry, wood science and engineering, agro-forestry economics and management, forest engineering, gardening, environmental art design, furniture design, light chemistry engineering and tourism management. In 2013 there were entirely 849 graduates from these 9 majors.

Next, we found the corresponding head teachers and counsellors who are in charge of student administrative works from those majors and asked them to send links to the questionnaire to the student's social medial (QQ and Wechat) online groups. Initially this was done for the 2013 graduates only, but as we received only around 200 valid answered questionnaires, so the 2012 graduates were also contacted afterwards. The answered questionnaires were mainly submitted by phone (338, accounted for 77.17%), and we in total received 509 questionnaires, out of which 438 (86%) were considered as valid ones. Sampled interviewees were all racially/ethnically Chinese Hans (Table 2).

Table 2: basic information questionnaire sample tables

Project		**Number of samples**	**Percentage (%)**
Year	2012	221	50.46
	2013	217	49.54
	Total	438	100.00
Sex	Male	196	44.75
	Female	242	55.25
	Total	438	100.00
Major	Forestry	71	16.21
	Forest chemicals	4	0.91
	Wood science and engineering	103	23.52
	Agro-forestry economics and management	19	4.34
	Forest engineering	8	1.83
	Garden	65	14.84
	Environmental art design	20	4.57
	Furniture design	28	6.40
	Light chemical engineering	97	22.15
	Tourism management	23	5.25
	Total	438	100.00

3 RESULTS

3.1 BEI results analysis

Twenty-five cases of interview results, in accordance with the factors of success and failure, were encoded with the important skills and personality traits developed by GOFE, and were also analysed as excellent performing and average performing student comparisons. Results showed that important skills in achieving success, ordered by frequency from high to low, were as follows: *communication skills, forestry expertise, adaptability, learning ability, teamwork, negotiation techniques*; Personalities, which lead to success, sorted by frequency from high to low, are: *responsible, diligent in working and learning, goal-oriented, persistent, dares to challenge*. The most impactful skills in failure interview stories, sorted by frequency from high to low, were: *communication skills, experience, professional skills, market estimating skills, negotiation skills, conflict resolution skills;* Personalities, which lead to failure, sorted by frequency from high to low, were: *careless, interests, doubts*, and so on. Visible influences on both successes and failures are the most important skills of communication.

Through comparison between excellent performance respondents and average performance ones, we didn't find significant differences between these two groups concerning important skills affecting success, but in terms of personality which lead to success, excellent performance group turns out to be more goal-oriented and persistent while general performance group is more diligent in working and learning. Concerning the skills affecting failure, excellent group suffers more from misjudgement of the market while average performance group more from their weak ability in handling conflicts. Personality significantly differentiates these two groups regarding its effects on causing failure, in general performance group, carelessness, uninterested in work and suspiciousness were detected while excellent group is hardly affected by them (Annex).

3.2 Descriptive results of the questionnaire analysis

Based on the research objective of GOFE, a questionnaire with single choice (six-level Likert scale) and multiple choice questions was used. The open-ended questions investigated main sources of the professional competencies, importance of study methods, contributions and relevance of university curriculum to current job. Multiple choice questions were aimed to find out what and how the graduates have been studying since they started working.

Concerning sources of professional ability (Table 3), study after work (average 5.26) makes greater contribution than school education (average 3.85).

Table 3: vocational ability source contribution (1 contribution Minimum →6 contribution maximum)

Topics/ Options	1	2	3	4	5	6	Average
School education	18 (4.11%)	40 (9.13%)	105 (23.97%)	149 (34.02%)	79 (18.04%)	47 (10.73%)	3.85
Work study	1 (0.23%)	1 (0.23%)	11 (2.51%)	70 (15.98%)	144 (32.88%)	211 (48.17%)	5.26

Among online learning, lifelong learning, learning from peers or experts, learning by doing, etc., Table 4 shows that lifelong learning and learning by doing are the most important learning styles, with an average score 5.27 and 5.26 respectively, followed by learning from peers or experts (average 4.91) and the importance of online learning (average 3.27).

Table 4: the importance of learning (1 importance of minimum →6 importance of maximum)

Topics/ Options	1	2	3	4	5	6	Average
Online learning	33 (7.53%)	80 (18.26 %)	110 (25.11 %)	116 (26.48 %)	63 (14.38 %)	36 (8.22%)	3.27
Lifelong learning	6 (1.37%)	6 (1.37%)	21 (4.79%)	50 (11.42 %)	101 (23.06 %)	254 (58.99 %)	5.27
Colleagues and experts	6 (1.37%)	9 (2.05%)	34 (7.76%)	81 (18.49 %)	149 (34.02 %)	159 (36.3%)	4.91
Learning by doing	3 (0.68%)	1 (0.23%)	13 (2.97%)	54 (12.33 %)	157 (35.84 %)	210 (47.95 %)	5.26
Other	57 (13.01 %)	56 (12.79 %)	102 (23.29 %)	115 (26.26 %)	66 (15.07 %)	42 (9.59%)	2.41

Among all kinds of college courses, Table 5 indicates that IT courses and major studies are most relevant to current job. The contributions of Language studies, management courses and economics courses are more or less the same concerning the relevance between job and university curriculum, showing a clear central tendency.

Table 5: College courses on the relevance of the work in China (1 irrelevant →6 most relevant)

Topics/ Options	1	2	3	4	5	6	Average
Economics courses	58 (13.24 %)	64 (14.61%)	88 (20.09%)	121 (27.63 %)	70 (15.98%)	37 (8.45%)	3.44
Management courses	38 (8.68%)	53 (12.1%)	95 (21.69%)	135 (30.82 %)	76 (17.35%)	41 (9.36%)	3.64
Major studies	35 (7.99%)	25 (5.71%)	65 (14.84%)	109 (24.89 %)	100 (22.83%)	104 (23.74%)	4.20
Foreign languages	40 (9.13%)	41 (9.36%)	76 (17.35%)	106 (24.2%)	85 (19.41%)	90 (20.55%)	3.97
IT courses	24 (5.48%)	24 (5.48%)	60 (13.7%)	126 (28.77 %)	106 (24.2%)	98 (22.37%)	4.28

Table 6 shows that IT courses and major studies make greatest contribution to professional competency. The contributions of foreign languages studies, management courses and economics courses to the professional competency are very close, showing a clear central tendency. Through comparison between Table 5 and table 6, it is easy to notice that the contributions of university curriculum (economics, management, major studies, foreign language, IT) to the relevance of the work and the professional competency share a same trend.

Table 6: Contribution to the professional ability of University courses (1 contribution most →6 contribution maximum)

Topics/ Options	1	2	3	4	5	6	Average
Economics courses	56 (12.79 %)	75 (17.12 %)	80 (18.26 %)	122 (27.85 %)	61 (13.93 %)	44 (10.05 %)	3.43
Management courses	41 (9.36%)	64 (14.61 %)	94 (21.46 %)	110 (25.11 %)	73 (16.67 %)	56 (12.79 %)	3.63
Major studies	26 (5.94%)	33 (7.53%)	67 (15.3%)	112 (25.57 %)	101 (23.06 %)	99 (22.6%)	4.20
Foreign languages	37 (8.45%)	36 (8.22%)	76 (17.35 %)	108 (24.66 %)	86 (19.63 %)	95 (21.69 %)	3.84
IT courses	17 (3.88%)	32 (7.31%)	71 (16.21 %)	118 (26.94 %)	110 (25.11 %)	90 (20.55 %)	4.24

In occupational / Job match, Table 7 shows that 155 respondents (35.39%) believe their current jobs don't match their education background, thus the score of match between major and current job is 3.12, the lowest among all the statements. On the other hand, the scores of match between job and personality, personal interest, individual expectation, experience and skills are quite close: 4.08, 4.03, 4.02 and 3.99 respectively.

Table 7: Professional / Job matching (1 is incompatible with →6 compatible OR 1=totally disagree…6 totally agree)

Statement	1	2	3	4	5	6	Average
a	45 (10.27 %)	30 (6.85 %)	58 (13.24 %)	121 (27.63 %)	101 (23.06 %)	83 (18.95 %)	4.03
b	22 (5.02%)	38 (8.68 %)	90 (20.55 %)	117 (26.71 %)	100 (22.83 %)	71 (16.21 %)	4.02
c	155 (35.39 %)	42 (9.59 %)	49 (11.19 %)	62 (14.16 %)	49 (11.19 %)	81 (18.49 %)	3.12
d	42 (9.59%)	34 (7.76 %)	66 (15.07 %)	122 (27.85 %)	93 (21.23 %)	81 (18.49 %)	3.99
e	20 (4.57%)	35 (7.99 %)	80 (18.26 %)	124 (28.31 %)	111 (25.34 %)	68 (15.53 %)	4.08

Note: a- I feel very compatible with my current position; b- current work requirements are consistent with my own interests, hobbies;c- current work match my own undergraduate major; d- current work is consistent with my own experience, skills; e- current work match my own personality

In terms of learning after work, Table 8 shows that "job knowledge and skills" is the most popular, accounting for more than 88.58%; furthermore, slightly more than 50% respondents choose to develop their hobbies or sports and fitness activities.

Table 8: Work of learning content (multiple choices):

Learning content	The number of (person)	The proportion
Job knowledge and skills	388	88.58%
Hobby development	254	57.99%
Sports and fitness	220	50.23%
Other	38	8.68%

According to Table 9, obviously self-study is the most popular learning method (85.39%) after work, followed by on-the-job training, teacher or tutor to teach, approximately up to 60%, online learning accounts for about 48% while postgraduate or part-time further education, nearly 20%.

Table 9: After graduation (multiple choices):

Learning methods?	The number of (person)	
Self-study	374	85.39%
On-the-job training	259	59.13%
Teacher or tutor to teach	262	59.82%
Online learning	210	47.95%
Grad school or full-time education	86	19.63%
Other	28	6.39%

Suggestions and Prospects

Based on the 25 samples of the BEI interviews, we make the following recommendations concerning the future forest education in cultivating or exploiting the potential of students to achieve more success and meanwhile face failures in a right way:

(1) try to cultivate and improve students ' communication skills. Twenty-five participants talked about success and failure stories, suggesting that the most important skills-communication skills- are to communicate effectively; bad communication leads to failure.

(2) increase emphasis on developing university students ' professional skills, adaptability, ability to learn, teamwork, and negotiation techniques in order to both contribute to competencies needed for success and to avoid failure.

(3) pay close attention to university students' personality development, especially to strengthen the "serious and responsible, diligent, goal-oriented, adherence, and dare to challenge" traits which play important roles in achieving success, and to avoid traits like carelessness and suspiciousness. Guide the students to value the consistency of personal interests and hobbies with work.

According to the questionnaire survey with 438 valid statistical results, we also have some suggestions on curriculum setting and teaching methods in colleges and universities:

(1) forestry undergraduate curricula should reflect the general education. Optimization of IT courses, language studies, management and economics courses is highly recommended besides existing major studies, as those courses are significantly relevant with students' future jobs, and make great contribution to their professional competency.

(2) based on market needs, more online education courses should be offered. Questionnaire surveys indicated school education is the base while study after work is the main source for professional competency. Most important learning methods

after work are lifelong learning and learning-by-doing, especially self-study (accounted for 85.39%), moreover, 88.58% of the respondents choose to learn job-related knowledge and skills after work. Therefore, the online courses should be targeted to meet the graduates' need for life-long learning to help to further develop their professional competency.

Because BEI samples are too small in number and were interviewed via acquaintance recommendation, the results might be lacking representativeness, in addition, coding errors may have led to instability of the results. However, those obstacles can be overcome in future through expanding the sample size in order to refine the theoretically saturated results. In view of BEI and questionnaire survey samples being from Nanjing Forestry University, results only represent Nanjing Forestry University, but we foresee that increasing the sample of other forestry institutions in the future would enhance the results of external effects.

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[1] About the author: Chen Yi-min, Nanjing forestry University, research interests, and the college students ' self-management of human resources management and employment.
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Annex

BEI summary tables of participants (n=25) in China, GOFE, 2017.

Successes				**Failures**			
General skills		Personality characteristics		General skills		Personality characteristics	
Communication skills (30 times)	Excellent/14 Average /16	Serious and responsible (15 times)	Excellent/7 Average / 8	Communication skills (19 times)	Excellent/9 General /10	Careless (7 times)	Excellent/0 General /7
The forestry profession Skills (23 times)	Excellent/14 Average /9	Studious (13 times)	Excellent/4 Average / 9	Experience (10 times)	Excellent/5 General /5	Interest (1 times)	Excellent/0 General /1
Adaptability (21 times)	Excellent/10 Average /11	Goal-oriented (9 times)	Excellent/6 Average / 3	Professional skills (6 times)	Excellent/4 General /2	Suspect (1 times)	Excellent/0 General /1
Learning ability (11 times)	Excellent /6 Average /5	Stick (5 times)	Excellent/3 Average / 2	Marketing judgment (5 times)	Excellent/5 General /0	--	
Team Capacity (7 times)	Excellent /4 Average /3	Dare to challenge (5 times)	Excellent/2 Average /3	Negotiation skills (3 times)	Excellent/2 Average /1	--	
Negotiation skills (6 times)	Excellent /2 average /4	--		Ability to deal with conflict (3 times)	Excellent/0 Average /3	--	
Independence (2 times)	Excellent /2 Average /0	--		Teamwork (2 times)	Excellent/1	--	
Time management skills (1 times)	Excellent /1 Average / 0	--			Average /1		

Appendix D. **Colombia**

Final REPORT Global Outlook On Forest Education (GOFE) Colombia

Sinú river, Municipality of Tierra Alta – Córdoba, Colombia. Picture by Fredy Giovani Angarita, 2016

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ABSTRACT

Colombia has five undergraduate forest engineering programs. A few years ago, the Colombian educational authority requested that all undergraduate engineering programs evaluate their curricula to align with the competency model for education. Although all the forestry programs were revised, there is no evidence of how competencies were evaluated. This report presents the results of an exploratory qualitative study aimed to describe the competencies of the graduates of the Universidad Distrital Francisco Jose de Caldas 'forestry program. To accomplish this goal, 40 Behavioral Event Interviews (BEI) were applied to graduates from 2012 to 2016. In the first place, program authorities provided a list of all graduates, then 100 graduates were randomly selected to be evaluated by an expert panel composed by 8 employers and 5 professors, 24 of the graduates were ranked as top performers and 16 as average. The syllabi of each class in the program were reviewed to be able to do a gap analysis.

The results showed that the most relevant generic competencies that help graduates demonstrate good performance are: accuracy and diligence, learning capability, teamwork and social skills. Regarding the competencies related to the forest field, the most salient are: measurement and inventories, environmental impact assessment and ecology of tropical forests, management and use of forest resources. Meanwhile, those generic competencies that appeared among incidents of failure are: accuracy and diligence, time management and responsibility, whereas, the forest field specifics competencies under there events are: measurement and inventories, environmental impact assessment and silviculture.

Although some competencies were mentioned in both events, successes and failures, the frequencies were higher in the successes than in the failures. The generic competencies that were more frequently mentioned by graduates were found in the syllabi, professors encouraging students to give oral presentations of different topics, examinations, and workshops. Only one competency (accuracy and diligence) was not explicitly mentioned in the syllabi. It is recommended to make revisions of the syllabi to include modern teaching methods that will allow students to acquire both generic and specific competencies.

1. INTRODUCTION

The Republic of Colombia is a country in Latin America with a large forest cover. Approximately, 52.2% of its 1.142.348 Km^2 is covered by different forest types that host hundreds of species of flora and fauna (IDEAM, 2015), the potential for forest being 56.2% (IGAC, 2017). About 0.45% of the territory is covered with plantations (Ministerio de Agricultura y Desarrollo Rural, 2017) mainly pine and eucalyptus. However, the area of natural forest in Colombia with respect to the area of the country has been declining gradually; in 1990 the total area of forest was 56.4%, then in 2010, 53% and more recently in 2014, 51.6% (IDEAM, 2015) and deforestation rate increased by a significant 44% with respect to the previous year (IDEAM, 2017) implying that there is an urgent need to include sustainable forest management in the development plans that will emerge from the Colombian agreement to end the armed conflict, reduce illicit crops, and build peace (Ministerio de Ambiente y Desarrollo Sostenible, 2016).

Forest management and conservation activities have long traditions in the country. Of the all forest programs in Colombia, the most common is the Forest Engineering (equivalent to bachelor's degree) with an estimated duration of 5 years. The first forest engineering school dates back to 1951 in the Universidad Nacional campus Medellín; right after, in 1952 the Universidad Distrital Francisco José de Caldas (UDFJC) created the forest engineering program as one of the first engineering programs of the University. Then, the Universidad del Tolima founded its program in 1961, the Universidad Industrial de Santander (UIS) in 1996, and Universidad del Cauca in 1999 (ACIF, 2009). Thus, five schools prepare engineers to work in forest related activities around the country. Due to the lack of schools in different areas of the country four 3-year technical programs were created, each program specialized in one area as follows: plantations, timber markets, and restoration and harvesting. There is also a 2-year technical school that specializes in harvesting. These schools cover also three agroforestry engineering programs and the one technical school also covers agroforestry in its offerings (Villarraga et al., 2015).

In 2003 the Ministry of Education of Colombia, the authority for higher education, decreed that all engineering programs should includes courses that cover economics, bussines, management, social sciences and humanities (Resolution N° 2773, 2003). Following this regulation, the forest engineering program of UDFJC offers 74 courses, 65 compulsory and 9 elective courses, all of 74 based on five generic competencies (critical thinking, writing and verbal communication, logic, interpretation of the environment in a historic and geospatial way, and creativity) and six specific competencies (mapping, project design and appraisal, innovation, diagnosis and monitoring of forest related problems, promote strategies to reduce forest damage).

2. METHODOLOGY

This study is part of the GOFE project that aims to evaluate competencies for forestry program graduates. We therefore, used common methodology based on the Behavioral Event Interviews (BEI). First, we prepared a list of public and non-public organizations that are known to hire forest engineers. Then, we contacted 8 supervisors and bosses to provide an objective rank on the professionals´ of performance of the forest engineer they have hired. At the same time, and to be able to obtain a list of 100 graduates, we used a list of graduates from 2013 to 2015 provided by the academic department of the forest engineer program of UDFJC.

Due to the fact that most of the participants of the panel of experts ranked graduates with more than 3 years of experience, and with the purpose to obtain high-rank performers, we created another panel of experts composed by five adjunct professors who have also hired graduates in their private practices, to rank graduates of the list.

Then for the final list, we selected all 24 graduates who were ranked as “top performers” and randomly selected 16 graduates who were ranked as “average” from the 76 left on the list. We contacted the participants through Facebook®, since the email and phone address associated with the list provided by the academic department of the forestry program were expired. Once we had a contact number we made a face-to-face interview with the participants, interviews were based on a predetermined design elaborated by GOFE project to ask the necessary questions for this project.

Data analysis was also based on a list of codes provided by GOFE. It was necessary to include new codes since they were reported for participants. In the section 3, we added the code 3.2.d “actors of armed conflict”. For the section 5 – specific competencies, we added those shown in Table 1. However, this codes do not correspond to the most frequently events of success or failure.

Table 1. Created codes for specific competencies

5.1	**The forest sector know-how**
m	Measurement and inventory
n	Environmental impacts assessment [1]
o	Sustainable forest planning
p	Natural risks and risk management
q	GIS
r	Climate change adapting
s	Community forestry
t	Measurements and forest modeling
u	Silviculture

3. RESULTS

Besides codification, we also analyzed some demographics of the participants. There were slightly more males than females, 23 and 17 respectively. Most of the participants were in their late twenties, 60% between 25 and 27 years old (13 female and 11 male) and the rest of the participants (3 female and 7 male) belonged to the range of 26 to 33 years old.

Out of the 40 graduates, 9 of them graduated in 2013, 16 in 2014, and 15 in 2015. The proportion female to male is almost 1 to 1 for each year. During the interview, 80% of the graduates mentioned they did not have postgraduate studies; while the other 20% (8 graduates) held a postgraduate degree (Specialization: 1 year; Master: 2 years) as shown in Table 2.

Table 2. Postgraduate studies carried out by the interviewees

Name of the postgraduate program	Level	Number of graduates
Natural Resource Management	Specialization[2]	2
Environmental Management	Specialization	1
Engineering project management	Specialization	1
GIS	Specialization	1
Appraisal	Specialization	1
University teaching	Specialization	1
Use forest management and conservation	Master	1

About the time spent in college to complete the undergraduate program, 77% of the participants graduated in a period of 5 to 7 years; on average, all the participants completed their program in 6.9 years. Figure 1 provided more detail information.

Seven out of the 40 participants had to temporarily Interrupt studies due to several reasons us such health, family matters or going to work. Four of those seven stayed 2 years out of school, 1 one year, and two six months (a semester).

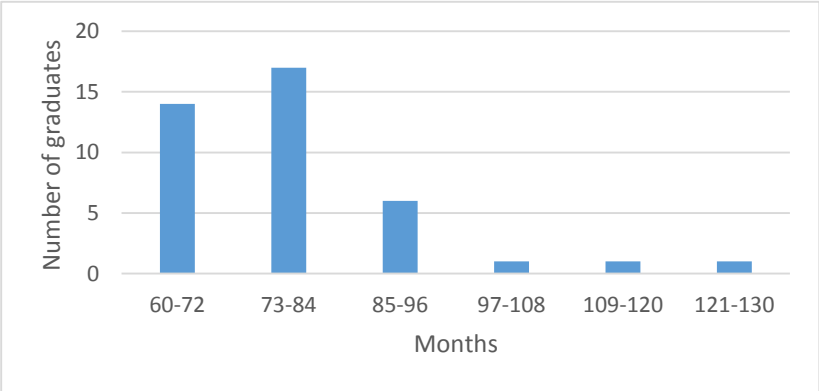

Figure 1. Time of permanence to complete the program

[2] According to Colombian legislation in Decree 1295 of 2010, the specialization programs aim to deepen the knowledge of an area of occupation, discipline or profession, the development of specific competencies for the purpose of its improvement and better performance labor. Generally, the professional specialization programs last 1 year.

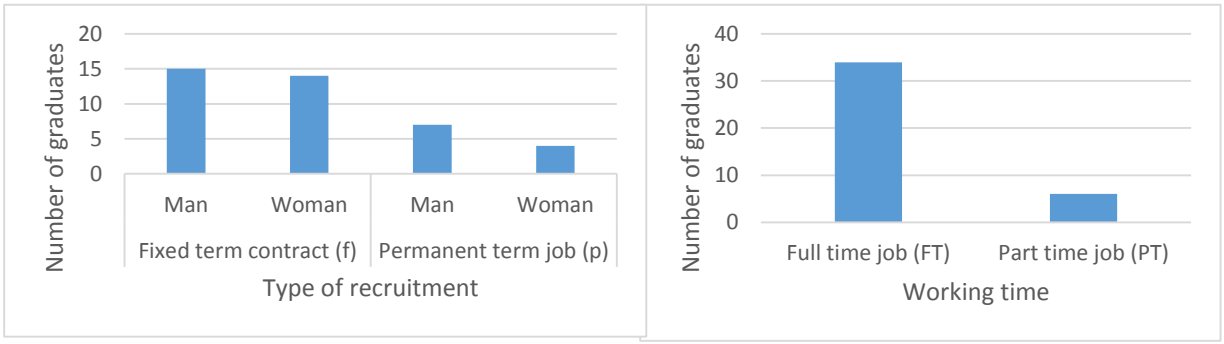

Figure 2. Type of employment

About their most recent work, figure 1 shows frequencies; clearly more than 75% are working on a contract with fixed terms. Four of the participants reported not to be employed at the time of the interview, but we included information of their last job. Full time employment is more frequent, only 15% were working part time.

It is observed that 20 graduates who represent 50% of the sample have remained in their last job between 1 and 12 months, 7 of them between 19 and 24 months, 6 graduates during a period between 13 and 18 months and the last 7, have been in their job between 25 and 36 months. The four graduates who currently do not have work, 3 remained in their last job between 1 and 6 months and 1 between 19 and 24 months.

When respondents were asked about the total years of total working experience during their permanence in college and after graduation, 50% of the graduates have worked between 2 to 5 years; meanwhile, a small percentage (3%) has experience of 8 to 10 years, more details are present in figure 3.

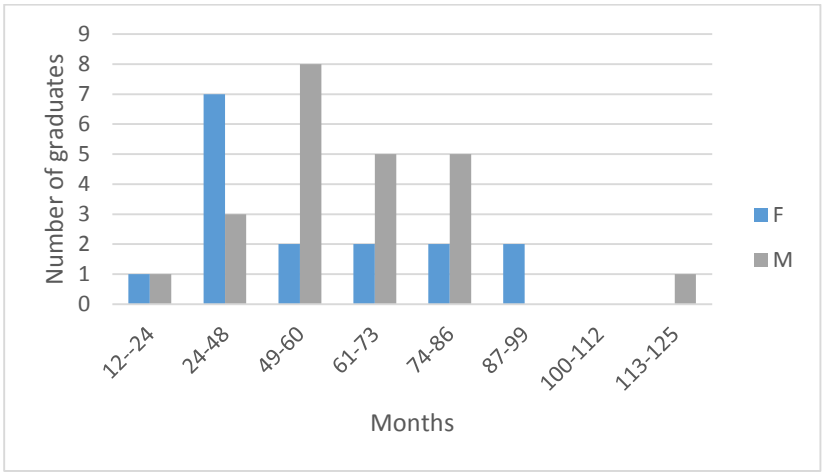

Figure 3. Total working experience

The majority (97.5%) of the graduates interviewed worked at the same time they attended college. Of 27.5% worked in forest related sector, while 70% worked in both forest and others

sectors, meanwhile one graduate never had a job. Figures 4a and 4b show in detail the time of experience by sector. The figures show that work experience during college is concentrated in other sectors such as seller, in a call center and waiter.

In terms of experience after graduation, 72.5% have worked in forest related sector only.

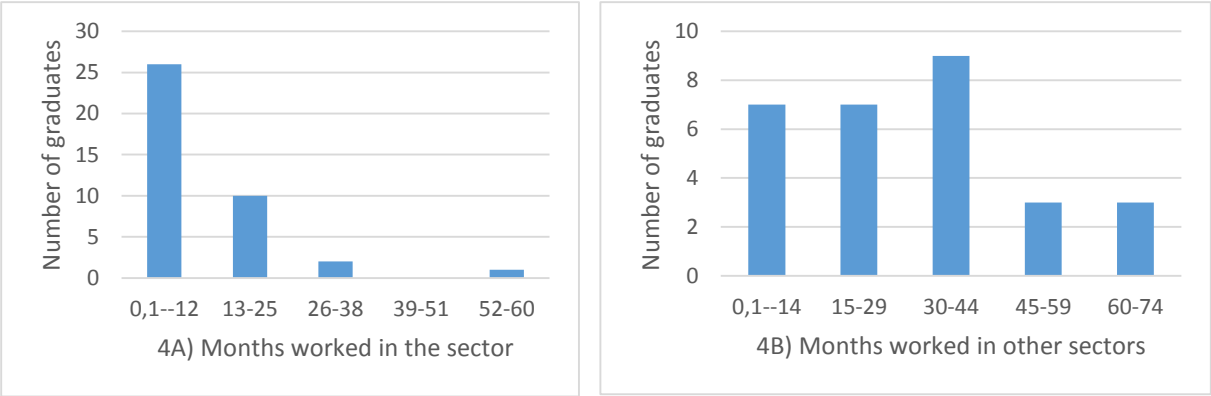

Figure 4. Work experience during undergraduate

(Figure 5A); meanwhile, 25% of graduates have worked in other areas different from the forestry sector (Figure 5B). Two participants mentioned they worked for a year in both forestry and non-forestry professions. It is worth mentioning that a participant mentioned that he has worked longer outside the forestry sector, because it has not been easy to obtain forest employment.

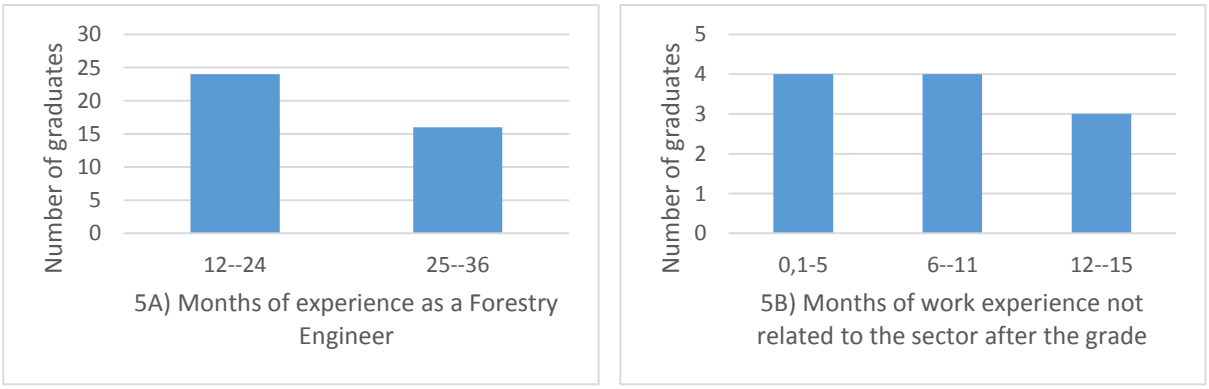

Figure 5. Working experience after graduation

Figure 6 shows the total number of contracts signed by graduates during college time, 50% had between 0 to 3 contracts (it is worth mentioning that only one of the graduates did not work during college). A high percentage of graduates (54%) mentioned to have more than 4 contracts during college with a maximum number of 11 contracts.

The number of contracts after graduation is shown in figure 6b, where it is observed that 75% of participants claimed to have worked between 1 and 4 contracts during their professional career. Since the past two decades, the job market in Colombia has suffered several crises due to several factors. In the forestry and environmental sectors it is common to have contracts for 3, 6, 8 and 12 months. Professionals are hired for short periods of time for projects, such

as evaluations, inventories, even literature reviews; this explains why graduates have large number of contracts in short periods of time.

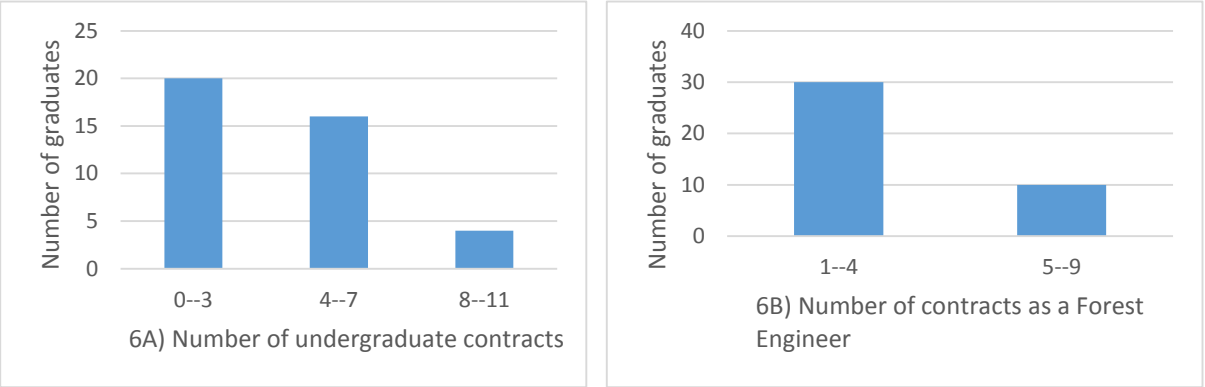

Figure 6.Number of contracts after graduation

Events of success:
Table 3 describes generic and specific competencies, the assigned code and the frequency with what each code was mentioned during the interviews, where we asked about successful events in their forest related jobs after graduation. The most mentioned generic competencies were: Accuracy and diligence, learning capability and teamwork and social work. In relation to specific competencies, measurement and inventories, environmental impact assessment and ecology of tropical forests, management and use of forest were the most mentioned. Some of the responses are:

"*The objective of the project was to reach a goal of 380 hectares in the year and I together with the team in charge, managed to plant 410 ha*."

"I got to do my job and with very good results……. I learned much more than I expected in 6 months after graduation. I appreciate that I was working with the forest engineer, he had experience and I learned a lot from him".

"Good planning of field activities for forest management and good relationship with coworkers, made us do a good job. I did very well because I knew how to work with the community that lived in the forest.... my bosses ask me if I wanted to take on more responsibilities".

Events of failure:
From table 3, the most mentioned competencies were accuracy and diligence, time management and responsibility. With regard to specific competencies, these were measurement and inventories, environmental impact assessment and silviculture.

From the table it is clear that some of the competencies are mentioned in both failure and success; however, the frequencies are higher for success. This implies that those competencies are very important for good performance of job duties. It is also clear that generic competencies are more salient than those associated with the forestry sector *per se*. Some examples of unsuccessful events:

"I did not elaborate the forest inventory reports as I progressed with the work, I accumulated the data and did not present a weekly report, instead I presented it to the month that made my boss scold me frequently."

"I had to do a forest fire plan, but I did not want to do it ……and that caused delays in other jobs. I was very worried, but I only acted until my boss pushed me to do it, I made the plan."

"My responsibility was to check the plant´s material that was assigned to the peasants, but I did not do this review very often, (because of other activities……...) and they were delayed in planting because of me."

Table 3. Most common generic and specific competencies mentioned by graduates in events of success and failure

		Success		Failure	
Competency	Code	Frecuency	Number of graduates	Frequency	Number of graduates
Accuracy and diligence	5.2.2.n	80	34	41	23
Learning capability	5.2.5.d	54	24	2	2
Teamwork and social work	5.2.1.b	43	23	10	9
Time management	5.2.2.f	41	18	35	20
Responsibility	5.2.2.h	42	21	23	15
Measurement and inventories	5.1.m	44	25	4	4
Environmental impact assessment	5.1.n	21	15	2	2
Ecology of tropical forests, management and use of	5.1.h	26	15	-	-
Silviculture	5.1.u	18	13	2	2

4. GAP ANALYSIS

Based on the aforementioned competencies, a review of syllabi of the subjects was done to identify the objectives of each of them with respect to the competencies, materials, and methods used for the students to acquire them and the method of evaluation through which the teacher verifies that the student acquired or not the competency.

Table 4. Gap analysis based on competencies mentioned in failure

Competencies BEI (codes)	Aims	Material and methods	Assessment
Accuracy and diligence (5.2.2.n), Time management (5.2.2.f), Responsibility (5.2.2.h)	Time management (Time management) Social and Scientific Responsibility (responsibility)	Workshops, reports and / or projects. Use of virtual classrooms at specific times. Oral presentations.	Compliance with the delivery of papers, reports, projects, degree work and conducting exams and quizzes, at established dates and times. Respect for the class schedules established by the University
Learning capability (5.2.5.d)	Learning by doing	Workshops, assignments in class, resolutions of mathematical logical problems. Review of bibliography. Debates.	Delivery of papers, reports, projects and tests.
Teamwork and social work (5.2.1.b)	Interpersonal competencies	Group work (laboratories, field trips, intra and extra class work)	Group discussions for the distribution of papers, reports, projects and degree work. Consensus. Group projects oral presentation, participation in meetings with the community.
Measurement and inventories (5.1.m)	Forest Measurements	Field trips and workshops.	Presentation of the report of the fieldwork that corresponds to a forest inventory.
Environmental impact assessment (5.1.n)	Environmental impact assessment	Field trips, workshops, mapping.	Presentation of an Environmental Impact Study.
Ecology of tropical forests, management and use of (5.1.h)	Dendrology, Soils, hydrographic basin	Field trips and workshops.	Realization of technical documents such as Management Plans and River Basin management (POMCA in Spanish), presentation of dichotomous keys for the identification of plant species and reports of physical and chemical characterization of soils
Silviculture (5.1.u)	Silviculture of plantations, arboriculture	Field trips, workshops, laboratories.	Presentation of papers, reports, projects and tests.

The competencies of time management and responsibility were explicitly mentioned in the syllabi, which are supposed to be acquired through project presentation, reports, team assignments, and thesis for graduation. Some syllabi explicitly mentioned the importance of complying with due dates and attendance of class on time.

Competencies related to team work and social work are mentioned in the syllabi as interpersonal competencies, which can be developed with work team assignments that can further be evaluated in oral presentations, in addition, the graduation thesis could be developed in groups of two people. Although some courses integrated social research tools such as questionnaires and interviews to address issues such as integrated watershed management, the underlying reason of their utility is not totally understood (Villarraga et al., 2015).

The competency of learning capability is mentioned in the syllabi as learning by doing, which is acquired in workshops, lab practices, and class assignments such as math problem solving, literature review, and take-home projects.

About specific competencies the syllabi of UDFJC mentioned courses related to the engineering of forests such as mensuration and inventories, ecology, tropical forest, and forest management, dendrology, soils, hydrographic basin management, tropical silviculture, silviculture of plantations, and arboriculture; there is also a course on environmental impact assessment, all of these were mentioned by graduates interviewed.

The methods for evaluating specific competencies are the traditional ones, take-home assignments, presentations, quizzes, lab practices, field trips, partial written evaluations, and a final evaluation that accounts for 30% of the final grade, the lowest passing grade for a course is 3.0 in a 1.0 to 5.0 scale.

5. IMPLICATIONS

When comparing the competencies of the events of success and failure, all of them have higher frequencies on the success ones. This implies that these competencies required more attention; clearly they are fundamental for a good performance or poor performance. It is also of significance to see that the majority of those competencies are in the generic group.

Although the competency accuracy and diligence was not mentioned in the syllabi, we assumed that they could be developed during the course of the program by turning in all the assignments on time. This implies that if the professor is strict with times and does not allow room for tardiness, students eventually developed the competency. Perhaps, it would be useful to explicitly write in the syllabi how that competency is going to be evaluated. In this regard, it would be also useful to update the syllabi with innovative methods of teaching learning that allow the development of these competencies and make them available permanently in the website of the program.

All the competencies associated with events of failure were generic, therefore, we recommend to place more attention on new methods of learning that help in the development of these competencies.

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Appendix E. **Finland**

Photo: Mika Rekola

Global Outlook on Forest Education - Country report FINLAND

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ABSTRACT

This report provides preliminary Finnish results from Global Outlook of Forestry Education (GOFE) study. University of Helsinki Forest Sciences graduates (n=26) from 2012-2013 were interviewed during the academic year 2016-2017. Interviews first examined employment status and then applied Behavioural Event Interview (BEI) procedure in order to trace differentiating and threshold competencies needed in working life. Results showed that most common differentiating competencies were time management, group work and social skills and independence - threshold competencies being almost similar. It seems that especially time management was essential for both differentiating and threshold competencies. The fact, in line with earlier studies, that subject specific competencies were related to neither differentiating nor threshold competencies can be interpreted as a satisfactory result. Graduates felt that they are qualified with respect to subject-specific competencies. After BEI results a gap analysis was conducted where competency needs were compared to documents describing educational aims, materials, and assessing methods. A recommendation from Gap analysis is that several of the most important differentiating and threshold competencies which are written as curriculum level documents should also be mentioned in the course level documents. Leadership and management was seemingly the competency that should be taken into curriculum more intensively. The assessment system should be based more on competencies so that the most important differentiating and threshold competencies are assessed explicitly. This needs some new frameworks, instructions and practical tools for teaching and learning.

1. INTRODUCTION

1.2. Finnish forestry

Geographically, Finland is located in Northern Europe in an intermediate zone between maritime and continental climates. Biologically, it belongs for the most part to the boreal vegetation zone. The number of plant species is low, only four coniferous tree species types are native to Finland, and less than 30 deciduous trees and arborescent shrubs. The majority of forests are dominated by coniferous, with broadleaves often growing in mixed stands.

Three fourths of the land area, some 23 million hectares (76%), is under forests. That makes Finland the most extensive European forested country. Forests are thus an important environment for Finns. The most common forms of recreation in forests are hiking, camping, picking berries and mushrooms, orienteering and cross-country skiing. Access to, and the recreational use of, forests is free of charge for everyone in Finland this provision also extends to private lands.

Forests in Finland are mainly (60 % of area and 73% of annual increment) owned by private non-industrial forest owners. Private forests produce over 80% of the roundwood purchased annually by the forest products industry in Finland. In 2016 forest growth was 105.5 million cubic meter (Luke Natural Resources Institute Finland. 2017a) and the annual cutting removal was 70 million cubic meter (Luke Natural Resources Institute Finland. 2017b). The forest industry's wood consumption was 67.4 million cubic meter in 2016 (Official Statistics of Finland (2017). Forest industry production has been between 3 and 6 per cent of Gross National Product in this century (Hetemäki and Hänninen 2013).

Forest education

Forest education is taught in three levels: vocational, university of applied sciences, and university level. Vocational schools, altogether 18 units located around the country, provide education for forest machinery drivers and manual workers. These three-year programs provide around 530 new professionals per year.

Six universities of applied sciences, also called polytechnics, provide education for forest engineers. Around 220 forest engineering degrees (BSc) are earned annually from four-year program and 10 degrees from continuing polytechnic program (equivalent to MSc). Two universities provide academic forest science degrees (BSc, MSc, PhD). University of Eastern Finland comprises around one third of annual graduates and University of Helsinki (UH) provides the remaining two thirds. The Bologna model of education followed (3+2+4 years) has produced annually around 70 BSc, 100 MSc, and 15 PhD degrees.

Educational units in all three levels differ in terms of ownership and governance. The regulation and public governance also varies between different levels of education. Generally, the main public regulation and steering goes through state financial support.

Local level municipalities and other non-profit organizations own the vocational and polytechnics schools. The funding provided for vocational education is based on the number of students enrolled by the school. Finnish university educational system is publicly financed and regulated by state. The funding of universities of applied sciences from the government comes through core funding, which is based on the unit cost per student, project funding and performance-based funding.

Finnish universities are independent corporations under public law or foundations under private law. Each university and the Ministry of Education and Culture negotiate targets for the university and decide the resources required every three years. Universities receive funding from the state but they also raise external funding especially for research purposes. Universities can decide the content of the curricula rather freely. At UH forest education consists of three-years BSc and two-years MSc curricula. Public policy has been that MSc is seen relevant degree for labor markets, that is why all students selected through BSc entrance examinations are entitled to study both BSc and MSc degrees. Some students, e.g., those changing the topic after BSc, are selected directly to MSc program.

At UH both BSc and MSc Curricula were renewed in 2017 and will be put into practice in autumn 2017. Most of the courses in the new curricula do exist already and many of them has been running for years. Within a fixed curriculum, a teacher in charge can develop the course content and especially pedagogical approaches quite freely as far as the course aims and content are in line with the course description in the curriculum document. Typically, the course description is no longer than 150 words.

2 DATA AND METHODS

2.1 Data collection

The study material was acquired from UH data of graduation history. There were altogether 112 MSc degrees earned in 2012-2013 from forest related programs, 46 in 2012 and 66 in 2012. Of these figures after removing non-Finnish speaking graduates (12 + 15) and those graduates with old curricula (12 + 12) the sample size was 61 MSc graduates (Fig 1). Respondents were divided into two majors: Master's Degree in Forest Ecology and Management (FEM) and Forest Economics and Marketing (FEC). FEM and FEC are the main forestry education majors and programs and the only programs where an academic forester title can be earned at the UH. Responses were received by major subject and graduation year almost in the same proportions as the total number of graduates. Employment and other information was collected from a total of 26 people (Fig. 2). The response rate was thus 43%.

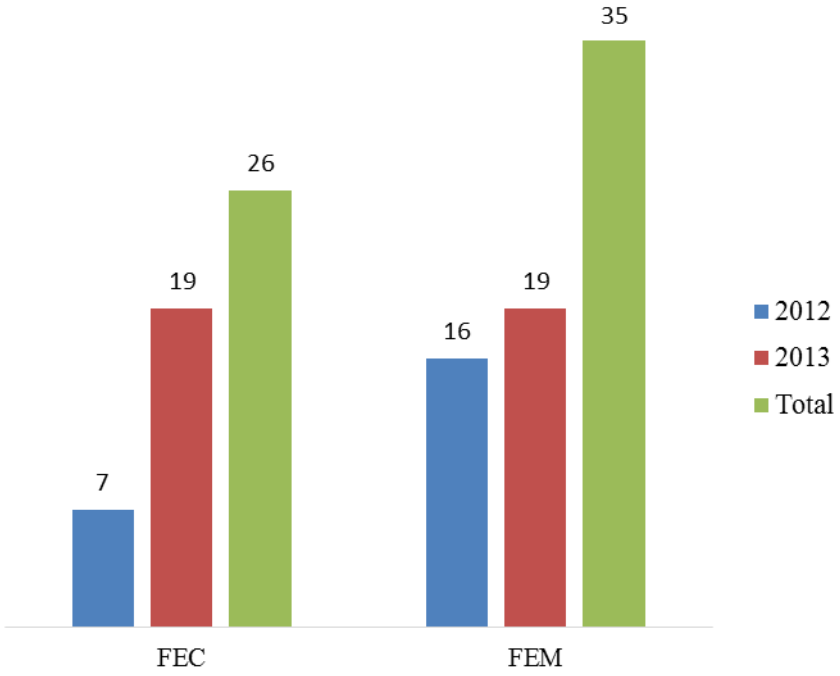

Fig. 1. Sample of MSc degree's graduates in 2012 and 2013 by major.

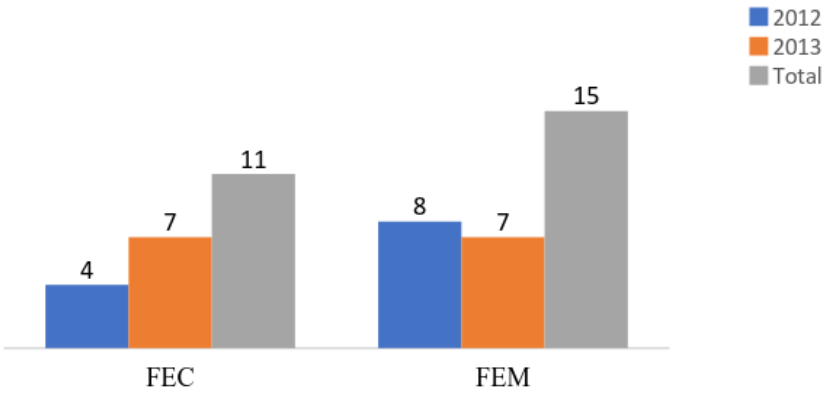

Fig. 2. Responses from every classes by major subject and graduation year.

The Finnish study followed the general GOFE procedure about data and methods main method being Behavioral Event Interview (BEI). Data was gathered at the University of Helsinki (UH), students who participated on course FOR160 Career Planning and Portfolio did the interviews in Finland. The major part of interviewers was the second year students.

Interviews were undertaken during November 2016-January 2017 when each student made one interview. Students planned the interview schedule independently and they found the contacts for graduates mainly via searching the Internet. Interviews were made either as a face-to-face meeting or remotely, for example through Skype. Students had an opportunity to choose their own interviewees from a given list, allowing them to utilize their personal knowledge of graduates' place of residence or contact information.

Data collection and processing was well-defined before the implementation of interviews. The answering alternatives were categorized with different codes to standardize the response material. In addition, for students there were accurate instructions how to store and analyze the responses. Based on examples and given instructions, every student made the transcript and coding of data. The study used pre-fined recording and summary platforms. The collection of the material emphasized the privacy of the interviewees, and therefore code numbers were used for the interviewees.

The research method used was a theme interview, consisting of three sections. In

section A, background and work history information was collected. In section B, workplace events were collected for later qualitative analysis. Basically, section B was the phase where BEI interviews were undertaken. In case that Section B was not able to carry out for every respondent, section C was targeted for people who were not employed or whose work experience was less than one year.

BEI interviews segregated factors that induce feelings of success or failure in the working life. In the interviews, both successes and failures were collected from the experiences linked to three individual events or situations. The interviews were recorded and the results were analyzed qualitatively afterwards. Competencies were categorized into detailed forest subject specific and generic competencies based on GOFE general coding. After the implementation of BEI interviews and their qualitative analysis made by students, the gap analysis was used to explain the conclusions from the study.

2.2 GAP analysis

The very last section of the study was a GAP analysis. Because in Finland MSc degree is seen the most relevant for labor market, gap analysis is concerning both BSc and MSc curricula.

The question of this exploratory gap analysis was to reflect competencies that were found important in BEI analysis (later on developed into BEI competencies) with the education provided by forest sciences curricula. Education is typically described using learning outcomes, skills and competencies or capabilities (AHELO 2013, Kemper 2009). These competencies thus construct an elementary ingredient and aim of education. Furthermore, curricula can be seen as a construct of three main parts: 1) learning aims, 2) learning methods and materials, and 3) learning assessment. All these three main elements should be aligned (Biggs 1996).

The main research question of the GAP analysis is: *to what extent are the BEI competencies achieved in education?* In order to answer this question in the spirit of Biggs (1996) it is split into three questions as follows:

1. *Do the aims of curricula include BEI competencies?*
2. *Can a student learn (and to what extent) BEI competencies with learning methods and materials are described in the forestry curricula?*
3. *Do learning assessment systems measure BEI competencies?*

The method used in the gap analysis was document analysis of forest science curricula plans and a document describing UH competency based curriculum design. Experts views from the draft GAP analysis were asked from BSc and MSc programme directors and a group of teacher and student representatives.

3 RESULTS

3.1 Working history and current work

The position of individuals in the labor market sectors varied significantly (Fig. 3). The average age of respondents was 32 years. Altogether five respondents have a family, and four of them had at least two children. There were 16 (62%) men and 10 (38%) women among the respondents. There were 18 permanent employees and 4 fixed-term employees. Only 1 person worked part-time, while 21 worked full-time. There were 4 people outside the working life (Fig. 4).

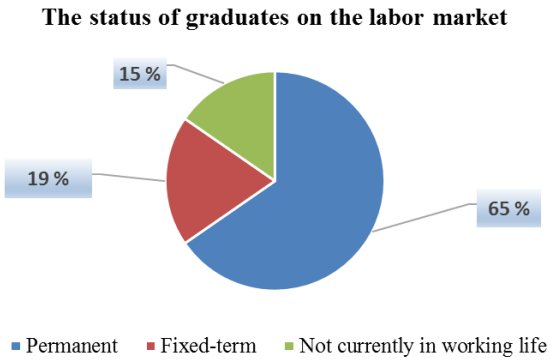

Fig 3. The graduates were mainly in permanent work.

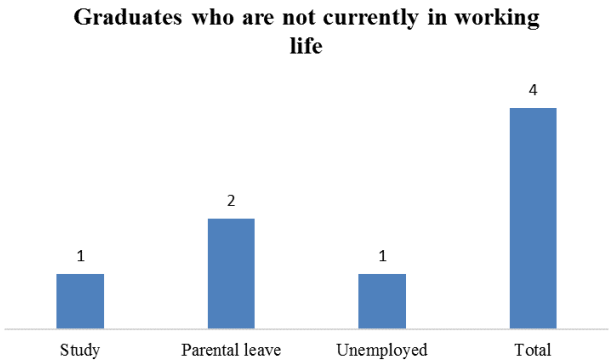

Fig 4. Some graduates were not in working life due to three reasons.

The total work experience was considerably higher than the work experience gained after graduation (Table 1). After the studies, the forestry graduates were well-employed. During the studies, forestry and other fields of work were employed in almost equal rate, conducted over an average of more than a year. On average, graduates have had four work contracts during the studies and two contracts after graduation.

Table 1. The segmentation of work experience among the respondents. The numbers are averages calculated among all respondents. Italic numbers do not correspond to the total sum of work experience because of rounding.

The timing of work experience	months
The experience of forest work during the studies	*14*
Other work experience during the studies	*19*
The experience of forest work after graduation	*35*
Other work experience after graduation	*7*
The total amount of work experience (also part-time work)	**76**

Most of the graduates work in the private sector (Fig. 5). The private sector employed 55% of graduates. One third of the graduates worked in the public sector. Public sector employers were, for example, the Natural Resources Center, the University of Helsinki and individual city administration units. In the public sector work, the tasks are focused on scientific activities and forestry. Private sector employers varied widely. The Central Union of Agricultural Producers and Forest Owners (MTK), FSC and UN (UNEP) employed a total of 3 individuals (Association/Organization).

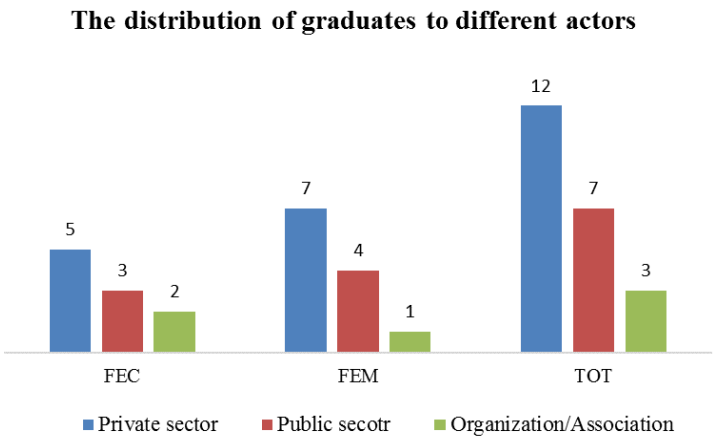

Fig. 5. Private sector was the biggest employer for the graduates.

Less than half worked in traditional forestry work (Fig. 6). Of the respondents 40% worked in forestry, logging or forestry services. Professional and scientific activities employed 23% of respondents. None of the respondents worked for the long-haulage, sawn and wood products industry or paper and board production of timber. The respondents consisted of two doctoral students who worked for the university.

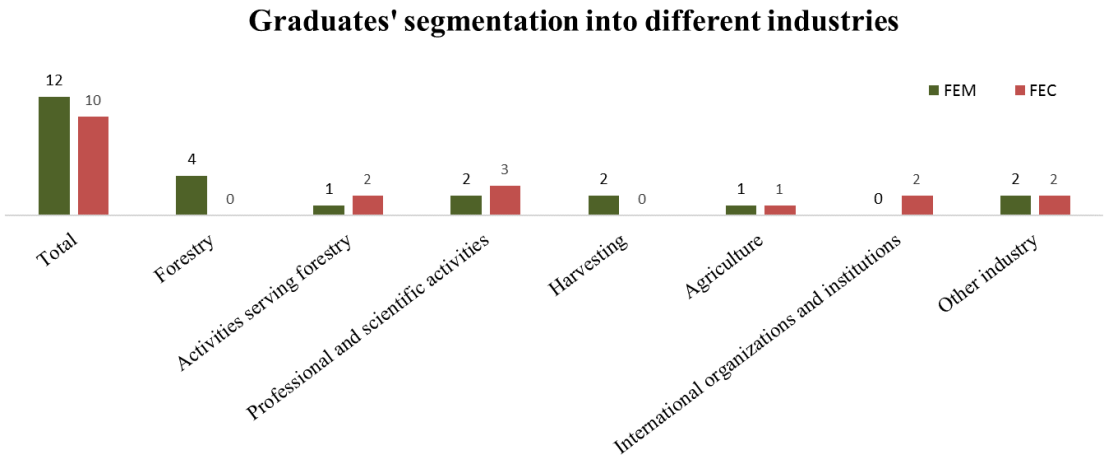

Fig 6. Graduates were segmented widely into different industries. FEC graduates were not employed in forestry or harvesting.

Most of the FEM graduates worked in forestry. Of FEM graduates 58% worked in forestry, logging or forestry operations. There was also one FEM graduate farmer. Other service activities include landscaping and marketing activities.
FEC graduates were divided in different industries fragmentally. About one fifth of FEC graduates worked in forestry. Only two people worked in activities serving forestry and they were in consultancy positions. The rest of the respondents were very diversely divided in different sectors, for example, in international organizations and institutions.

3.2 Competencies and GAP analysis

Altogether more than 30 different competencies were coded in BEI interview transcripts. The most frequently mentioned competencies from interviews are listed in the Table 2.

Table 2. The most important competencies in success and failure cases.

Differentiating competencies (Success)	Threshold competencies (Failures)
Entrepreneurship (5.2.2.c)	Time management skills (5.2.2.f)
Time management skills (5.2.2.f)	Negotiation skills (5.2.1.a)
Group work and social skills (5.2.1.b)	Tolerance (5.2.1.e)
Independence (5.2.5.f)	

Most of the competencies were related to generic competencies. Forest sciences related competencies were mentioned only a few times, of those the most frequent being forest technology and logistics. Differentiating competencies (success cases) were time management, group work and social skills and independence. Threshold competencies (failure cases) and differentiating competencies have many similarities. First, time management as such belongs to both categories. Second, Group work and

social skills (success) and negotiation skills and tolerance (failures) all belong to category of skills related to human relations. Next, we illustrate using quotations how competencies were manifested in transcripts.

As an example of an entrepreneurship competencies (5.2.2.c) in success cases is as follows:

"We have received more volume and got better process as we developed the models for contracts. Using these new action models and logistic solutions we have been successful in round wood trade. Income is now three times higher than expenditures" (Respondent #48)

Time management skills (5.2.2.f) were frequently mentioned both in success and threshold cases. It seems that time management mentioned explicitly in both cases is extremely important for both differentiating and threshold skills. The two examples of these competencies from interviews are below, first success and then failure case:

"It was like a proud of all that. I was responsible for… responding to it (offer) in time. Of course I had a colleague with me…to help me with practicalities. However, the general responsibility for doing it in a right way in right time, it was mine." (Respondent #25)

"*Well, this work is so free in terms of calendar and time allocation, so it is sometimes a challenge how time use and planning is working. Every now and then things accumulate and then between those moments there would be time to plan, if you just understand it then."*(Respondent #40)

Group work and social skills (5.2.1.b) were commonly found from success cases, whereas Negotiation skills (5.2.1.a) related to them where found common in failure cases. Quotations below show examples of both those cases from interviews as follows:

"With the previous boss, yes, it was a challenging time…he was used to leadership style where you do not question anything. However, I have used to say it if I disagree and that caused problems. But it worked for me, because he started to give respect just because I opposed" (Respondent #61)

"Two years I was working for them. They said that after working two years you can find visa. I then started to negotiate, I told that now I have been working two years and now it would be time to take a step forward to get a permanent visa. We began to negotiate and I realized that they somehow got shocked …and suddenly in (another) meeting they said that you are fired" (Respondent #52)

Competencies from BEI interviews were then used in gap analysis. The starting point of the analysis were written documents concerning education. Analysis of UH documents in relation to the most common competencies from BEI interviews are described in the Table 3. In relation to the most important differentiating and threshold competencies, independence and time management were mentioned in the general

aims of the curriculum. Tolerance as such was not mentioned, however, social skills were emphasised. Negotiation skills were not mentioned as such in the UH competency based curriculum design document. Whereas, they were mentioned earlier but not anymore in 2017 curricula version.

Table 3. The most important BEI competencies and their position in relation to the UH's curricula elements.

	Curricula (BSc and MSc) elements		
BEI Competencies (code) and (competency category mentioned in the University of Helsinki competency based curriculum design document)	**Aims**	**Material and methods**	**Assessment**
Independency (5.2.5.f) Tolerance (5.2.1.e) Time management skills (5.2.2.f) UH competency: (independence and life-long learning)	Self-direction and self management mentioned (=independence and time management)	Personal Study Plan (PSP) Thesis works Project works Student surveys Internships	PSP discussions with professor Thesis supervision and evaluation (especially MSc level) Project work guidance and evaluations
Group work and social skills (5.2.1.b) Negotiation skills (5.2.1.a) UH competency: group work and social skills	communication, cooperation, group work	Group assignments, writing reports, oral presentations, foreign languages, student exchange programs, field courses, visiting lecturer, working life excursions, multidisciplinary courses	Reflections and assessment of group assignments in terms of group work skills, oral presentation feedback student exchange feedback, field course feedback

The above mentioned competencies are also sometimes written in the aims of course level descriptions, for instance, one of the aims of MSC thesis is to plan and implement a research project in a time frame. This aim clearly refers to time management competencies. However, the course level competencies mainly consist of subject-specific competencies and not as such those most important differentiating and threshold competencies from BEI results.

There are several materials and methods that can be seen as learning tools for the most important differentiating and threshold competencies. Thesis work especially in MSc level is a considerably large independent effort. So far, the working load of MSc thesis has been 40 ECTS credits at UH, in the future it is going to be 30 ECTS. However, it is not clear in which way supervision of thesis takes into account of these self-directional and self-management skills. How many supervisors provide feedback to students related to these skills? There are some instructions about the supervision (the template supervision contract), however, how feedback on time-management

during the thesis work process is given by supervisors is unknown. The same questions can be asked in relation to internship supervision. Also, other elements of leadership and management are rather weak in the design document even though the document mentions that target competencies of MSc graduate is that he/she is competent to lead people. There are leadership and management related courses at the BSc and MSc curriculum for those who specialize in forest economics and marketing. Project management was the only explicitly mentioned material and method at the MSc level related to leadership.

The assessment methods for courses are typically based on written exams, essays or other types of individual course assignments, oral presentations, learning diaries including self-evaluations, or group work reports and presentations. The teacher in charge may independently decide the assessment methods. However, the course assessment criteria should be based on the course aims documented in the curriculum. The generic competencies are mentioned as aims in the study programme.

4 CONCLUSION

Graduates have a considerably high amount of working experience during studies. Employability was good and was mainly based on permanent contracts. There were differences between major subjects related to employment in the different industries. Competencies associated with the successes illustrate the areas of expertise that lead workers to reach high performance (differentiating competencies). Competencies that emerged in failures, in turn, indicated that some areas of expertise are not sufficiently controlled to achieve even the satisfaction performance (threshold competencies). In other words, employees feel that they were not qualified in tasks they were working with.

Both differentiating and threshold competencies were mainly related to generic competencies. In both success and failure events, significant competencies in working life were attached to leadership and other generic competency areas such as human relationships. Communication competencies were more often associated with successes rather than failures. Instead, general academic competencies were equally combined with successes and failures. For only one person, research skills were associated with the success of a working life.

The fact that subject specific competencies were related to neither differentiating nor threshold competencies can be interpreted as a satisfactory result. Graduates felt that they are qualified with respect to subject-specific competencies, that is, their level of knowledge and practice in forest related subjects were satisfactory. Interestingly, these competencies were not either seen issues which made graduates different from others in terms of high performance.

5 RECOMMENDATIONS

Several of the most important differentiating and threshold competencies which are written as curriculum level aims should also be mentioned in the course level documents as well. The assessment system should be based more on competencies so that the most important differentiating and threshold competencies are assessed explicitly. This needs some new frameworks, instructions and practical tools for teaching and learning.

As an example, it is recommended that learning of leadership and management skills are made more explicit, that is, special courses are needed and instructions as to how these skills are learned during other studies including thesis and internship. Leadership and management education should target all forest science students and not only economics and marketing students.

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Appendix F. **Iran**

Picture 1: Fall Namakabroud, Hyrcanian forests - North of Iran, photo by: Seyedreza Asvad

Assessment of Forest Education in the Country of Iran

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ABSTRACT

Assessment of education outcomes is needed for improvement of forestry education systems in Iran. Modern education is necessary for modern forestry. Annually, twenty-two state and private universities admit forestry students in Iran. According to university admission data, about 780 job-seeking technicians, and professionals with bachelors, masters and doctors of philosophy degrees were graduated from these universities per year. Commensurate with different education methods in the universities, the education quality was different. For this reason, the quality of forestry education was assessed amongst graduated persons. Behavioral event interviews (BEI) were done with 18 performers, with 10 superior and 8 average performers. Results indicated that most of graduated persons had post-graduate degrees, such as an MSc and/or a PhD from different universities. Most of them were graduated from University of Tehran (38%). Those with PhDs were employed in the academic sector for teaching and research. The average time in work experience for performers was 84 months. The highest degree of performers was PhD in forestry. Seventy-eight percent had full time jobs with permanent time contracts. The average age of graduates was 32 years old. Based on this study, some guidelines were identified by graduated persons to improve the education quality in Iran, such as decreasing the number of enrolled students of universities, more qualitative and employment-based education, and more applied courses in forestry.

Keywords: Behavioural event interviews (BEI), Forestry, Graduated persons, Quality, Iran

1 INTRODUCTION

1.1 The state of Iran forests:

Iran forests are less than 7.4% of the total land area in the country. There are 12.2 million hectares of forest, including temperate, semi-humid, semi-arid, and arid forests in Iran. According to the available definition of FAO, 'forest' is an area covered by trees with a minimum height of five meters, with canopy cover of more than 10%, covering a minimum area of 0.5 ha (FRWO 2009). Ecologists and botanists have divided Iran forests into five vegetation regions based on climate including Caspian, Arasbaran, Zagros, Irano-Touranian, and Khalijo-omani. Most part of these forests are hardwood. The most important species are *Fagus orientalis, Carpinus betulus, Quercus castanifolia, Buxus hyrcana, Parrotia persica, Taxus baccata, Pistacia mutica, Q. macranthera, Q. komarovii, Q. infecturia, and Q. libani.* Iran is considered one of the dry or semi-arid and low forest-cover countries (LFCC) (Sagheb-Talebi et al. 2004).

1.2 Forestry education in Iran:

Forestry higher education (FHE) was started by the Ministry of Higher Education to provide experts with higher quality education. Nowadays, forestry students are being educated by the Ministry of Science, Research and Technology (MSRT), Islamic Azad University, and Jahad e Agriculture Ministry (Mirzaei 2010). Newly beginning for Iran, the field of "Forest and Range" in 1952, the Department of Forestry started teaching at the Faculty of Agriculture at the University of Tehran. In 1963, the Institute of Forest and Range was replaced with the Department of Forestry, and in 1966, with the establishment of Faculty of Forestry, the current Department of Forestry and Forest Economics began its activities under the Faculty of Natural Resources in the College of Agriculture & Natural Resources. Before that, Gorgan University of Agricultural Sciences and Natural Resources (GUASNR), the first higher education institute in Iran specializing in agricultural sciences and natural resources, was inaugurated by Agricultural Minister as the Junior College of Forestry and Range Management in 1957. Currently, seventeen universities such as Tabriz, Tehran, Urmia, Kurdistan, Sari, Gorgan, Guilan, and others admit forestry students at the bachelor, master, and PhD degree level. Annually, around 780 students graduate from these universities. As the demand of natural resources graduates was commensurate with the management level of natural resources of the country, by decreasing the level of forests (from 18 million hectares in 1943 to 12 million hectares in 2017) and the annual degradation of the country's pastures, the demand for labor force has declined during this period.

2 DATA AND METHODS

2.1 Data collection

Data were collected by semi-structured questionnaires through interviews from teachers and graduates of forestry field from Iran universities. Samples were from different universities at three degree levels, BSc, MSc, and PhD. Behavioral event interviews (BEI) following the GOFE project protocol were completed with 18 performers, with 10 superior and 8 average performers. These people were from different universities of Iran including Tabriz, Tehran, Gorgan, Urmia, Sari, Guilan, and etc. Employment and other information was collected from them. Data were analyzed by SPSS 19 and MS Excel. Over 80% of the performers were male, and ages ranged from 26 to 49 (Table 1).

***Table 1**. Descriptive statistics of age of samples*

Variable	Min	Max	Mean	Std. Deviation	Gender	
Age	26	49	33.8	5.2	F	M
Frequency					3	15
Percent					16.7	83.3
Total					18	

3 RESULTS

3.1 Working situation analysis

Graduated persons had different experiences and status in the labor market. Most of them worked with permanent contracts (78%) and some of them had fixed period contracts (22%). Also, seventy-eight and twenty-two percent of graduated persons had full time and part time jobs, respectively. The average working experience was 92 months, varying from 15 to 300 months. All of the studied persons were employed, although some of them were employed in unrelated jobs to their studies, such as shop keeping.

The working experience period is illustrated in Table 2. Fifty percent of graduated persons had 13 months working experience related to their own field during their studies. The average working experience other than those related to their own field during studies was about three months, with seventy-seven percent of studied persons having three months of unrelated work experience during their studies. Sixteen percent of people had 61 months working experience related to their own field after graduation. Most of them (60%) have experienced non related work to their own field for about 15 months.

***Table 2**. The working experience period before and after graduation in Iran, GOFE*

The timing of work experience	**Months (average)**
The experience of forest work during the studies	13
Other work experience during the studies	3
The experience of forest work after graduation	61
Other work experience after graduation	15
The total amount of work experience (also part-time work)	92

Seventy-eight percent of people had no work contracts during studies, with the average work contract during studies being less than one contract. In regard to number of contracts after graduation, 27% of people were not employed. The average number of work contracts after graduation was nine. Eighty-nine percent of these people worked in the public sector. 27.8% of the performers were employed at the education sector and 61.2% of them were employed at the Natural Resources Bureaus.

The most important competencies from interviews are listed in Table 3. Table 3 showed the differences between superior and average performers in terms of type of skill. Also, frequencies of these competencies have been listed. Type of success and failures were different. *Team work* and *working in a multidisciplinary groups* were important failure factors for superior persons. While *organization and co-ordination* was a main success factors of average performers. A main skill of average performers was *project management*.

***Table 3.** The most important competencies from superior and average performers*

Superior				Average			
IMPORTANT SKILLS (Success)	n	IMPORTANT SKILLS (Failures)	n	IMPORTANT SKILLS (Success)	n	IMPORTANT SKILLS (Failures)	n
Education, training and supervision (5.2.1.d)	4	Group work and social skills (5.2.1.b)	4	Project management (5.2.2.e)	6	Ecology, ecosystem biology and equivalent (5.1.a)	2
Creativity (5.2.5.c.)	4	To work in a multidisciplinary group (5.2.5.g)	3	Organization and co-ordination (5.2.1.c)	4	Financial planning and budgeting (5.2.2.b)	2
Forest resources management (5.1.e)	2	-		Metacognition (5.2.5.b)	2	-	

3.2 GAP analysis

The most important differentiating competencies (in success cases) for superior and average performers were *creativity, training and education, organization and co-ordination* and *project management* skills. Failure cases most often involved *group work*, *social skills,* and *financial planning*. *Organization and coordination* and *working in multidisciplinary groups* mentioned in success and failure cases were very important for both differentiating and threshold skills (Table 3). Document analysis regarding Iranian universities forestry curricula in relation to BEI competencies are described in Table 4.

One of the most important mentioned skills was *creativity*. Creativity is an important skill that can be helpful in other subjects. This skill can improve education and management abilities of performers by giving them skills to help adapt to new situations. Curriculum document analysis shows many courses in regards to forest management. Management skills are necessary for managing forestry plans. They are also needed for managing project affairs especially during research activities at MSc and PhD levels. Some performers have stated that they have higher skill levels in *education and training*. This skill is easily assessed by students and faculty. When they use creativity in education system, they will have significant outputs.

The second section of competencies focuses on *group work and social skills*. Students need assignments practicing working in a multidisciplinary groups and projects. The focus of these competencies is about making relationships and cooperation. There are several materials and methods that can be incorporated to give students practice in these areas before encountering them in a professional setting. Preparation of oral and poster presentations are activities that work well for groups and involve social skills. Also, cooperation in forestry planning is needed but there is not trained or emphasised in any current course. After finishing the forestry bachelor degree, cooperation is a necessary skill for writing multidisciplinary forestry plans.

Table 4. The most important BEI competencies and their position in relation to the curricula Iranian universities elements.

	Curricula (BSc, MSc, and PhD) elements		
BEI Competencies and competency category mentioned in the Iranian Universities competency based on curriculum design document	**Aims**	**Material and methods**	**Assessment**
Education, training and supervision (5.2.1.d) Creativity (5.2.5.c.) Forest resources management (5.1.e) Metacognition (5.2.5.b) Project management skills (5.2.2.e) Iranian Universities competency: (management and life- long learning)	Better training, Self-direction and self-management mentioned (=creativity and time and project management)	New training methods Thesis and project works New management method	Training assessment by students and university Thesis supervision and evaluation (especially MSc and PhD level) Project work guidance and evaluation
Group work and social skills (5.2.1.b) To work in a multidisciplinary group (5.2.5.g) Organization and co-ordination (5.2.1.c) Iranian Universities competency: group work and social skills and communication methods	Communication, organization, cooperation and group works	Group assignments, writing reports, oral presentations, poster and brochure preparation, language learning, student exchange programs, field courses, visiting lecturer, multidisciplinary courses and researches	Reflections and assessment of group assignments in terms of group work skills, oral presentation feedback, Field course feedback

4 IMPLICATIONS

According to the results, most of performers had negative emotions about forestry fields. One reason is high admission of this field at the different universities and low employment rate of the graduate persons. Another reason is low importance of forest and environment in the social programs. These factors led to negative emotions among performers. Another failure competency among superior persons was teamwork and social skills. Teamwork skills have not been included in university curricula enough, and for this reason, teamwork spirits was often weak among the studied persons with people often alone during work time. We believe increasing the teamwork spirit among students and graduated persons is possible with some related courses.

Iran is one of the LFCC, so planting trees and afforestation should be prioritized. In this regard, we should have many courses about the principle of afforestation in the different region of Iran including humid, semi humid, arid, and semi-arid environments. Currently there are only three credits covering afforestation.

Some of performers have stated that some curriculum plans do not meet the industry and Iranian forest's needs. For example, harvesting of non-wood forest products for reaching to sustainable forest management is more important but very few courses have been offered to students. Most of courses were designed during the establishment time of this field in Iran, about 30 years ago. Although most of courses have been revised, reviewing the existing forestry curriculum and preparing a new curriculum standard to update the system of education based on geographical regions is recommended. Also, maintenance of laws concerning occupation of graduates and acceptance priority of local students can improve the rate of occupation for FHE graduates. Using the current method of student acceptance at universities in Iran by means of an entrance examination should also be added as a requirement to the forestry programs. However, students already working in the forestry section and native students should be given additional consideration or priority. Furthermore, students who want to take higher graduate levels, should have work experience in the forestry field, in addition to their coursework experience. Sometimes, the curriculum plans are completed as planned but some parts of the field are missing. So, when experienced students conflict with a problem during work time in the industry or office, they notice that this part is incomplete.

Different forest ecosystems with different conditions/management regimes exist in Iran. Forest regions vary in terms of physiography, flora, socio-economic problems, etc. special courses are needed for these region to meet the management and ecologic needs. For this reason, the FHE curriculum should be renewed according to forest regions in Iran and educational planning must be done in each forest region. New forestry courses and attitudes in regards to new forest management systems and modern changes should be prepared in FHE. Suitable equipment for students and proper information technology for FHE implementation are necessary (Mirzaei 2010).

Over the past 60 years, the number of educational institutions of natural resources has increased from one center in 1952 to 17 state and private educational units in 2017. In spite of the expansion of supply, the demand for natural resources graduates has not increased and it has largely remained in the public sector. Therefore, it is seen that not only the supply and demand trends of natural resource graduates have not been proportionate in the past 40 years, but were opposite. Increasing supply and decreasing demand is one of the main reasons for unemployment of graduated

persons. These findings are in line with other researchers in higher education (Davis 1997; Borthwick and Murphy 1998; Siegfried and Stock 1999; Siegfried and Stock 2004).

More comprehensive research is needed to investigate the problems of the natural resources education system in Iran and presenting the necessary guidelines for quantitative and qualitative coincidence of the graduates' supply and demand. It seems that efforts of the authorities to increase the quantitative and qualitative matching of supply with the demand for the labor market in different fields, especially in the natural resources sector, can solve many of the unemployment problems of future forestry graduates of the country.

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Appendix G. **Mexico**

Picture: Lago de Arareco, Municipio de Bocoyna, Chihuahua. Picture by: Sandra Rodríguez 2015

Global Outlook On Forest Education (GOFE)
Mexico Final Report

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ABSTRACT

Around 28% of the continental area of Mexico that correspond to 55.3 millions of hectares is covered by temperate and tropical forest. There are 37 federal and state forestry schools around the country that train students on forest and forest management. Two states located in the temperate north part of Mexico produce around 50% of the timber of the country. This document presents the results of an exploratory study to evaluate competencies needed by forest engineers. Twenty behavioral event interviews (BEI) were conducted with graduates who work in the State of Chihuahua, the second largest timber producer of Mexico. In most of the successful experience stories, participants were working on a team and felt good about their successes. The most important general competencies associated with the successful events were leadership, time management, communication with non- experts, and learning capability. Meanwhile, the general competencies that may negatively affect performance were responsibility (too much), critical thinking, and the lack of specific skills to do research. It is worth mentioning that this last competency was also one of the most important in the success events. In terms of the competencies related to forest sector know-how, none of them were mentioned, reflecting that in technical aspects, students feel well-prepared to undertake their jobs; however, more attention should be paid to general competencies.

1. INTRODUCTION

Forest cover in Mexico is approximately 55.3 million of hectares distributed along the country, from temperate to tropical forests, that are home to thousands of species of flora and fauna. Despite is richness and its complex management, 80% of the forest is under common or *ejido* property (public government land). Ironically, the approximately 12 million people living in the forest have reportedly the lowest human development index (CONAFOR 2001). The contribution of the forest sector to the Gross National Product (GNP) is low, around 1.2% per year (SEMARNAT and CONANP 2015). Forest production is concentrated in three states, Durango, Chihuahua, and Michoacan (around 53.6% of total production), sawn wood of pine and oak is the major product commercialized (SEMARNAT, 2016).

Out of the 21.6 million of hectares with potential to produce timber, only 8.6 million are under management, meaning that if all the potential areas were in production, the total contribution to GNP would increase. In addition, there are 16 million of hectares with the potential for reforestation and restoration. Thus, the potential to enhance the quality of life of people who depends on the forest is high. Mexico has worked hard to implement actions to favor reforestation, restoration, and sustainable forest management. However, there are still some issues (such forest fires, illegal logging, agriculture, and cattle expansion) that cause fragmentation and degradation and consequently erosion and sedimentation of water bodies (CONAFOR 2001).

To tackle those problems and to enhance sustainable management, thirty-seven[3] forestry education institutions prepare foresters around Mexico. Four of those institutions have technical orientation, two are oriented to agroforestry, and the other 33 prepare forest engineers. Although all institutions are located in strategic places for rural inhabitants to access them, only one institution carries the name of Community Forest Engineering (Ingeniera Forestal Communitaria). The 37 institutions are public by nature, six of them depend on the Federal Budget, while the others rely on state budget. The four technical schools are under the supervision and responsibility of Comision Nacional Forestal (CONAFOR), which is the forest authority of Mexico.

There are some accreditation organizations, such as the Comité Mexicano de Acreditación de la Educación Agronómica (COMEAA) and Comités Interinstitucionales para la Evaluación de la Educación Superior (CIEES) that supervise the quality of the forestry schools, which in turn are supervised by the Secretary of Public Education (SEP). Mexico has both tropical and temperate forests; therefore, the forestry engineering curriculums are designed to attend the needs of the region they are located.

All the curriculums include the basic courses for forestry science, such dendrology, forest mensuration and inventory, silviculture (temperate and tropical), forest legislation, economics, soils, forest management, wood technology, forest operations, forest health, and genetics. In addition, there courses on research methods, statistics, writing, English as a second language, project assessment, hydrology, rural development, and environmental impact assessment among others, that help forestry students to have a holistic view of the forest goods and services.

[3] Information from REFORESTAMOS Mexico. Unpublished document.

2. METHODOLOGY

The sample population for this study consists of graduates who work on the State of Chihuahua. It is worth mentioning that the state of Chihuahua is the second largest timber producer of the Country after the state of Durango. The first contact information was gathered from a group of professors of Universidad Autonoma de Chihuahua who provided a list of current employees in the state. Telephone calls were made to schedule a visit to employees, three companies were visited and from them the snow ball technique was applied to complete a list of 20 graduates who were refereed by their fellow colleagues.

Twenty graduates were interviewed applying the pre-established Behavioral Event Interview (BEI) provided by GOFE. All interviews were tape-recorded to further transcribe them. Once each interview was transcribed, a codification was made using the list of codes provided by the GOFE principal investigator. To reduce subjectivity two people codified the interviews in two different times. Finally, all data was upload to a matrix and reported to the GOFE principal investigator.

3. RESULTS

The participants of this study graduated from three different Universities as follows: 13 from Universidad Autónoma de Chihuahua, 4 from Universidad Juarez del Estado de Durango, 1 from Universidad Autónoma de Chapingo, and 1 from Instituto Tecnológico de la Zona Maya. This latter is a university located in the tropical area of Mexico. There were 14 males and 6 females. Only three participants have graduate studies at the master of science level. At the time of the interview, the rate of unemployment was 40%; meanwhile, 15% of participants had a permanent job and the remaining 45% had a fixed term contract. Only one participant worked for the government and had a permanent job. The other participants work for private businesses or civil associations.

From the 8 participants who were working in not forest related jobs, and one is studying. Participants who were employed in forestry held technical positions, with three being supervisors of other engineers. Considering general working experience, the average time spent working for the sample population was of 36 months; however, it is important to clarify that three of the participants had 7 to 10 years of experience because they finished their high school education in one of the technical forestry schools, after which they pursued a career as forestry engineers, giving them an advantage over other students; so they worked while in college. In addition, another participant was “lucky” (in his words) to start working when he was in college for only 2 years. In contrast, four participants did not have any experience on the field. If calculated, the average work experience for the “typical” graduates resulting in 18.6 months. Table 1 summarizes the distribution of work experience before and after graduation.

Table 1. Work experience (in months) of participants in the GOFE project for Mexico, 2017.

Experience	Average in months
Working experience related to own field during studies (months)	**14.3**
Working experience other than those related to own field during studies (months)	**14.7**
Working experience related to own field after graduation (months)	**21.1**
Working experience not related to own field after graduation (months)	**7.8**

In terms of the number of contracts before graduation the average for the 20 participants were 0.85 (maximum=4, minimum=0). Similarly, the number of contracts after graduation was 1.5 (maximum=5, minimum=0). It is worth mentioning that 3 of the interviews have not had a job in the field since graduation.

5. COMPETENCIES

The competencies related to forest science were barely mentioned as factors that would affect success or failure (Table 2). Good knowledge of wildlife, forest fires, forest management, and urban silviculture allowed graduates to succeed in their work. Meanwhile, a lack of knowledge of tropical ecology was a constraint for one of the graduates. This is likely explained due to the fact that graduates from non-tropical schools have less knowledge of tropical silviculture and management.

> "one of my best achievements has been to be able to find a job in an area are passion about it, I love conservation, and I am working on projects related to fauna monitoring and on a biodiversity system"

> "I feel like new when my supervisor sends me to work on temperate forest"

Leadership, time management, and communication with non-experts were the competencies most mentioned in the success events. Meanwhile, responsibility, learning capability, critical thinking, initiative, oral communication, and to apply knowledge in practice were the competencies related to failure. Learning capability was mentioned as a factor that have some incidence on both success and failure.

> "Engineers recommend me with others because I always arrive on time and it is ok with me to get up very early to be able to go to the field before noon when the heat is unbearable"

> "It is really hard for me to communicate in public, I get nervous"

Emphasis of the competencies in the list (90%) were general competencies (Table 2). This implies that forest related competencies are fulfilled, graduates feel secure about their

knowledge; however general competencies are complementary for the performance of their jobs.

Table 2. Frequencies of the competencies mentioned in the BEI of participants from Mexico, (n=20), GOFE, 2017.

Competency	FREQUENCIES		
	Code	Sucess	Failure
Wildlife	5.1.c	2	0
Leadership	5.2.2.d	4	0
Time management	5.2.2.f	5	1
communication with non-experts	5.2.3.f	4	2
Responsibility	5.2.2.h	3	6
Crital thinking	5.2.4.c	0	6
Learning capability	5.2.5.d	5	5
Initiative	5.2.2.l	1	3
Oral communication	5.2.3.i	1	3
To apply knowledge in practice	5.2.5.a	2	3
Organization and coordination	5.2.1.c	2	2
Entreprenurship	5.2.2.c	2	2
Information processing skills	5.2.4.a	2	2
Ethical commitment	5.2.5.e	2	2
Negotiation	5.2.1.a	2	1
Resistance to preasure	5.2.2.k	2	1
Problem solving	5.2.5.h	1	2
Ecosystem management and restoration	5.1.b	1	0
Another (Forest fires)	5.1.L	1	0
Urban silviculture	5.1.m	1	0
Decision making	5.2.2.g	1	1
Subordinate	5.2.2.m	1	0
Working in international environment	5.2.3.h	1	0
To work in a multidisciplinary group	5.2.5.g	1	0
Ecology of tropical forest	5.1.h	0	1
Team work and social	5.2.1.b	0	1
Tolerance	5.2.1.e	0	1
Financial planning and budgeting	5.2.2.b	0	1
Project management	5.2.2.e	0	1
Reliability	5.2.2.i	0	1
To work independently	5.2.5.f	0	1

Since more than 50% of the participants were graduates of Universidad Autonoma de Chihuahua (UACH), a brief GAP analysis could be presented. The educational model of UACH is based on competencies base learning, it defines the basic competencies in 5 groups: sociocultural, problem solving, team work and leadership, entreprenurship, and comunication. Each group of competencies have their domains and established list of actions that will serve

as performance evidences, such participation in cultural, artistic, sport and scientific events that allow students to develop the sociocultural competency: These basic competencies are the same for all educational programs in UACH. In terms of specific competencies, the University is divided in Departments that comprised related programs, forest engineering belongs to the Agricultural Department (DES agropecuaria) along with agrotechnology and animal science and ecology programs. This DES has five common competencies: Sustainable development and ecosystems, use and operation of tools and equipment, management of production systems, strategic resources management, and technology transfer. Students from DES are supposed to develop these competencies due to their work in the agriculture systems. More specifically, the competencies for forest engineers are: sustainable management of the forest ecosystems, research and technology transfer in forestry, problem solving related to forest, chain of commercialization, forest technology and production, training and extension of forest culture. To acquire basic and specific competencies, students completed 332 credits distributed in 48 courses, 25 courses addressed forest related competencies, 10 DES and the rest are divided into English as a second language, optional courses (which are mainly forest related) and socioculture. A closer look to the curriculum indicates that 38 courses are specific, this is the reason students have a strong knowledge of forest management related topics. Although the analytic programs for each course includes basic competencies such communication and problem solving, there is strong emphasis on technical matters.

6. IMPLICATIONS

This exploratory study uncovers important aspects of forest education and the competencies required to achieve good performance at work. More attention could be placed to generic competencies implying that professor could make an extra effort to include different teaching and evaluation methods that help to develop general competencies. At the University level, perhaps more extra-curriculum activities could be promoted to involve students in practical projects in where students could cultivate general competencies that would be useful in their future professional practice. In addition, graduates complaint about the lack of jobs in their field; they stated that most of the jobs are related to timber extraction and those jobs are already taken for graduates who have more years of experience. This issue was previously observed by a forestry consultancy firm (REFORESTAMOS). In an effort to reduce unemployment the firm organized a forest entrepreneurship contest around all forestry schools of Mexico to encourage students and professor to present business models for non-timber forest products. Due to their success and evaluations that show that professors need to be trained as well, in August 2017 they provided the first course for professor to be trained in basic concepts of entrepreneurship so they can guide their students for the next year´s contest. Forestry programs authorities could join the initiative to allow their professors and encourage students to participate in these type of events that serve two objectives, outreach with private sector and development of basic competencies.

This particular case study faced several difficulties for data collection. The list of graduates provided by the Universidad Autónoma de Chihuahua was complete, but the email addresses to contact graduates was out of date, seriously hindering our ability to contact graduates. To overcome this issue and to account for a good representation of forest sector of Mexico, the study included graduates from 4 different universities, all of them working in the state of Chihuahua and 90% of the participants graduated from the two schools located in the main timber producers' areas of Mexico.

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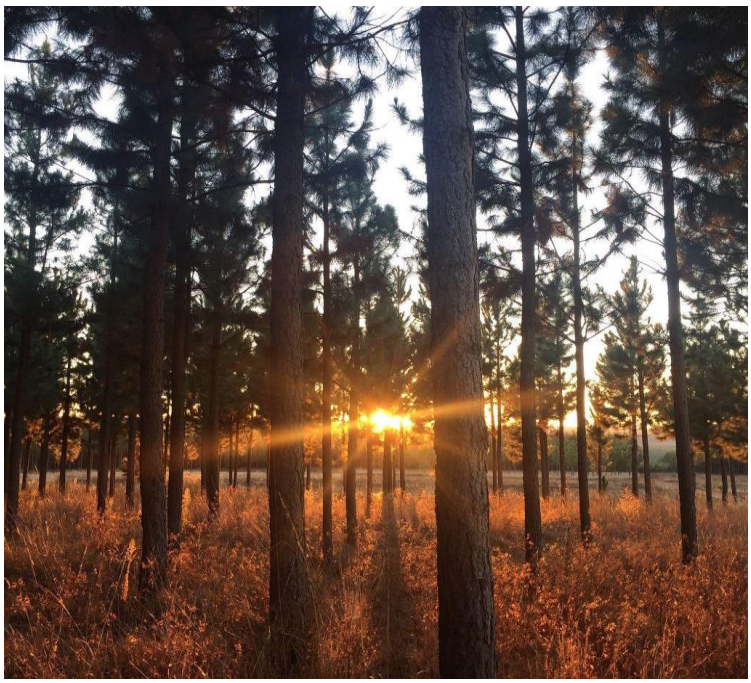
Appendix H. **South Africa**



Taken by: *Ignis Steenkamp*

A review of forestry curricula in South African tertiary institutions

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ABSTRACT

A modern day forester assumes a variety of roles that constantly challenge them to remain professionally relevant in a dynamic system including the continuously expanding number of stakeholders that need to be engaged in the forestry sector cuts across political, social and economic boundaries; therefore, this study is important in understanding how a forester's job has shifted from simply managing trees and forests for timber to managing trees and forests to achieve the interests of various stakeholders. The focus of this research is to provide a baseline study that will highlight the range and improve our understanding of forestry education programmes in South African tertiary institutions. A variety of data collection methods were used to complete this empirical research. The research strategy adopted was implementing case studies where students and academic experts from four tertiary institutions and forestry employers were interviewed. The findings from this research highlighted some of the key issues associated with forestry curriculum design such as the subject of the disciplinarity of forestry as a profession as opposed to more interdisciplinary where in addition to modules that are grounded in the discipline, other types of natural sciences are also considered in curriculum design. The main conclusions drawn from this study are that a higher level of integration of social sciences in forestry curricula is pivotal to resolving some of the challenges facing the forestry sector, and that in light of programmes whose delivery process is severely restricted by budget constraints, solutions developed jointly between industry and tertiary institutions should be on going.

Keywords: curriculum design, disciplinarity, forestry education, social sciences

1. INTRODUCTION

Forestry education from a South African perspective

South Africa's total land area is 122.3 million ha and of this; approximately 1.35 million ha is used for plantation forestry. Woodlands (locally referred to as savannas) which are the dominant vegetation type in South Africa and natural forests cover approximately 29 million ha. The rest of the total land area is designated for grazing (68.8%), arable land (13.7%), conservation (9.6%) and urban areas (7%) (Längin and Ackerman, 2007). Nearly all the timber used for commercial purposes in South Africa originates from plantations; the principal species planted are hard woods (*Eucalyptus spp*. 39%), softwoods (*Pinus spp.* 52%) and Wattle (*Acacia mearnsii.* 8%) (DWAF, 2004; FSA, 2003). The wood processing industry and commercial forestry plantations play an important role in South Africa's economy, in 2003 both contributed approximately $911.7 million towards the country's Gross Domestic Product (GDP) (FSA, 2003). South Africa's forestry sector has also made significant contributions to rural unemployment by creating between 200 000 and 600 000 job opportunities in areas where unemployment generally thrives.

The socio-political developments that have taken place over the last 25 years have impacted tertiary level forestry education in one way or another. During this period, South Africa has experienced an overall reduction in total plantation area and afforestation. Conservation pressure is the main contributor to the reduction in plantation area specifically with regard to society's increased awareness of the importance of water conservation. The protection of wetlands and catchment areas has resulted in contested spaces between conservation initiatives and commercial forestry plantations. Längin and Ackerman, 2007, highlighted that the current rate of afforestation is approximately 2 000 ha per annum compared to the 45 000 ha peak which was achieved in the early 1990s. In the political arena, the significant changes that have occurred in the ownership and privatization of government plantations have also negatively impacted tertiary level forestry education by drastically reducing its access to resources (Längin and Ackerman, 2007). Before these changes occurred, the government dominated higher forestry education through financing its institutions, offering financial support for students in the form of bursaries and two-year internships for forestry graduates which eventually led to permanent employment within government. With an estimated 80% of private plantations currently under land-claims, land ownership will continue to pose a challenge to South Africa's forestry sector (Chamberlain *et al.,* 2005).

Another factor that has had negative impacts on funding for institutions is outsourcing, major companies in the forestry sector have contracted out all their operations. This has resulted in a forestry sector that is saturated with contractors, most of which are poorly trained and unqualified to conduct such forest operations and sadly, this situation has not improved over the years (Längin *et al.,* 2006; Morkel, 2000). Furthermore, the impacts of outsourcing are evident from the increase in fire damage to plantations in regions that experience summer rainfall and the lack of basic research capacity as a result of the current fragmentation in the country's tertiary level forestry education system. To elaborate, government and higher education forestry institutions conduct only 10% of the forestry sector's research (Längin and Ackerman, 2007). The duo between outsourcing and the rationalisation of technical expertise by companies has drastically reduced employment opportunities for professional foresters. The above mentioned challenges of the privatisation of state owned plantations, major

companies outsourcing their operations to contractors, land claims and the sector's water consumption in the midst of serious environmental problems such as water scarcity all have painted a negative image of the forestry sector to society and most importantly an undesirable image of forestry as career for young people (Längin and Ackerman, 2007).

In South Africa, higher education in forestry began in 1905 at the South African College in Tokai, Cape Town. Stellenbosch University (SUN) and the Saasveld School of Forestry, now known as the Nelson Mandela Metropolitan University (NMMU) after a merger in 2005 established their higher education forestry qualifications in 1932. They offer a professional BSc Forestry degree and a technical National Diploma (Ndip) in forestry respectively. At the college level, Fort Cox College for Agriculture and Forestry which was established under the no longer existing Swartkop Forestry School (1946) started their programme in 1970. The University of Venda (UV) and the University of KwaZulu-Natal (UKZN) were the last two institutions to join as providers of professional forestry training in 1999 and 2000 respectively. The University of Venda (UV) offers a BSc Agriculture and Forestry combination while UKZN used to offer a no longer existing BSc Agriculture with Forestry as a major (Längin and Ackerman, 2007; Underwood *et al*., 2008). It hasn't been easy for UV and UKZN to maintain their qualifications as a result of low student numbers and inadequate staff capacity hence the termination of the qualification in UKZN.

South Africa's forestry education is no exception to the global trend of a decline in funding compared to the support governments used to provide and as a result, forestry faculties along with their forestry programmes and modules have drastically had to be scaled down. A key characteristic that sets forestry apart from other professions is that it is shaped by the continuously changing local and national perception and attitude towards it (Längin and Ackerman, 2007). Hence, public opinion shapes forest management practices as well as the kind of forestry graduates required to deal with emerging issues and new trends of the 21st century. This means that South African forestry institutions are in a position where they have to achieve more output with less input in the midst of striving to maintain the country's qualifications at international standards.

2. KEY QUESTIONS and OBJECTIVES

Given that there is no local record of a study of this nature, the aim of this research is to provide a baseline study that will highlight the range and improve our understanding of forestry education programmes in South African tertiary institutions.

The objectives of this study are as follows:

1) Conduct Behavioural Event Interviews (BEIs) to determine the competency of undergraduate students acquiring forestry qualifications.
2) Conduct a Gap Analysis to determine whether the needs of the forestry sector are being met by the forestry education system.

3. METHODOLOGY

N= 33 students

N= 19 Forestry students

N= 14 Natural Resources students

Table 1: *Tertiary institutions represented in the student sample and their geographical location*

Institution	**Programme**	**Representation (%)**	**Geographic Region**
University of Venda	BSc Agriculture (Forestry)	6	Limpopo Province
	BSc Environmental Sciences	8	
University of KwaZulu-Natal	BSc Environmental Sciences	8	KwaZulu-Natal Province
Nelson Mandela Metropolitan University	NDip Forestry	7	Eastern Cape Province
Stellenbosch University	BSc Forestry and Natural Resource Sciences	6	Western Cape Province

Case study as a Research strategy

The research strategy I chose to adopt to complete this empirical research is implementing case studies where a variety of stakeholders concerned were interviewed. One undergraduate forestry programme was selected from all the participating universities, a sample of students, academic experts and employers were interviewed and supporting secondary documents from the selected programmes were also assessed. To obtain a rich output from this detailed and time-consuming undertaking, a variety of data collection methods were used to study South Africa's tertiary level forestry education system. A purposive sampling technique was implemented in all the data collection methods used in this research. Purposive sampling was my chosen technique because only a limited number of primary data sources could contribute to the areas explored by the objectives of this research. Sample size determination posed a considerable challenge for this research because student numbers were very low in the majority of the selected forestry programmes. Therefore, the sample sizes for these programmes are low; however, they are representative of nearly 100 % of the entire population. Ensuring the perspectives of all stakeholders were captured was important for this research because tertiary education is a complex environment, hence, choosing to implement case studies as my research strategy was most suitable for achieving the aim and objectives of this research.

Data analysis

Behavioural Event Interviews (BEIs)

Student BEIs were analysed thematically following a coding process, competencies were captured using the guidance of a coding template that was provided by the bigger global effort. The codes were abstracted using three different levels of analysis, namely, themes, codes and sub-codes. Only the codes for pre-defined competencies were captured, no additional codes were included in the sets as they were found in the transcripts. Again, examining the content for very specific things meant that my focus would be kept on the task at hand. The coding template was slightly revised in line with the objectives of this research. The transcripts were analysed line-by-line, not in sentence form and multiple codes were permitted for each line as suggested by Spencer and Spencer, 1993. All the codes generated from each student's transcript were captured on an excel sheet and the codes for the three most frequent competencies under the two categories (successes and failures) were noted.

The theory behind this approach follows that the competencies associated to an interviewee's success stories communicate differentiating characteristics while those that are associated with their failures communicate threshold or essential characteristics for successful overall job performance (Campion *et al.,* 2011). A summary of success stories is thus based on the competencies that attributed to those successes and in the case of failures, their interpretation is open to question, however, in all likelihood the competencies attributed to those failures were lacking in the event hence the end result was a failure. For example, if a student described an unsuccessful pathogen laboratory test on their transcript and mentioned something to the effect of "I should have been more accurate" in the process, (code: 3.2.2.l on the coding template), this is an indication that accuracy is a threshold competency for successful lab work.

In addition to the visual examination of the excel sheet for the most frequent codes, the researcher was permitted to use their own judgment to decide which competencies and also seemed important on the basis of the level of complexity at which they were displayed (Spencer and Spencer, 1993). This is because the relationship between the frequency of occurrence of a particular code and its importance is not one that necessarily goes hand in hand.

4. RESULTS

Objective 1: Behavioural Event Interviews (BEIs)

Across all four institutions and both curriculum structures, the gender profile is slightly skewed towards female students where they make up 52% of the sample while male students only 48%. It is satisfying to see that women are adequately represented and have opportunities to get empowered in the field of natural sciences. Ethnic group representation in the sample is made up of 82% Black, 12% White, 3% Coloured and 3% Indian students. The marital status of all interviewed students is single of which is not surprising because 97% of them are between the age of eighteen and twenty-four.

Students displayed an outstanding performance in the behaviours noted during the interviews. They averaged well above 80% in six of the seven positive performance indicators: (1) body language, nonverbal cues and use of eye contact, (2) candidate was polite and well-mannered to the interviewer, (3) candidate's demeanour was assertive, confident and focused, (4) candidate arrived to the interview on time with time to spare, (5) candidate was dressed appropriately for an interview setting and (6) candidate appeared to show genuine interest and enthusiasm for the role. In contrast, only 59% answered comprehensively and coherently, the remaining 41% performed below acceptable standards in answering competency based questions, their answers were very limited. This result indicates a development need in oral communication skills.

Almost all of the competencies coded are non-technical, discipline-specific competencies are very small in number that they are not considered in these results. Table 2 is a summary of the results obtained from students undertaking forestry qualifications. The three most important differentiating characteristics from success stories are leadership ability (3.2.2.c), financial planning and budgeting (3.2.2.a) and education, training and supervision (3.2.1.d). From stories of failure, time management (3.2.2.e), accuracy and diligence (3.2.2.l) and financial planning and budgeting (3.2.2.a) are the most essential characteristics for successful overall performance.

Table 2: *Summary of the most important skills captured from students undertaking forestry qualifications, n=19.*

Most important skills from Success stories	**Most important skills from Failure stories**
Leadership ability	Accuracy and diligence
Financial planning and budgeting	Time management
Education, training and supervision	Financial planning and budgeting

Table 3 is a summary of the results obtained from students undertaking natural resources qualifications. The three most important differentiating characteristics from success stories are accuracy and diligence (3.2.2.l), resistance to pressure (3.2.2.i) and financial planning and budgeting (3.2.2.a). From stories of failure, resistance to pressure (3.2.2.i), time management (3.2.2.e) and the ability to adapt (3.2.2.m) are the most essential characteristics for successful overall performance.

Table 3: *Summary of the codes captured from students undertaking natural resources qualifications, n=14.*

Most important skills from Success stories	**Most important skills from Failure stories**
Accuracy and diligence	Resistance to pressure
Resistance to pressure	Time management
Financial planning and budgeting	Ability to adapt

Financial planning and budgeting (Table 2) and possessing the ability to resist pressure (Table 3) appear in both stories of success and failure as the most important characteristics in their respective curriculum structure; this highlights their significant role in both differentiating and essential characteristics and reinforces the importance of capturing behaviours attributed to success so that they can be taught to those whose failures are evidently a result of a lack of competency in those very same behaviours.

Objective 2: Gap analysis

Across all employer categories, the importance of traditional forestry competencies such as silviculture (4.4), forest health (4.3), forest operations and technology (4.2) and the biology of trees (4.2) was relatively high (Figure 1). However, the competencies given the highest ratings were written communication skills (4.8), oral presentation skills (4.7) and computer literacy (4.7) (Figure 2). Also, having an interest in ideas and desire to continue learning (4.6) and the ability to plan and execute tasks independently (4.5) were given higher ratings compared to traditional forestry competencies (Figure 2). The emphasis placed on non-technical competencies resonates with previous other studies in forestry education (Sample *et al*., 1999). Employers' ratings reveal that they are moderately pleased with the overall performance of graduates they have recruited in previous years. This is evident in that there are gaps

between employers' importance ratings and their ratings of new graduates' performance for all thirty-six competencies under investigation. The biggest gaps lie in understanding of economic and business realities (2.3), leadership ability (2.1) and oral presentation skills (2.0) (Figure 2).

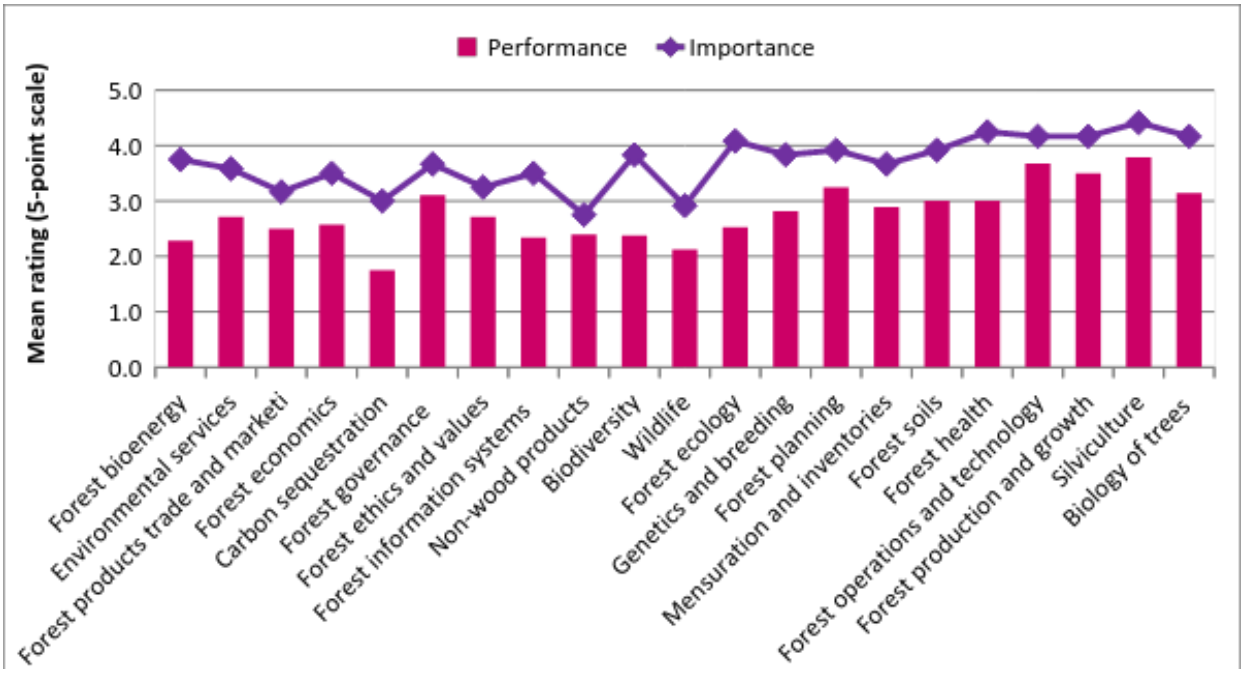

Figure 1: *Employers' ratings of the importance of forestry subject areas needed for successful overall job performance versus the performance of new graduates, on a scale of 1-5, n=12.*

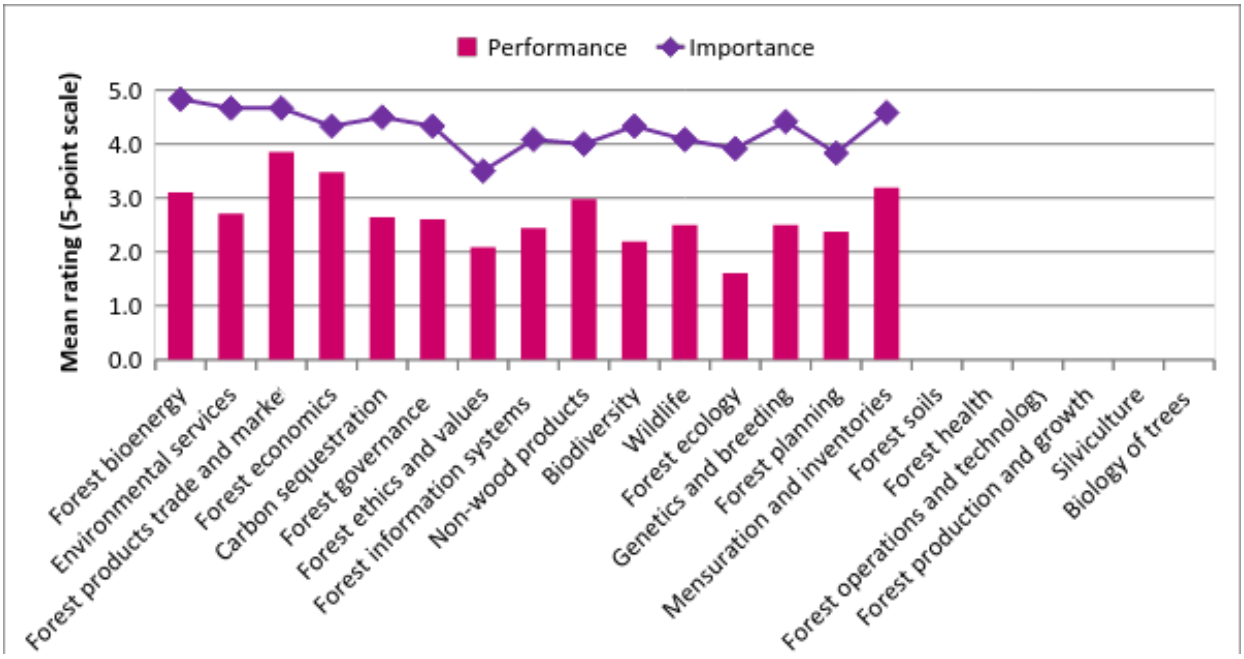

Figure 2: *Employers' ratings of the importance of non-technical competencies needed for successful overall job*

performance versus the performance of new graduates, on a scale of 1-5, n=12.

5. IMPLICATIONS

Students' motivations for choosing forestry as a field of study

The results of this research showed that a significant number of students enrolled in tertiary level forestry qualifications are there for many reasons other than wanting to become foresters; this group of students were not attracted to forestry because they particularly enjoy working with nature and the environment. They entered the forestry profession only after they were turned down as prospective students in other fields, predominantly in medicine and engineering. From a substantial amount of research conducted on tertiary level forestry education, this result was expected and it is consistent with the findings of many studies conducted on this topic; Africa and Europe have been struggling to attract quality students into their forestry programmes (Miller, 2004; Temu and Ogweno, 2007). Students from these regions seldom regard forestry as a profession that can sustain their livelihoods.

The truth that a significant number of forestry applicants are students that have been turned down by other fields and lack the desired motivation to pursue forestry as a profession is a serious cause for concern. On the contrary, forestry institutions may regard this as an opportunity rather than a hurdle; institutions could adopt a proactive approach where they raise the profile and value of forestry qualifications to these unsure students. Additionally, this could potentially improve their motivation, change their negative perceptions of forestry over time and as a result minimise dropout rates in programmes with enrolment numbers that are very low (Arvelo, 2001). There is a need to improve the profile of forestry education and the profession at a national scale.

Pursuing this further, out of the modest enrolment numbers, some students have not changed their negative perceptions about the value of their forestry qualification over time. They regard their forestry qualification as a backup plan and have no intention of practicing within the forestry sector; in fact, they still want to pursue their dream careers in medicine and engineering. This situation will have serious implications for the future of the profession in terms of building capacity within national forestry education (postgraduate students) and training institutions (academic staff) and industry in terms of experiencing an inadequate supply of graduates. This may be true; however, we need to critically assess the country's needs before expanding the forestry education system without a clear direction as a means to overcome these potential future challenges.

Addressing capacity gaps in the midst of diverse challenges

Generally speaking, industry employers expressed a definite lack of capacity in South Africa with regard to postgraduate students. In the same way research institutions said it was even more of a challenge when finding good academic staff to fill research and lecturing positions. Some may say that the issue of a lack of postgraduate students is really complex because in addition to the lack of motivations for choosing forestry as a field of study, there are ample socio-economic factors that also influence a student's decision to study further. For instance, the pressure families put on students as well as the pressure the students put on themselves to become breadwinners, this makes it difficult for them to decline a job offer to pursue postgraduate qualifications. This is pertinent to South Africa's forestry education system

especially since 88% of the final year students interviewed in this research are from previously disadvantaged ethnic groups.

UKZN is planning to introduce forestry postgraduate qualifications that could potentially fill the gap. Compared to the university's undergraduate forestry qualifications which were terminated, some academics think that their postgraduate degrees will stand a better chance of success. This may be true, however, the challenges explored in this research indicate that the future of these qualifications is worrisome because enrolment numbers in undergraduate qualifications are very low and more so in postgraduate qualifications. Nonetheless from an opposing point of view this may be regarded as an opportunity for South Africa's forestry education system to expand and explore other avenues in forestry research in addition to traditional forestry areas like silviculture and forest operations and technology which have been dominating the research space. This additional perspective will be valuable because apart from South Africa's plantation-based forestry sector, forests assume other crucial positions in the socio-economic challenges facing Sub-Saharan Africa such as HIV/AIDS and global environmental issues such as the SDGs and climate change. These topics highlight the country's local context and for this reason, South Africa's forestry education system should consider explicitly addressing them in its curriculum.

Employers' perspective of South Africa's forestry education system

Employers' ratings of the importance of forestry subject areas and non-technical competencies needed for successful overall job performance versus the performance of new graduates revealed that employers are moderately pleased with the overall performance of the graduates they have recruited in previous years. A significant number of employers acknowledged that they do not expect graduates to know everything upon their arrival, they said that graduates still have a lot to learn and the value that they bring to an organization is based on what they learn and how much they are willing to learn while they are there. By contrast, when it comes to a competency like written communication skills, which is the highest ranked of the thirty-six competencies for successful overall job performance, it becomes difficult for them to grasp how a graduate managed to go through university up to postgraduate level in some instances and still cannot manage to write decently.

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Appendix I. **Sweden**

A useful skill needed amongst foresters in Sweden is communication with private forest owners. Photo: Joakim Lundsten

Swedish forestry education for the 21st century

A case study on graduates from the Swedish University of Agricultural Sciences (SLU)

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ABSTRACT

There is a rapid change in the world on how we look at our natural resources, and how to manage them. The forestry profession is undergoing a shift and has to keep up with this ever-changing environment. This study aims to answer the question: Do Swedish forestry schools provide an education that matches the key competencies graduates need in their profession? The method of behavioural event interviews was used to better understand what are useful skills in the working life of 24 graduate students from the Swedish University of Agricultural Sciences Forestry Programs. The student program evaluation of the forestry programs at SLU that was conducted in 2016 was analysed to see where the gaps in the curriculum are, according to the students. I used this evaluation of current students to compare to skills needed in the working environment, according to the interviewed graduates of 2013. My results show a strong correlation between the students views on what is missing in the curriculum, as well as what skills are most useful in the working life of graduated students.

1. INTRODUCTION

In 1828 king Carl the 14th Johan decreed that a higher education on forests was to be created, resulting in the establishment of the Royal Forestry Institute (Samzelius, 1915). In 1977, 150 years after the forestry school was established, the Swedish University of Agricultural Sciences was formed through a fusion of the agricultural university, the forestry university and the veterinarian university that are now different faculties under the same educational institution (Söderström 1978). At the same time, it was also decided that the forestry school would move to Umeå as a measure for decentralization.

The effects of moving the forestry school to Umeå have altogether lead to a more comprehensive forest research. The forestry research done in Umeå, Uppsala and Alnarp are today world leading in forestry research, according to a recent university ranking done by the Center for World University Rankings (CWUR 2017).

The effects on the forestry education on the other hand have not seen the same positive effect. Since the move to Umeå, the university has seen lower numbers of applicants to the program. In 1996, a drastic measure was taken to solve the problem and the program changed from being a specialized forestry diploma to a general accreditation in forest sciences with a much more open curriculum. The program also changed names from the traditional "Jägmästare" to "Skogsvetare," a approximate translation would be "Hunting master" and "Forest knower." This change in name was done because of the low knowledge about the traditional name amongst youth.

However, the application numbers to the program continued to decline, and the problem continued so much that in the beginning of the 2000´s it was in a detrimental state and the school barely got enough students to fill the seats in the program. This resulted in a number of investigations and reports (Lundgren 2000; Högberg et al. 2001), and so in 2002 it was changed back to the old version and its traditional name Jägmästare. Nowadays, the problem still persists, and in 2015 the numbers of applicants to the program was down to not filling the seats once again with only 63 students at the roll call with a program open for 80 applicants (Swedish Higher Education Authority 2017).

Already in 1960, the principal for the forestry school expressed his concern that the education might be overlooked (Söderström 1978). He put it like this:

- "It is hard to at the same time serve two masters. It can be anticipated that the education will not be given the same priority as the research, as it does not give the same publicity to the professor. The more the research get specialized the more the need for putting efforts in making a coherent education." – Thorsten Streyffert.

In 2016 the student union conducted an evaluation of the forestry education, half of the students enrolled participated in the survey (Hallberg Sramek and Nilsson 2016). Many students felt that the education does not at all keep up with what is asked by employers for a forester position in this field of work today.

Here are some comments from the students:

- "Right now, it feels like there is no goal with our education. We are doing what we always have been doing and think it will turn out good."

- “We must take the step in to the modern world. Although about the same forest management knowledge apply today as 1960, the role of the modern forester has changed. It is not only cubic meter, machine types, and the number of hectares that are important to know. Social sciences are also important.”
- “Sometimes it feels like the education has not followed modernization.”

Study

The purpose of this study was to see if the forestry education in Sweden give the necessary skills needed in working life? I used semi structured interviews and followed the GOFE methodology to be able to pin out necessary skills in working life. I then compared this with what the current students think are lacking in their education with a simple gap analysis on the program evaluation from 2016.

Applied method

During the spring of 2017, altogether 24 Behavioral Event Interviews (BEI) were conducted to graduates of the 2013 class from the Swedish University of Agricultural Sciences. During the interviews three success stories and three failure stories were asked to be given by the interviewee’s as examples to observe important skills needed in such situations. At the same time, the student comments in the program evaluation were analyzed to give a good picture of what is lacking in the curriculum to further compared it with the result from the key competencies obtaining on the BEI. I used a simple analysis to observe the student comments from the student evaluation by searching the document and then listing the most reoccurring competencies suggested by the students. I compared the student’s recommendations with the results from the interviews to see what skills are not focused on enough in the curriculum.

2. RESULTS

Table 1) Overview of respondents

Total number of participants	24
Sex	4 f 20 m
Age (average, min-max)	30,2 26-42
Highest degree earned	5 BSc 19 MSc
Year of graduation	2013
Full time job / Part time job	23 full time 1 unemployed
Permanent term job / fixed term contract	20 permanent 3 contract

Table 2) Respondents' work experience

Work experience	**months**
The experience of forest work during the studies	*8,75*
Other work experience during the studies	*2,6*
The experience of forest related work after graduation	*42*
Other work experience after graduation	*0,5*
The total amount of work experience (also part-time work)	**53,85**

Results from GOFE coding

Skills in the success stories

1. The forest sector know-how, specifically economics and practical forest management - Many graduates had use of their knowledge on practical forest management and economics in their first jobs.
2. Communication with non-experts - Communication showed to be an important skill in most of the jobs.
3. Time management - Time management showed to be very important to do a good job.

Skills in the failure stories

1. Knowledge of legislation - Many felt uncertain of legislation when they started working.
2. Forest resource management - Practical forestry knowledge was sometimes lacking and sometimes lead to failures during the first jobs.
3. Time management - Prioritizing and planning one's time was difficult for several graduates.

Quotations from the interviews

- "It is hard in the beginning, because it is not something we learn from our education- to become a businessman. In school we learned absolutely nothing about that, but in reality most of us work as salesmen in the industry as we are buying timber."
- "Taxes and legislation I know to little of. When the forest owner asks me, I have to re-direct him to someone who knows."
- "It is always harder to work with people. That's something we do not get from the education. I think that most of those who study in the program will find themselves in situations where they have to be able to communicate with people."

Results from the analysis of the program evaluation

From 279 comments, the following were the skills that reoccurred the most:

1. Internships / The forest sector know-how
2. Economy
3. Human dimensions / Communication
4. Law and legislation

Gap analysis

The forest sector know-how, law and legislation, economy and communications occur both as skill that the graduates needed in their working life, and also in the recommendations by the students who participated in the evaluation. This suggests that these topics are not covered enough in the curriculum.

3. IMPLICATIONS

The forest sector know-how, law and legislation, economy, communications and time management are all skills that are essential as a forester in the 21st century. The fact that communication and human dimensions showed to be an important skill for forestry graduates is not surprising, as it has been found previously in (Arevalo et al. 2010, Bullard 2014, Vanclay 2007, Sample et al. 2015).

The students view on what is missing in the forestry education corresponds very well with the findings from the graduate interviews. Listening to the students and implementing their recommendations will not only make a better fit between education and working life, in return it will also make a more attractive education for young people to pursue. A forestry education that keeps up with an ever-changing world.

Since most scientific funding and prestige are dependent on the faculty's accomplishments in research, undergraduate education may not be given the same attention (Muscatine 2009). I believe that this is a systemic problem that needs to be addressed in order to come up with a long-term solution for Swedish forestry education.

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Appendix J. **The United States of America**

REPORT
GLOBAL OUTLOOK ON FOREST EDUCATION
Joint IUFRO–IFSA Task Force on Forest Education

Picture 1: A mixed northern hardwood forest typically found in the northeastern United States, photo by Tara L. Bal.

Forestry education competency analysis of recent graduates in the U.S.

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ABSTRACT
The purpose of this report is to provide results from a pilot-study that presents a US perspective on the Global Outlook of Forestry Education (GOFE) study. The study reports and assesses responses by recently graduated students to a set of globally agreed-upon survey questions, using the Behavioral Event Interview process and coding from the GOFE project. The survey sought to identify perspectives of successful and not-very-successful experiences encountered by recent graduates in forestry and natural resources related majors. It offers perspectives as they relate to key interactions in the workplace within one to five years after graduating. The goal is to identify factors related to both setbacks and positive influences in order to provide recommendations to help improve forestry education in the US and globally. Based on the preliminary results, many of the experiences are associated with human relations, including communications, management, and leadership skills. Very few, if any, relate to knowledge deficit or a lack in an educational component that cannot be learned on the job or that was not addressed during their program of study. These findings support those of earlier studies. One issue with the data shown here is that is it primarily representative of only one institution in the US that offers these programs, while there are over eighty accredited programs in the US. However, the curriculum these students followed is accredited and thus, can serve as a snapshot or model of forestry higher education. Further evaluation of curriculum recommendations is warranted to ensure graduate success in these fields and that society benefits.

Keywords: Behavioral event interviews (BEI), Forestry professionals, Ecology professionals, Wildlife professionals, Alumni

1 INTRODUCTION

1.1 Forests in the US

The current land base in the United States (US) is about one-third forested, with over 309 million hectares of forestland, highly varied in climate and ecosystems. The United States has the fourth largest forested area of any nation today, with 8% of the world's forests (FAO 2000). Forest types range from arid scrub to productive timber in hardwood, softwood, and mixed species forests, containing over 800 tree species across the landscape. Much of the Nation's forests are privately owned in the east, while most federal forestland is in the west. Currently, ninety-one percent of US wood production is produced on private lands (USDA Forest Service 2014). The US was heavily logged and deforested during the 19th century. Today there is more forestland than 100 years ago with the volume and number of trees in the US increasing slightly each year (Oswalt et al 2014). Fifty-five percent of forests in the US are likely less than 70 years old (USDA Forest Service 2001). Forest Products are sent to diverse markets, including domestic and international, and including both traditional and newly emerging products, such as lumber, energy, and nanotechnology. Forest growth has been exceeding removals (overall removals in 2014 were 15.5 billion cubic feet) on US timberlands for several decades as growing forests mature, landowner education increases, investments are made in fire protection, and silvicultural management improves forest lands. That said, there are still issues of concern dramatically impacting US forests that natural resource managers must be aware of in order to successfully grow and manage forest lands including wildland fires, invasive species and diseases, climate trends, forest fragmentation, market pressure, and public policy (Goergen et al. 2013).

1.2 Forestry education in the US

There are currently eighty institutions belonging to the National Association of University

Forest Resources Programs (NAUFRP), whose members have programs and curricula leading to professional degrees in Forestry or conduct research in Forestry funded in part by the McIntire-Stennis Cooperative Forest Research Program, United States Department of Agriculture (NAUFRP 2017). The Society of American Foresters (SAF) has accredited post-secondary degree-granting institutions since 1935, with programs in Forestry, Urban Forestry, and Natural Resources and Ecosystem Management. Program accreditation is voluntary, though many federal jobs and state licensing may require accredited degrees. As of 2017, fifty-three institutions were accredited with at least one of these degree programs (SAF, www.eforester.org, 2017), assuring a high quality education for students enrolled in these programs. Programs are peer-reviewed and revised approximately every 10 years to ensure professionals meet the SAF curriculum standards (SAF Accreditation Handbook 2016). Forestry programs tend to have either a strong research/doctoral emphasis or a more practitioner/technical approach (O'Hara and Redelsheimer 2012). Within the United States, there are another 500 plus institutions, including large universities, private universities, and community colleges that have degree programs in environmental science, ecology, wildlife management, fisheries, rangeland management, and other natural resources-related curricula across bachelor's, master's, and PhD levels. These may include education for the logging industry as well as other degrees with that forestry workers may earn at the BS level, though they are not accredited by SAF. Many of the technical forestry jobs in the US have requirements that vary state to state (e.g. technical degrees, certificates, or professional development training), based on the organizations interests that is active in the region, such as the Forest Resources Association which provides continuing education for the forest products industry (Haworth et al 2007). Further, as the US educational system allows students to build their own programs based on electives towards their degrees, more than the typical forestry major students may well be educated in forestry to some degree.

In recent decades there has been a national trend in enrollment increases in other natural resource-related fields of study at the undergraduate level, while forestry enrollment has been declining (Sharik et al 2015), suggesting that academic institutions need to examine the degree to which a forestry education is meeting the needs of society in general and relative

to other natural resource disciplines. Thus, a central question in this project is whether or not forestry students identified as "outstanding" or "superior" while pursuing their degrees turn out to be so in the workplace, and if the non-discipline-specific or "general" attributes or competencies that these students identify as important in the workplace differ from those identified by the "average" graduate. Moreover, do these skills or competencies differ from those identified by graduates from other natural resource disciplines? To examine these questions, we identified forestry and non-forestry natural-resource students pursuing their undergraduate degrees who were considered outstanding or superior and those who were considered "average" while pursuing their undergraduate degrees, and surveyed them in the workplace up to five years upon completing their degrees to identify general skills or competencies that were important in the successes and failures they had.

2 Methods

To begin assessing this question in the US, we have focused our efforts at our home University, Michigan Technological University, which is a member of NAUFRP, has had an accredited BS degree in Forestry since 1968, an accredited Masters of Forestry (MF), and is a doctoral degree-granting institution. Other degrees include a BS in Wildlife Ecology and Management, Applied Ecology and Environmental Science, Natural Resources Management , and MS degrees in Forestry, Forest Ecology and Management, Applied Ecology, Forest Molecular Genetics and Biotechnology, and a Masters of Geographic Information Science. Recent students (alumni from Fall 2011 through Summer 2016) were contacted via a Survey Monkey email invitation asking to participate in the study in the spring of 2017 (Table 1). We initially focused on School of Forest Resources and Environmental Science (SFRES) graduates from Michigan Tech with undergraduate majors in Forestry, Wildlife Ecology and Management, and Applied Ecology and Environmental Science (n=154 alumni). Students were contacted with a Survey Monkey tool (emailed a link to the survey) to collect demographic data online about their careers and current job responsibilities, and requesting a follow-up interview over the phone. Invitations to the survey were also sent to students from the forestry/natural resource departments at the University of Georgia, University of Florida, and Oregon State University.

Table 1. Number of sample respondents and participants for GOFE survey and interviews for the United States. The survey link was sent to 154 Michigan Tech undergraduate alumni (all majors in SFRES) from Fall 2011 to Summer 2016.

	survey link (job status information)	Follow up Interview Complete
Michigan Technological University	24	16
Oregon State University	4	0
University of Georgia	2	1
Totals	30	17

Behavioral event interviews (BEI) were conducted with 17 participants from two institutions and two "majors," i.e., "Forestry" (n=6) and "Related Natural Resource Disciplines" or "Non-forestry" (Wildlife, Ecology, Biology, n=11). Participants were also rated as "Superior" (n=7) or "Average" (n=10) performers based on academic abilities, and participation in professional organizations while in school, most notably their involvement in leadership positions and level of responsibility taken on known work projects. Participation was on a voluntary basis, so participants may have started and not completed a survey in compliance with the follow-up request for the BEI (those results are not included in the descriptive statistics reported here). Participants were allowed to select 'prefer not to answer' for demographic data (Table 2).

Interviews were requested using the phraseology 'Successes' and 'Non-Successes' to increase willingness to participate, rather than 'Successes' and 'Failures', otherwise questions asked followed the BEI instructions for the GOFE project. This terminology was used in an attempt to receive more willingness for graduates to participate in surveys. No employers were contacted and all identifying information was removed from transcripts of interviewees. The transcribed interviews were coded according to a standard set of general skills or competencies developed in collaboration with the Global Outlook of Forestry Education identified codes. Competencies could be considered differentiating (separating low and high level of performers) or threshold competencies (essential skills indicating minimum or average requirements of performers) (see earlier chapter in GOFE Final Report).All survey results and interview coding were transcribed, collated, and analyzed using MS Excel. Proper interview methodology were followed to ensure anonymity of respondents and the voluntary nature of contributing responses to the study. Further, the Institutional Review Board of Michigan Technological University reviewed and approved the survey questions before they were asked.

Table 2. Demographics of participants in GOFE survey in the US (results collected via online survey).

	male		female	
n	14		16	
average age	26.64		25.8	
race/ethnicity n (%)	white/Caucasian	prefer not to answer	white/Caucasian	prefer not to answer
	10 (66%)	1 (6%)	15 (94%)	1 (6%)
	American Indian or Alaskan Native	Asian or Pacific Islander		
	2 (13%)	1 (6%)		

3 RESULTS

3.1 Demographic/Job Experience Data

The average age of participants was between 25 and 26 years, with an almost even divide of men and women participating. Of the 17 participants who completed both the Survey Monkey and BEI follow-up, only one was not currently working in a field related to their undergraduate studies (forestry or natural resources-related). Three participants were currently graduate students at other universities (all three were in related, but non-forestry majors as undergraduates). Approximately 35% reported their current working contract as permanent, while 65% were working in fixed-term job positions, many of which were seasonal positons, or had grant-based funding. Approximately 25% reported that they were working part time, while 75% reported they had full-time job positions. Including current graduate student respondents, more than half (10/17) of the participants were employed in governmental or other public positions, (e.g. Forest Service, National Park Service, state agencies, public universities), while less than half (7/17) were working for private companies, land trusts, or non-profit agencies. Job titles and the duties contained there-in varied (Table 3).

The average reported time in post-secondary education was 5.15 years (n=17). Average estimated working experience for all participants who completed BEI interviews was 53 months, including experience prior to and following graduation from college. Forestry majors averaged more working experience than other majors (Table 4). This may be partially explained by the participants who went on to graduate school (MS and PhD) after graduation, rather than pursuing jobs immediately, as all 3 of the participants with this the case averaged only 13 months of total working time in any job, and all

3 were non-forestry majors. The average total working time of other majors minus the three in graduate school is still less than forestry majors, suggesting these students have difficulties finding jobs, particularly in their own field. Average students tended to work more jobs not related to their own field, more so than superior-performing students (Table 4).

Table 3. List of example Job Titles reported by BEI participants from the US, 2017, GOFE.
graduate research assistant
district forester
trail crew technician
legislative assistant
inventory manager
park ranger
recruiting director
forest operations supervisor
conservation project manager
procurement forester
volunteer coordinator
endangered species technician
forestry assistance program forester

Non-forestry majors and average performing students also had on average a higher number of work contracts than forestry majors and superior students, respectively. Superior students had less work experience related to their field of study while enrolled than average students, but more work experience following graduation. Because we did not ask employers to rate the performance of our graduates whom they employed, there is no direct way to determine if superior students remained superior in the workplace relative to average students as judged by their employers. All Forestry majors were employed full time, while only 63% of other majors were in full time positions. Only 33% of Forestry majors were in fixed term contractual positions, while 81% of Other majors were in jobs with a fixed term contract. Many interviews by non-forestry majors referred to not being able to find jobs in their fields, for example "*Getting the degree I got (Applied Ecology), I got very beat down by sending out these application and hearing absolutely nothing back. I cannot tell you how many I filled out and spent time on except maybe 5 months later that they choose someone else, with very little knowledge or feedback as to why they chose someone else… So that's the main negative experience I've had outside of college. The struggle to find a job that I felt fit me*."

Table 4. Working experience reported from BEI participants from the United States, 2017, GOFE.

	Working Experience (months)						
	total time estimate, even if part time job	related to own field during studies	not related to own field during studies	related to own field after graduation	not related to own field after graduation	# work contracts during studies/prior graduation	# work contracts post-graduation
All US - BEI participants (n*=17)							
Average	53	14	10	34	7	4	3
minimum	21	0	0	6	0	0	0
maximum	118	52	48	90	64	11	8
standard error	6	3	4	6	5	1	0
Averages for categories of US - BEI participants							
Forestry Majors (n=6)	68	17	12	52	13	6	2
Other majors (n=11)	44	12	8	25	4	3	3
Other Majors** (n=8)	39	13	9	18	5	3	3
Superior students (n=7)	49	9	4	39	0	3	2
Average students (n=10)	56	18	15	30	13	5	3

*n refers to the number of respondents

** Other majors minus the three participants who went on to graduate school beyond a B.S. (currently in school)

3.2 BEI analysis

In all, there were 98 stories from previous students collected and coded. A total of 24 and 22 competencies were recorded as the most important general skills for Successes and Non-Successes, respectively, with 13 competencies overlapping in both areas. The frequencies and most important competencies are listed in Table 5. Two of the most important competencies overlap with success and non-success; *Communication with non-experts* and *Organization and co-ordination*. Depending on the context of the story, students may have either been proficient with these skills, or the lack thereof led to a non-success (failure).

Overall, success stories were more driven by competencies in skills related to Human Relations (5.2.1) and General Academic Skills (5.2.5). Non-successful events were more often associated with competencies or skills related to Leadership and Management (5.2.2) (Table5). Communication skills were important for both successes and non-successes. Forest Sector Know-how competencies (5.1) followed generally with the students' field of study, but were not often an important skill recorded, or even necessary to the story situation.

Table 5. Most Frequently coded Important General Skills (Section 5.2) for all BEI participants in GOFE for the United States, 2017.

Success	Frequency	Non-Success	Frequency
5.2.3f *communication with non-experts*	6	5.2.3f *communication with non-experts*	5
5.2.1d *education, training and supervision*	5	5.2.1c *organization and co-ordination*	4
5.2.1c *organization and co-ordination*	4	5.2.1e *tolerance*	4
5.2.1f other, networking	3	5.2.2n *accuracy and diligence*	4
5.2.2l initiative	3	5.2.2b financial planning and budgeting	3
5.2.5a to apply knowledge in practice	3	5.2.2h responsibility	3
5.2.5d learning capability	3	5.2.3i oral communication	3
5.2.5f to work independently	3	5.2.5a to apply knowledge in practice	3
5.2.1b teamwork and social	2	5.2.2e project management	2
5.2.2d leadership	2	5.2.2m subordinate	2
5.2.2g decision-making	2	5.2.3k other, communication in general	2
5.2.2j understanding of complex systems	2	5.2.5d learning capability	2
5.2.2a knowledge of legislation	1	5.2.5e ethical commitment	2
5.2.2h responsibility	1	5.2.2a knowledge of legislation	1
5.2.2k resistance to pressure	1	5.2.2d leadership	1
5.2.3a Information Technology	1	5.2.2f time management	1
5.2.3g presentation	1	5.2.2g decision-making	1
5.2.4a information processing skills (IT and statistics)	1	5.2.2j understanding of complex systems	1
5.2.4b analysis and synthesis	1	5.2.3a Information Technology	1
5.2.4c critical thinking	1	5.2.4c critical thinking	1
5.2.4d methods, or specific skills	1	5.2.4d methods, or specific skills	1
5.2.5e ethical commitment	1	5.2.5b metacognition	1
5.2.5g to work in a multidisciplinary group	1		
5.2.5h problem-solving	1		

For high and average performing graduates, the most common general skill reported overall was related to *Communication*, especially communication with non-experts and oral communication (Table 6). Communications were important for both successes and non-successes, as portrayed by the two examples here:

Coded as Success: *"(My job is) kind of more marketing, because my job kind of requires outreach, but you can't really help people if they don't know you exist or are there to help them. I guess I've kind of spent a lot of time looking at the demographics and doing kind of my own research on what's effective...but I've kind of keeping track of what's been working and what hasn't been*

working. So I'll mail out a flyer to a bunch of landowners and I actually get calls back, which it's kind of pricey because you've got to pay for postage and whatnot, but the demographic case studies show that people of this demographic like physical mail, they like to hold onto literature, so it's much more effective for me to send out than it is to maybe write a newspaper article that maybe gets seen once but doesn't really generate any kind of response. But at the same time I got to make sure that what I'm sending out is something they care about so if I say "hey, harvest your timber" that's probably not going to get the same response as saying "increase the wildlife benefits" or something like that, so that's kind of been a learning curve. I know I'm becoming more successful figuring out what works and what doesn't."

Coded as Non-Success: "*(Another story I have is about) communication and putting pride aside. So I went into the developmental stage of being a good human being and being an adult and good professional. In one of the field offices I worked, it was a massive struggle the entire summer I worked there. I butted heads with my supervisor daily. Being an intern, I considered all the employees there as my supervisors because they all interacted with me on a daily basis. But it was a lot of butting heads there because I was the young employee who came in from school with a ton of knowledge that a lot of those older employees were not as up to date with the technology and that led to a lot of clashes. It was very challenging over the summer… I had communication issues from one of my supervisors from area conservation and many times the communication was just unclear or sending mixed messages between me and my supervisor, which was just unsuccessful. Things were not communicated to us in the field office very well. So we were misled on a few things that led to contracts being unfunded and some work not being done."*

There are differentiating important competencies between high performing (superior) students and average students for both success and non-success stories (Table 6). In general, for high-performing (superior) students, the most frequently coded skills were related to group and leadership activities, while for average students they were less likely associated with individual, non-leadership activities. Moreover, average students seemed to be more challenged by communication skills than superior students, which aligns with the fact that the former group did not typically list group and leadership skills in their success stories. Communication being important in both successes and non-successes suggests that social skills are extremely important for both differentiating and threshold skills.

For all majors, general skills related to Leadership and Management (5.2.3) were frequently important for both success and non-success stories. The most important general skill set for successes reported

for Forestry majors was *Education, Training, Supervision* (5.2.1.d), while Non-forestry majors most frequently cited *Communication with Non-Experts* (5.2.3.f) as most important during their interviews (Table 6). The most important skills for non-successes reported for Forestry majors was *Communication with Non-Experts* (5.2.3.f) and *Financial Planning and Budgeting* (5.2.2.b), while Ecology/Wildlife majors most frequently related non-success stories to *Organization and Co-ordination* (5.2.1.c), *Accuracy and Diligence* (5.2.2.n), and *Oral Communication* (5.2.3.i). Thus, there seem to be no clear patterns that emerged in competencies between foresters and non-foresters, although it seems as though non-foresters placed a higher value on communications.

Table 6. Most frequently coded important General Skills (Section 5.2) for BEI participants in GOFE for the United States, 2017, by ranked performance while a student category (in parenthesis, n=frequency of most important coding).

Success (20 stories)	Not Success/Failures (19 stories)
high/superior performing graduates	
5.2.1.c *Organization and Co-ordination (3)*	***5.2.1.c*** *Organization and Co-ordination (3)*
5.2.1.d *Education, training and supervision (3)*	***5.2.2.b*** *Financial Planning and Budgeting (2)*
5.2.3.f *Communication with Non-Experts (3)*	***5.2.2.e*** *Project Management (2)*
	5.2.2.h *Responsibility (2)*
	5.2.2.n *Accuracy and Diligence (2)*
	5.2.3.f *Communication with Non-Experts (2)*
Success (30 stories)	**Not Success/Failures (29 stories)**
average performing graduates	
5.2.3.f *Communication with Non-Experts (3)*	***5.2.1.e*** *Tolerance-to tolerate social discomfort(3)*
5.2.5.a *To apply knowledge in practice (3)*	***5.2.3.f*** *Communication with Non-Experts (3)*
5.2.5.f *To work independently (3)*	***5.2.3.i*** *Oral Communication (3)*
Success (19 stories)	**Not Success/Failures (14 stories)**
Forestry majors	
5.2.1.d *Education, training and supervision (3)*	***5.2.2.b*** *Financial Planning and Budgeting (2)*
5.2.1.b *Teamwork and social (2)*	***5.2.3.f*** *Communication with Non-Experts (2)*
5.2.3.f *Communication with Non-Experts (2)*	
5.2.4.a *Information processing skills (2)*	
5.2.5.d *Learning capability (2)*	
Success (33 stories)	**Not Success/Failures (33 stories)**
Non-Forestry majors	
5.2.3.f *Communication with Non-Experts (4)*	***5.2.1.c*** *Organization and Co-ordination (3)*
5.2.1.c *Organization and Co-ordination (3)*	***5.2.2.n*** *Accuracy and Diligence (3)*
5.2.1.d *Education, training and supervision (3)*	***5.2.3.i*** *Oral Communication (3)*
5.2.1.f *Other, networking (3)*	

4 IMPLICATIONS

The Society of American Foresters curriculum standards for Forestry majors includes standards for oral and written communication skills to be developed throughout the curriculum. It is worth noting that communication strategies are not typically the strongest component in forestry education

programs, though students may take a number of courses. Hence, judging by the efficacy of the results, communications skills may not be correlated with the forestry education offerings. Nevertheless, the significant communications-based responses indicate the importance of recommending this skill in forestry programs. Universities that are SAF-accredited should be regularly reviewing and updating their curriculum to meet the standards and improve student outcomes as professionals to meet society's needs. Other natural resources related majors could benefit by having curriculum standards that help ensure a higher standard of professionalism and more regard for these majors by employers. It is a challenge in higher education that undergraduate enrollment in the United States has been increasing in natural resources related fields, but declining in forestry (Sharik et al 2015), while natural resources-related jobs are not increasing proportionally. This appears to be reflected in the amount of jobs that other majors have taken not related to their field (Table 4) or the more temporal nature of the jobs that they do take.

The most frequent career skills involve social interactions and social planning. Forest sector know-how was rarely a cause for a non-success (failure) story, suggesting our students are well prepared with technical skills for success, while most other specialized knowledge comes with job experience. Communication experience and more real-world, interdisciplinary interactions seem to be key to increasing student's confidence in early career settings. The sentiment of one interviewee even indicates that the interpersonal relationship and communication was just as important if not more, than actual forest management happening: "*As a positive…even though I didn't succeed necessarily in changing the approach to forestry (at my work), I did strengthen some relationships with individuals and the forest and I think that's a win.*" These findings regarding the importance of social and communication skills are in general agreement with those of Bullard et al. (2014) and Sample et al. (2015).

The fact that superior students most frequently referenced group and leadership skills as most important in the workplace, while average students noted individual, non-leadership skills as most important, is not surprising given that superior students were originally identified on the basis of extra-curricular group involvement and leadership activities by their institutions. It is, however, noteworthy that these skills, which are associated with leadership positions in the workplace and profession, carry over from a student's college experience.

Forestry student numbers have been declining in the United States, which is especially important given that out of all natural resource-related fields of study, forestry has the lowest enrollment levels of females and minority students (Sharik et al 2015). It is of note that the forestry

majors and superior students in this study sample (not all overlapping) had, on average, fewer short term jobs, more full-time jobs, and more jobs in their own field after graduation, suggesting more secure career pathways. As a first step towards understanding the gaps from experiences, this study may help offer strategies programmatic changes to forestry programs in the United States.

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