



State of the art and development needs of forestry service contractors
in the Northern Periphery and Arctic region

Thomas Kronholm, Amanda Sosa, Euan Bowditch,
Sarah Pohlschneider, Katri Hamunen, Pasi Rikkonen



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Preface

Forest Business Innovation and Advancement in the Northern Periphery (FOBIA) is a three-year project started in 2017 with funding from the European Regional Development Fund via the Northern Periphery and Arctic Programme 2014–2020. Research and education organizations and private and public partners in Finland, Scotland, Sweden and Ireland participated the FOBIA project. This report is based on work undertaken in the project's work package (WP) focusing on business models for forestry service contractors, and it is the result of a close cooperation between researchers and industry partners. The results presented in the report are based on data that have been collected and compiled by project partners in respective country. The project partners involved in the WP are:

- Swedish University of Agricultural Sciences (responsible partner for the WP)
- The Swedish Association of Forestry Contractors
- Natural Resources Institute Finland
- Inverness College – University of the Highlands and Islands
- TTS Työteho-seura
- Waterford Institute of Technology

A special thanks to all partners who have contributed to the completion of this report, including all the contractors and other organizations who have dedicated time and effort to share information about the business models currently applied by forestry service contractors.

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Thomas Kronholm
WP coordinator
thomas.kronholm@slu.se

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1 Introduction

Despite differences in the forestry history and culture between Finland, Sweden, Ireland and Scotland, the forestry service sector faces common challenges such as declining profitability, - especially for small wood-harvesting enterprises, inadequate business management skills and scarcity of skilled employees. Therefore, enhancing businesses management and operational efficiency is required for ensuring the sustainability of forestry service businesses. The aim of the FOBIA project is to improve the competitiveness of forestry service suppliers by:

- Promoting the development of innovative business models.
- Providing tools and methods to improve operational efficiency.
- Developing and piloting the use of digital platforms for training, networking and trading of services.

A comprehensive review of the status of forestry service business in the participating countries lays foundations for the development of business models. The Swedish University of Agricultural Sciences (SLU) developed a framework for characterizing the business models applied by forestry service contractors (Benjaminsson et al. 2019). The business model was divided into main components in terms of the services provided, the structure of enterprise, and revenue streams. This tool was later used in a series of interviews and surveys carried out by the project partners. This report synthesizes the results from these surveys and interviews, with the aim of:

1. Providing state of the art descriptions of the business models applied by the forestry service contractors in Finland, Sweden, Ireland and Scotland,
2. Comparing the status and development needs by highlighting similarities and differences in the firm and market structures.

The report includes general descriptions for all four countries, but has a special focus on the conditions prevailing in the northern peripheral areas. Thereby, the report enables national and transnational comparisons, providing valuable information for benchmarking and highlighting successful business practices.

1.1 The northern periphery and arctic area

The northern periphery and arctic (NPA) area consists of regions in nine countries located in the northern parts of Europe and in the Atlantic zone (Fig. 1). These regions share a number of common features, e.g. low population density, low accessibility, low economic diversity, high impact of climate change, and abundant natural resources (Northern Periphery and Arctic Programme Secretariat, 2018). In the countries covered by this report, forests are an important source of incomes for the local people. The forests also provide opportunities for recreation and outdoor activities, as well as eco-system services. Forests and forestry service contractors will also have an important role in boosting of the bio-economy as the public interest to develop new products from environmentally-friendly materials, and exchange fossil-based energy sources to renewables ones, increases (Staffas et al., 2013; Ollikainen, 2014).

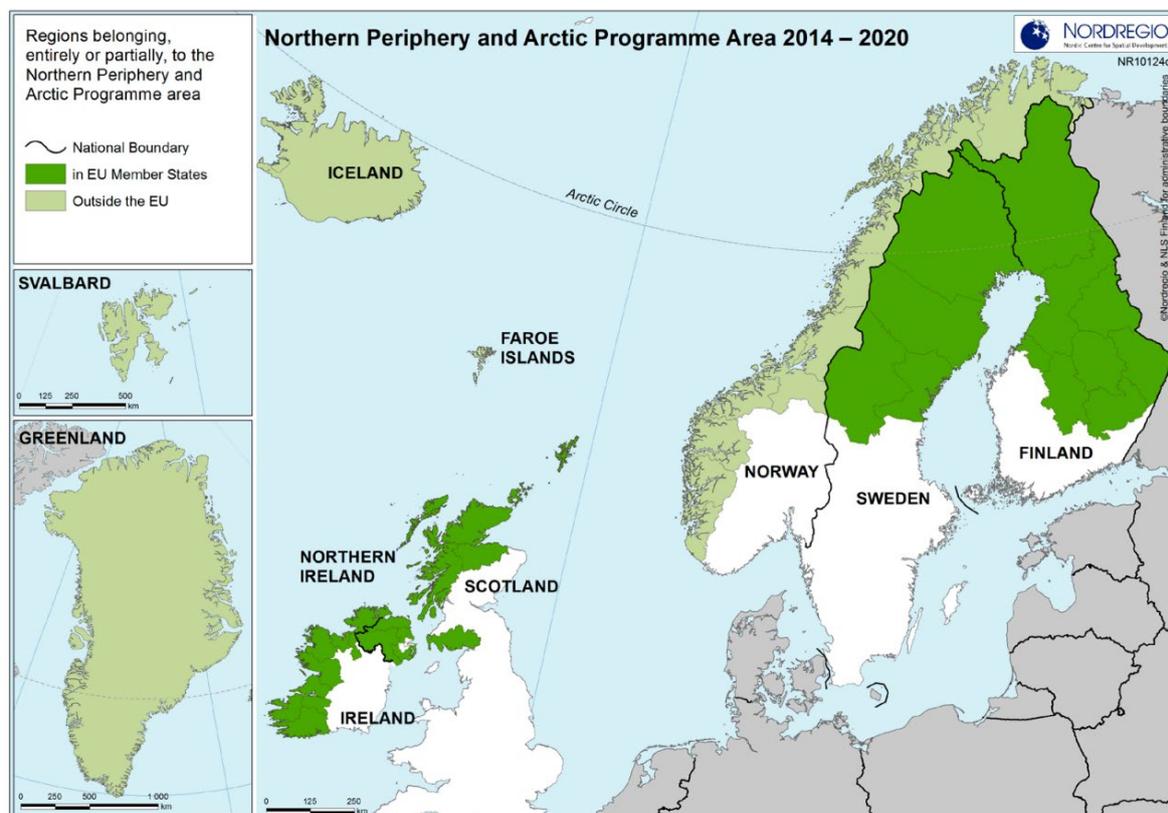


Figure 1. The Northern Periphery and Arctic Programme Area. Design: Julien Grunfelder (Nordregio 2015)

1.2 Forestry and the forest contracting sector

The forestry service contractors constitute the backbone of the industry's supply chain as most of the harvesting and silvicultural work has been outsourced to specialized firms (Slee, 2006; Ager, 2014). Therefore, forestry service contractors also play an important role in managing the forest landscape which provides the public both social and economic benefits. Furthermore,

forestry entrepreneurship is an important source for work and income for people and municipalities in remote areas with low economic diversity but abundant forests resources.

Sweden and Finland have considerably larger forestry sectors than Ireland and Scotland (Table 1). In recent years, the annual roundwood removals in Finland and Sweden have well exceeded 70 million cubic meters (Swedish Forest Agency, 2018; Natural Resources Institute Finland, 2019b). In 2017, the annual harvest in Ireland was 3.5 million cubic meters, while Scotland in 2016 harvested 8.4 million cubic meters (Department of Agriculture, Food and Marine, 2018; Scottish Government, 2017). Afforestation programs have resulted in a growing stock of forests in Ireland and Scotland, creating thereby better conditions for entrepreneurship in the forestry service sector. In Scotland, the annual harvesting rate is rising and has been estimated to soon exceed ten million cubic meters. The roundwood supply in Ireland is predicted to reach eight million cubic meters by 2035, and this increment will come from maturing privately owned, subsidized forests, and primarily in the form of large-sized assortments (Phillips et al. 2016).

Table 1. Overview of the forest sector in participating countries.

	Ireland ⁽¹⁾	Scotland ⁽²⁾	Finland ⁽³⁾	Sweden ⁽⁴⁾
Forest land (million ha)	0.8 (total)	1.5 (total)	20.3 (productive forest land)	23.2 (productive forest land)
Harvesting volume (million m ³)	3.5 (o.b.)	8.4 (o.b.)	78.2 (o.b.)	72.8 (s.u.b.)
People working in the forestry sector	12,000	20,000	65,000	70,000

⁽¹⁾ Department of Agriculture, Food and Marine 2018; ⁽²⁾ Scottish Government 2017; CJC Consulting 2015; Forestry Commission, 2019; ⁽³⁾ Natural Resource Institute Finland 2017, 2019a,b; ⁽⁴⁾ Swedish Forest Agency 2014, 2018; Skogsindustrierna 2018.

These four markets are at different stages of their development, which offers opportunities for comparisons about the structure of forestry service businesses and their challenges. There is also potential for learning from the each other’s experiences. The forestry service markets in the Nordic countries are mature, and with a long tradition in contracting that has been practiced since the 19th century when farmers did harvesting work in wintertime. The mechanization of harvesting started in the mid-1900 when farm tractors entered logging sites. In Sweden, the forest companies (industry owners) invested in machinery, while in Finland the harvesting contractors primarily owned the machinery. Since the 1990’s, most of the forest operations have again been outsourced to independent contractors (Ager, 2014; Pakkanen and Leikola, 2013). The number of Swedish contractors has been estimated to be around 3,700, of which 2,500 offer forest services as the main business (Häggström et al., 2013). In 2017, the number of forest machine enterprises (harvesting contractors) in Finland was 2241 (Metsätöns 2018), and the number of silvicultural entrepreneurs has been estimated to be 650 (Suomen Metsäkeskus 2014).

In Scotland the forests have had a history of overuse and continual deforestation. In the 1700’s, introduction of domesticated grazing herbivores caused widespread deforestation. The 19th century saw the rise of sporting estates and large landowners that focused on sporting pursuits, especially deer stalking and grouse shooting. This caused a further reduction of forests in Scotland. After the First World War, much of the timber in Scotland had been harvested to aid

the war effort and only 5% of the country was covered at the time. Due to the threat of future conflicts, it was recognized that a strategic reserve of timber would be needed. Therefore, sustainable timber supplies and regulation of activity would be required. This resulted in the formation of the Forestry Commission in 1919. After a century, the powers have been devolved to Scotland and Scottish Forestry is now the representative government agency. There is no current data on the past numbers of forestry contractors. However, estates in Scotland at one time would have possessed their own in-house forestry crew to manage and cut the timber. On some estates, in-house foresters has been reduced from 17 in the mid-20th century to one forester in the late 20th century.

This shift was indicative of forests being viewed as a lower priority by larger estates, but also created a gap and opportunity for contractors to fill. Additionally, the peaks in the availability of timber or plantations coming online for their final rotation provides supply for contractors to thrive and build upon their businesses. Ideally, that will rise further with expanding forests. Despite efforts to create a regular supply and continuous rotation of end-product trees this does not always happen. Therefore, contractors have to take advantage of peaks in demand and survive the troughs when demand hits low numbers. Scottish Forestry has reported a projected peak of supply in 2030 with a steady decline in softwood availability until 2060 to around 63% of the availability in 2030 (Forestry Commission, 2018). Hardwood supply is projected to steadily rise until it peaks in 2050, but the hardwood peak only represents 5% of the softwood peak volume (Forestry Commission, 2018). In 1996, Anderson et al. estimated the number of harvesting and establishment contractors stood at 219, which is very low in comparison to Finnish and Swedish numbers. Although in comparison, Finland and Sweden harvest roughly ten times more than Scotland annually and have 17 times more forest area. Therefore, having the huge disparities in contractor base is reasonable considering the sector size and infrastructure.

Imported timber is expected to rise from 60% presently to 78% between 2032 and 2050 due to the lack of planting of productive forests (Scottish Government, 2019). This rise and peak provides contractors with general trends for work supply, competitiveness and profitability and currently many contractors may be considering either transitioning to another sector, retiring or will have to diversify their services within the next ten years to match the Scottish wood production trend. Key aims of the Scottish timber industry is to increase Scottish supply of construction grade timber by 50% by 2030, and develop and train current and potential workforce, which includes harvesting operators and other contracting services (SFTT, 2018).

Ireland has an emerging forest state. In the early 1900's, the forest cover was only 1.5% but due to afforestation initiatives decades ago the national forest currently covers 11% of the total land area. The Irish State initiated the establishment of forests on mountain land, which consisted of mainly exposure-tolerant and fast growing conifers (Teagasc, 2017a). In 1989, a semi-state forest company called Coillte Teoranta was established and today it owns and manages more than half of the forests (51%) (Department of Agriculture, Food and the Marine, 2019). A substantial initiative to increase the level of afforestation by private landowners (mostly farmers) also occurred in the 1980's following the introduction of grants and an annual premium scheme for afforestation. Currently, 49% of the forests with an average parcel size of 9.6 ha

(Department of Agriculture, Food and the Marine, 2017), are privately owned by over 21,000 individual forest owners (Teagasc, 2017b). In general, the forests are young, with nearly three quarters of the stocked forest area being less than 30 years of age (Department of Agriculture, Food and the Marine, 2017)

The forest industry in Ireland is making a €2.3 billion contribution to the national economy or roughly 1% of GDP (Forest Industries Ireland, 2018). This sector employs around 12,000 people across the state, in activities ranging from planting and harvesting forests, to wood transport and processing (Phillips et al., 2016). In response to the rise of private planting and harvesting, the number of forestry management companies has increased significantly in recent years. These companies provide services such as grant application, insurance, forest establishment, forest management, forest road design and construction, etc. Harvesting and transport operations are mostly outsourced and carried out by independent contractors. The harvested timber is supplied to a processing sector that is mainly oriented to construction – sawn timber and panel products.

2 What is a business model?

The concept of business models became popular among scholars and practitioners during the development of the IT-sector and the emergence of online businesses in the 1990's and has thereafter received considerable attention. Yet, no globally accepted definition of a business model has so far been established (Wirtz et al., 2016). Zott et al. (2011) concluded that the concept of business model has often been taken for granted and used without an explicit definition. This implies a risk of misinterpretation or unclear meaning in associated context. Therefore, it is important to briefly define the concept and explain how it was applied in this project.

Business models can be defined as “*a simplified and aggregated representation of the relevant activities of a company*” (Wirtz et al. 2016). In other words, business models explain how firms create, market and deliver value to customers in a profitable way (Magretta, 2002; Osterwalder and Pigneur, 2005; Teece, 2010). Moreover, a business model is predominantly considered to represent a holistic perspective on the enterprise, rather than focusing on product level strategies.

To make the business models more concrete and easy to grasp, they are often expressed through their underlying components, e.g. *customers, resources, networks, value proposition/market offering, strategy, procurement* and *finances* (Wirtz et al., 2016). However, the number of components illustrating business models has varied from only two up to nine (Morris et al., 2005; Boons and Lüdeke-Freund, 2013; Wirtz et al., 2016). Thus, the approach for describing the business models in the forest contracting sector was dependent on the level of abstraction required for achieving the project's goals. Making the components and their interconnections visible a more explicit model was selected. This helps to understand how high-level strategies and practical actions are aligned in the firm, and how they could be developed in order to increase competitiveness by creating innovative business models (Joyce and Paquin 2016).

The Business Model Canvas (BMC) is a framework developed by Osterwalder and Pigneur (2010) and encompasses many aspects of a business model. It contains nine components (Table 2), structured around four core elements: customers, value proposition, infrastructure and finances. This tool has the ability to capture and represent business models as well as stimulate business model innovation (Joyce and Paquin 2016). The BMC has not been widely used for analyzing business models in the forestry service sector. However, as part of this project, a BMC was adapted and tested to forestry service businesses (Benjaminsson et al. 2019), and later applied in the present report (see section 3.1).

Table 2. Components of the business model canvas developed by Osterwalder and Pigneur (2010).

Component	Core content
Value proposition	What products or services does the firm offer the market?
Customers	To whom is the firm selling its product or service?
Channels	How is the product/service delivered to the customer (e.g. retail stores, websites, staff)?
Customer relationships	How personalized is the relationship? A more specialized product/service may require closer relationship with the customer.
Key activities	What are the core processes in the production of the product/service?
Key resources	What resources are necessary for the production of the product/service?
Key partners	Which external organizations are necessary for the production of the product/service?
Cost structure	What kind of cost structure does the company have (e.g. owned or leased machines; in-house or outsourced production)?
Revenue streams	What pricing strategies does the firm apply?

3 Methodology

The work presented in this report was started by developing a framework for characterizing business models applied by forestry service contractors. Thereafter, national surveys, interviews and analyses of register data were performed in order to provide state of the art descriptions about the business models applied by the contractors in Finland, Sweden, Ireland and Scotland.

3.1 Characterizing the business models of forestry service contractors

The work was initiated by modifying and testing the canvas model of Osterwalder and Pigneur (2010) for characterizing the business models of forestry service contractors (Benjaminsson, 2018; Benjaminsson et al., 2019). The framework includes a set of key questions for capturing relevant content of each component (Fig. 2), which were developed and tested through ten semi-structured interviews of researchers and market experts in Finland, Sweden, Ireland and Scotland. It was concluded that the framework is a structured and straightforward tool applicable to capture and compare the differences between business models. Thus, the partners responsible for data collection were provided a template document for data collection based on this framework.

Use of subcontractors or other cooperation <ul style="list-style-type: none"> Do you use subcontractors or cooperate with other contractors? If so: is it long- or short-term arrangements? How do you buy/negotiate the terms for those services? 	Machinery <ul style="list-style-type: none"> Do you need machinery? How many machines do you have? How specialized are the machines for a certain type of service? What affect your choice of machinery: your preference, the market demand, customer requirements, your company's economy, or other factors? 	Services performed <ul style="list-style-type: none"> What services do you offer? To what degree are you engaged in forestry services? Do you perform non-forestry services? What affected your choice of design: your preference, the demand, customer requirements, the company's economy, or other factors? 	How services are sold <ul style="list-style-type: none"> How do you sell your services to customers, regarding purchase method? How long contracts do you have? Why do you sell the services this way: because of your own preference or the market conditions? 	Customers <ul style="list-style-type: none"> Who are your <u>main</u> customer/s? How many customers do you have? What affects the number of customers: your preference or the market conditions?
	Personnel <ul style="list-style-type: none"> How many employees do you have? Are they employed full-time or seasonal/temporarily? What competences do you require when hiring and how does that affect your recruitment? 			
How services are priced <ul style="list-style-type: none"> How is pricing done? Why are services paid this way: because of your own preference or the market conditions? What can you do to get extra paid/get a higher price? 				

Figure 2. Framework for characterizing business models applied by forestry service contractors (Benjaminsson 2018; Benjaminsson et al. 2019).

3.2 Data collection

Project partners were responsible for collecting data from their countries. Due to differences in legislation and cultural traditions, there were differences in the availability of information. The following sections describe the data collected in each country and how it was acquired.

3.2.1 Sweden

The Swedish Association of Forestry Contractors (SE) compiled data from their member and certification registers in the beginning of 2018. These registers contained more than 1,700 entries, but after removing cases irrelevant for the project (e.g. insurance companies, machine manufacturers, forestry schools, municipalities and sawmills) the sample contained 1,603 enterprises. Of these cases, 40% were located within the Swedish NPA area: Västerbotten (196), Jämtland (181), Västernorrland (134) and Norrbotten (126). According to SE's own estimates, the register covers about 60–70% of professional forestry contractors in Sweden. In comparison, Häggström et al. (2013) have estimated that the total number of forestry contractors in Sweden was approx. 3,700 in 2009, of which 2,500 primarily focused on forestry work while the rest performed forestry services occasionally (< 25% of their annual working time). Based on these figures, SE's register includes 40–60% of the forestry contractors in Sweden. However, the contractors with primary interest in forestry are likely overrepresented in the sample as they are more prone to become members and/or certified than occasional contractors.

The registers included contact information, the numbers of employees and machines, main type of business, services offered and the contractor's main customer. However, the information available about individual members varied. In general, there was more information available for certified enterprises. The registers also contained information about contractors who at the time were not members or certified. A summary of the affiliations of the contractors included in the data is presented in Table 3.

Table 3. The analyzed contractors' affiliation to the Swedish Association of Forestry Contractors (SE).

		Affiliation		Certification		Total
				No	Yes	
Membership	No	Count	448	340	788	
		% within Membership	56,9%	43,1%	100,0%	
		% within Certification	60,8%	39,3%	49,2%	
		% of Total	27,9%	21,2%	49,2%	
	Yes	Count	289	526	815	
		% within Membership	35,5%	64,5%	100,0%	
		% within Certification	39,2%	60,7%	50,8%	
		% of Total	18,0%	32,8%	50,8%	
Total	Count	737	866	1603		
	% within Membership	46,0%	54,0%	100,0%		
	% within Certification	100,0%	100,0%	100,0%		
	% of Total	46,0%	54,0%	100,0%		

In Sweden, income statements and balance sheets are publicly available for limited liability companies, but not for sole traders, economic associations (co-operatives) or trading/limited partnerships. Thereby, it was possible to obtain financial information about limited liability companies and add this to our data set by using companies' id-numbers. The Retriever Business database was used for collecting financial statements for the period 2012–2016. Out of the 1603 cases, 969 were limited companies, 419 sole traders, and 46 trading/limited partnerships or other forms of businesses. The remaining 169 cases lacked information about their legal status. Based on the collected information, key performance indicators such as net profit margin, solidity (equity ratio), liquidity (quick ratio) and return on investments were calculated.

In addition, a survey was conducted in the fall of 2018 (Larsson, 2019). A questionnaire was sent to 812 limited liability companies in the Swedish NPA area that were registered to offer harvesting or silvicultural services, out of which 243 responses were collected. However, 57 of them replied that they no longer perform any forestry services and did therefore not complete the survey. These data provided a deeper insight into the contractors' challenges and development needs, as well as information about how they sell services, what type of machines they use, and from where they recruit their employees.

3.2.2 Ireland

There is no official registry providing the exact number of forest service contractors in Ireland. By 2018, approximately 230 companies were registered at the national Companies Registration Office (CRO), indicating forestry, logging and related services as their main business activity. On closer inspection, 30% of these companies provided arboricultural services, 20% offered forest management, 16% harvesting operations, and the rest provided services such as haulage, forestry investment, Christmas trees, and rent of machinery. This information in addition to a contact list from the Agriculture and Food Development Authority (Teagasc) were used to develop a database of harvesting contractors. In all, 63 companies were identified to provide harvesting services in the country.

In Ireland, the study concentrated on wood harvesting contractors, and for this study, 15 harvesting companies participated in person-to-person and phone interviews. The interviews covered the different sections of the business canvas via 18 questions. Table 4 shows the nature of the questions.

Another part of this study was to assess the financial health of forest harvesting businesses. Depending on the size of the company, a variety of financial statements may be available through the CRO (2019). All companies provide a balance sheet and income statement each year; large companies may also provide a cash flow statement as well as a stakeholder's equity statement. Yearly financial statements from 2014 to 2018 were obtained from 15 harvesting companies with different years in service (4 to 34 years). A financial statement analysis was carried out to assess how forest harvesting companies are performing.

Table 4. Interview guide for contractor interviews in Ireland.

Questions asked	
Services performed in the market (Value Proposition, Key Activities)	Aim
1. What services does your company offer? 2. To what degree is your company engaged in forestry services? Do you perform non-forestry services? 3. What affects your choice of service design: your references, the demand, customer requirements, the company's economy, or other factors?	Characterize the main differences between the contractors regarding: Services offered, degree of specialization, degree that contractors engaged in the forestry industry or other business areas, and what conditions affect the contractor's choice of service design.
The Customer (Customer segment)	
4. Who are your company's main customer? 5. How many customers does your company have? 6. What affects the number of customers: your choice or other factors?	Identify who are the main customers that buy harvesting services, what reasons affect the number of customers.
How services are sold (Customer Relationship, Channels)	
7. How does your company sell services in terms of purchase methods and contract lengths? 8. Why do you sell them that way?	Describe the different ways harvesting services are sold and the reasons behind it.
How services are priced (Revenue Streams)	
9. How are prices set? 10. What can you do to get paid extra/get a higher price?	Identify how contractors set their prices, and if there are situations where the contractor can get a higher price.
Machines and personnel (Key Resources, Cost Structure)	
11. How many employees do you have? 12. Are they employed full-time or seasonal/temporarily? 13. Are the employees domestic or foreign?	Assess if the number of employees, contract length and nationality differ depending on the services the contractor offers.
14. How many machines does your company have? How specialised are the machines for a certain kind of service?	If the contractor have machinery, identify how many machines are owned by contractor's and how specialized the machinery is.
15. What affects your choice of machinery?	Identify what affects the choice of machinery: the contractor himself, uncertainty in demand, customer requirements, the contractor's economy, or other factors
Use of subcontractor (Key Partners)	
16. Do you use subcontractors or cooperate with other contractors? 17. If so, is it long- or short-term arrangements? 18. How do you buy/negotiate those services?	Assess if it is common to cooperate with or to buy services from other contractors. If there is cooperation how the services are acquire and if these are long or short-term arrangements

3.2.3 Finland

In Finland, data were collected and analyzed in two phases. First, the overall profitability of the wood harvesting business was summarized based on the public financial statements of limited liability companies (n = 1,109). For in-depth analysis of the business models, 84 wood harvesting companies were selected from the financial accounts database VOITTO+. The selection criteria were: 1) registered as wood harvesting business in the trade register, 2) location within the NPA area, 3) balanced representation of the regions within the NPA area, 4) availability of financial accounts, and 5) representative size distribution in terms of turnover.

The selected companies were divided in four groups:

G1): 18 companies (turnover > 2 million euros)

G2): 20 companies (turnover between 2 and 1 million euros)

G3): 25 companies (turnover between 1 million and 500 000 euros)

G4): 21 companies (turnover < 500 000 euros)

Profitability, solidity and liquidity evaluation for the years 2012–2016 were calculated for these contractors.

In the second phase, 19 (out of 84 contractors) were interviewed to analyze the business model components. The set of the interviewed contractors was a balanced representation of different regions and different sizes of companies. The questions were developed based on the BMC framework. Questions were both open-ended and structured, and the data obtained was both quantitative and qualitative. These 19 companies were categorized into three groups based on annual turnover: small (n = 8; turnover < 500 000 euros), medium (n = 7; turnover 500 000 – 2 million euros), and large (n = 4; turnover > 2 million euros). In Finland, the median annual turnover of wood harvesting enterprises is around 600 000 euros (Jaakkola, 2018; Penttinen et al. 2011), meaning that large- and medium-sized enterprises are overrepresented in the sample.

3.2.4 Scotland

In Scotland, there is no obligation for the contractors to report to a common public-facing database regarding their business activities. The Forestry Contracting Association (FCA) in Scotland is the representative body of membership but has limited scope and powers. In part due to the low funding and the historical nature of the association. The FCA primarily communicate updates to their members about health and safety practices, regulations and any other news, as well as hosting their members businesses on their website. Registered contracting companies also submit their annual financial reports to Inland Revenue and are available to view on a limited basis on sites such as Company House. However, profit and loss statements are omitted for most companies. Therefore, finding primary sources for profitability of Scottish contractors has been difficult during the project and has mainly been discovered through direct

contact with contractors themselves. Balance sheets have been viewed for nearly 200 companies.

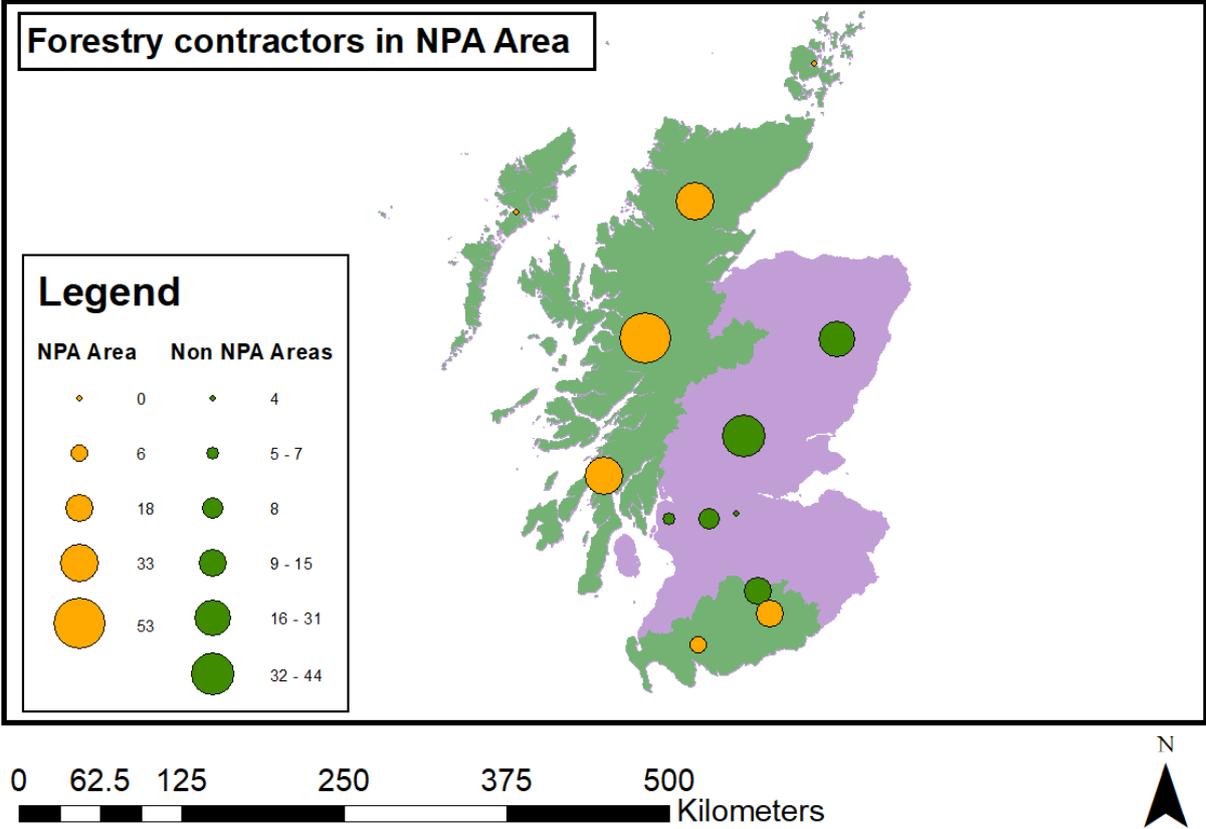


Figure 3. Geographical distribution of forestry contractors in Scotland.

FCA represents 469 members over the UK (Fig. 3), of which 179 companies, institutions and individuals were registered from Scotland. Through Company House, 288 forestry service contractors were found in Scotland. This compilation of companies provided the network base for all enquiries, as well as direct contacts through networks associated with the University of the Highlands and Islands, Scottish School of Forestry and staff contacts. In all, 13 semi-structured interviews were performed along with an online survey that was widely distributed to the forestry-contracting network in Scotland (41 respondents). Interviews conducted covered a range of forestry contractors, industry and entrepreneur experts. Additionally a national steering group was set-up for the project including associate partners and key industry representatives. These were used to evaluate the appropriateness of research and development, provide useful industry contacts and guide/test the developing work.

The focus of this study was upon machine operators; however, they only represent a section of the forestry-contracting sector. In many cases individuals offer multiple services, or have transitioned between the different types of services. Main categories of forestry contractors in Scotland are:

- Harvesters (softwood/hardwood)
- Establishment (ground prep and planting)

- Forest management (maintenance, restoration, tender application, mapping and planning)
- Manual operators (chainsaws)

In some cases arboriculturists and agricultural services overlapped with main contracting services. Outlying services offered by only a few contractors included plant hire, road construction and fencing.

4 Business model characteristics

In the following sections, the business model characteristics are presented country-wise for each business model component.

4.1 Services performed by contactors

4.1.1 Sweden

The Swedish register data contained information about the services provided by harvesting and silvicultural contractors. For harvesting contractors cutting (for final felling or commercial thinning) and forwarding were the two most frequently offered services (Table 5). These services were often combined as almost half of the enterprises offered both services. Of those who offered cutting services, 83% also performed forwarding services. More contractors performed forwarding services than cutting services, and one out of four (24%) offering forwarding services did not perform harvesting. Further, harvesting contractors also reported to offer services such as energy wood harvesting (12%), pre-commercial thinning (8%), soil scarification (7%), ditching (4%), planning (4%), and planting (1%). Other services were offered by 5%.

The service most frequently offered by silvicultural contractors was pre-commercial thinning, followed by planting. Pre-commercial thinning was offered by 84% of silvicultural contractors, and planting by 41%. Further, of those who offered planting 93 % also offered pre-commercial thinning. Other services offered by the silvicultural contractors were soil scarification (12%), planning (10%) and ditching (7%). A few firms classified as silvicultural firms performed also cutting (2%) and forwarding services (5%). Other types of services were reported by 16% of the silvicultural contractors.

The register also contained 26 firms classified as planning contractors, but three of them reported offering also pre-commercial thinning.

Table 5. Services offered by the contractors in Sweden.

Service	NPA area		Outside NPA area		Total	
	Contractors offering the service	% of NPA area contractors (n 529)	Contractors offering the service	% of non-NPA area contractors (n 574)	Firms offering the service	% of total (n 1103)
Cutting	317	60	326	57	643	58
Forwarding	345	65	360	63	705	64
Pre-commercial thinning	123	23	146	25	269	24
Planting	36	7	62	11	98	9
Soil scarification	48	9	35	6	83	8
Bio fuel	44	8	65	11	109	10
Ditching	21	4	30	5	51	5
Planning	47	9	62	11	88	8
Other	55	10	52	9	107	10

4.1.2 Ireland

Based on the interviews carried out in Ireland, the majority of harvesting companies concentrate on providing services to the forestry sector. Only one company interviewed uses standard excavators fitted with harvesting heads, and this machinery configuration allows them to diversify and work in the construction sector (construction of road and bridges). The main activities performed are harvesting operations, with 14 companies offering both thinning and final felling services, and one company concentrating on final felling (Fig. 4). Contractors with higher number of machinery and employees tend to diversify their activities and include truck transportation, wood chipping, cleaning and site preparations, and construction of forest roads. Two companies offered specialized services such as cable harvesting and biomass bundling. The offering of these services is based on the demand and requirements of the customers, as well as the specifications and capacity of their harvesting equipment.

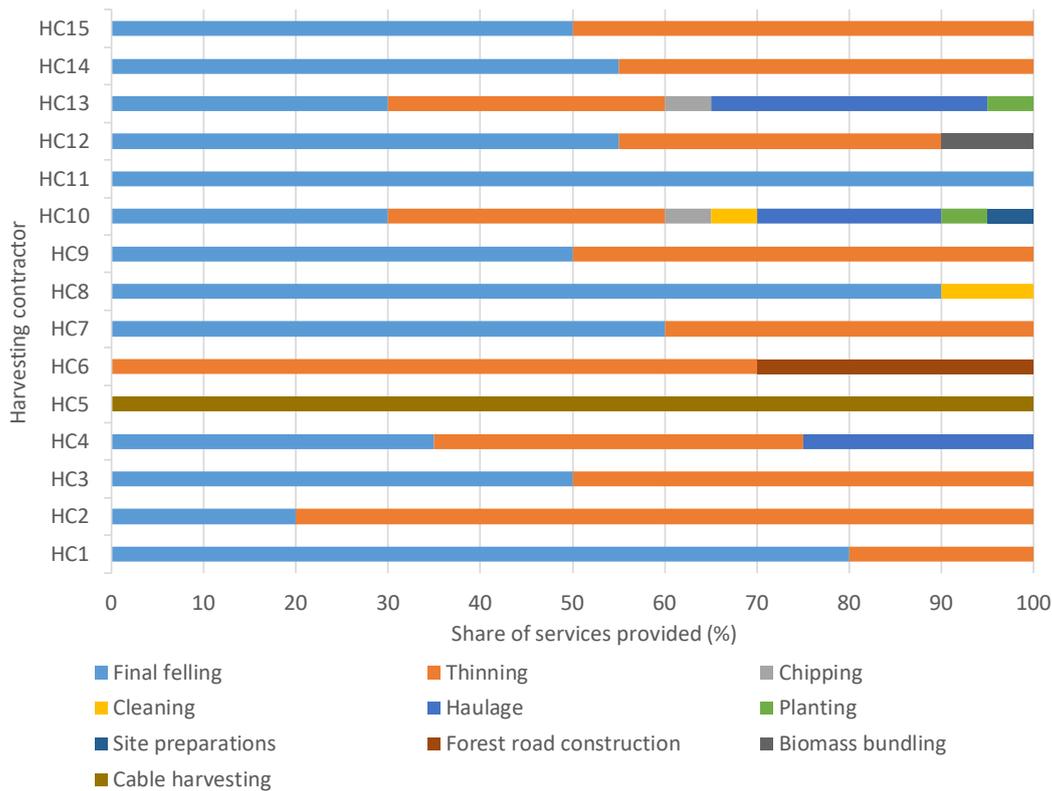


Figure 4. Services offered by the 15 harvesting contractors interviewed in Ireland.

4.1.3 Finland

In Finland, the survey was limited to wood harvesting contractors (limited liability companies), of which 19 were interviewed. More than 90% of the companies' turnover was generated from the harvesting of industrial roundwood, including both cutting and forwarding. Some companies offered energy wood harvesting, soil scarification, machine relocations and maintenance, and the planning of harvesting sites. The smallest and medium-sized companies focused on harvesting, while the largest enterprises provided long-distance transportation of roundwood and energy wood. However, these businesses were mostly based on partnership with other enterprises. Some of the interviewees anticipated that the purchase of roundwood could come a part of their business in the future.

4.1.4 Scotland

Information for 276 contractors was collected in Scotland from publically available records, of which around 100 stated a broad category and subsequent information was extracted from the company's online presence. There was a clear divide of contractors, with 138 coming from the NPA area and 138 from the non-NPA area. A large share of contractors (41%) were located in the Highlands and Islands (Fig. 5), but considering the size of the region this is not unexpected.

Regional distribution of contractors

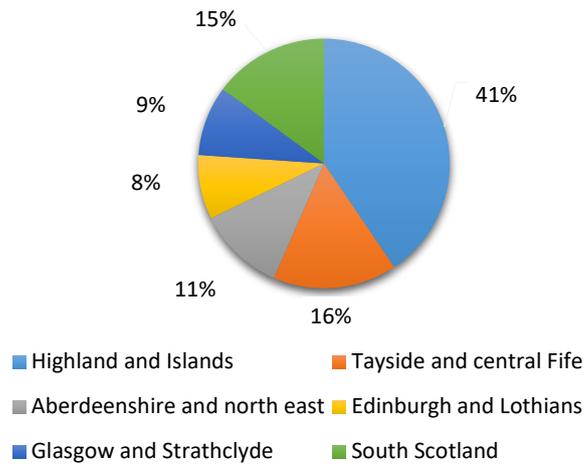


Figure 5. Regional distribution of contractors in Scotland.

The south of Scotland region was mainly represented by contractors in the Dumfries and Galloway area, which falls under the NPA area. A significant concentration of contractors came from the Tayside and Fife region, which focusses around Perthshire (considered to be a centrally accessible area of Scotland linking the north and south). A large share of companies offering arboricultural services clustered around the main city areas of Glasgow and Edinburgh due to the proximity to the urban forestry market.

Table 6. Services offered by contractors in Scotland.

Service	NPA Area		Non-NPA Area		Total	
	Contractors Offering the service	% of NPA area contractors (n 138)	Contractors offering service	% of non-NPA area contractors (n 138)	Companies offering the service	% of total (n 276)
Harvesting	37	26.8	29	21.0	66	23.9
Arboriculture	11	8.0	19	13.8	30	10.9
Planting	22	15.9	22	15.9	44	15.9
Ground prep	28	20.3	23	16.7	51	18.5
Forest management	21	15.2	21	15.2	42	15.2
Processing	6	4.3	5	3.6	11	4.0
Woodfuel	4	2.9	7	5.0	11	4.0
Chainsaws	7	5.0	3	2.2	10	3.6
Haulage	4	2.9	1	0.7	5	1.8
Construction	3	2.2	1	0.7	4	1.4
Other	22	15.9	21	15.2	43	15.6

Table 6 shows the services offered by the contractors, highlighting harvesting as the most common service. Still, one out of four contractors offering this service is relatively low in comparison with the Swedish sector. Ground preparation, planting and forest management services were the next most offered services and these four services covers the majority of the contracting sector in Scotland. Forwarding was not explicitly mentioned in the data gathered. Other services included plant hire, fencing, horse logging, training, drone operations and financial investment (Fig. 6).

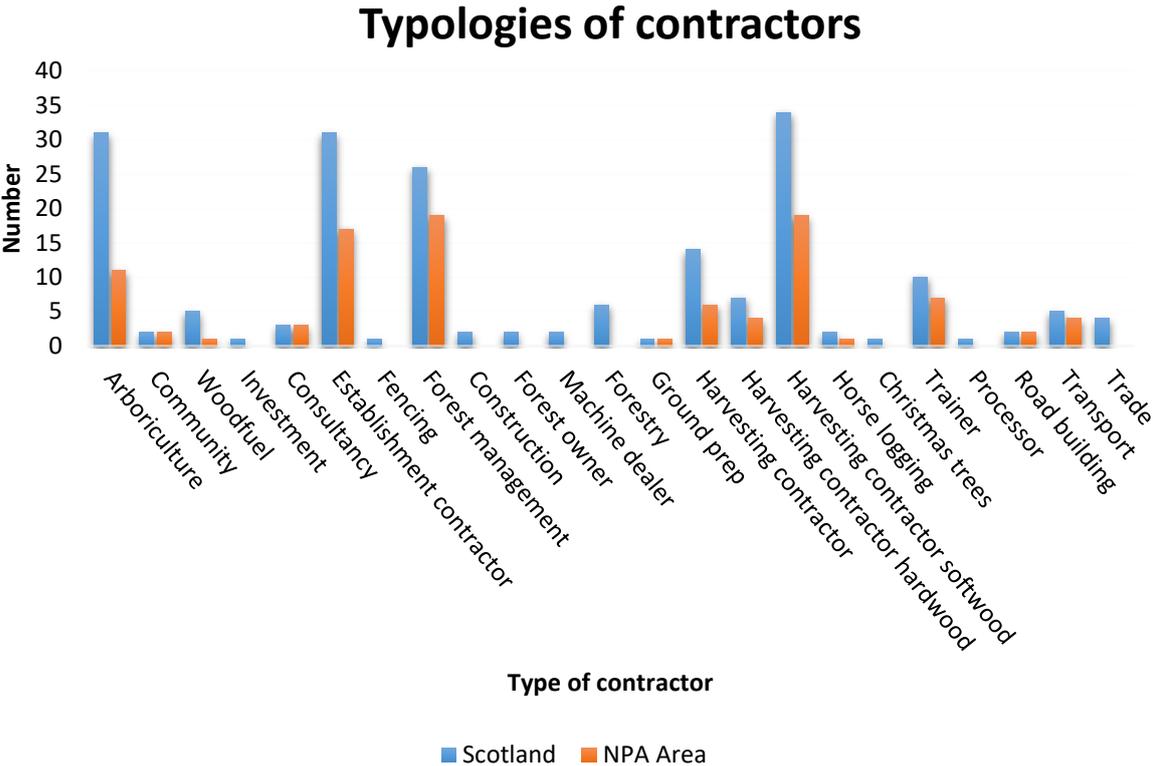


Figure 6. Services offered by forest contractors in Scotland.

Arboriculture and harvesting are the largest typologies of forestry contracting companies. Often the arboriculture companies offer multiple services such as felling, planting and forest management with a tendency to diversify their services.

4.2 Customers

4.2.1 Sweden

Larsson (2019) found that 84% of harvesting contractors and 67% of silvicultural contractors in the NPA area had a main customer that was accounted for $\geq 75\%$ of the firm’s turnover. The silvicultural contractors had on average a double amount of customers compared to the harvesting contractors (10 vs. 5 customers). However, when excluding private forest owners, whose individual share of a firm’s turnover may be small, the average number of customers was 5.3 for the silvicultural contractors and 1.7 for the harvesting contractors.

In SE’s register, the main customer was available for 933 enterprises and it was found that 10–15 forest companies and forest owners’ associations employed a large share of the contractors (Fig. 7). In the NPA area, SCA was the most frequent customer and together with Sveaskog, Holmen, Norra Skogsägarna, Norrskog and Martinson they provided a large share of work for almost 300 contractors. Outside the NPA, the forest owners’ associations Södra and Mellanskog were the main customer of 110 and 62 contractors, respectively.

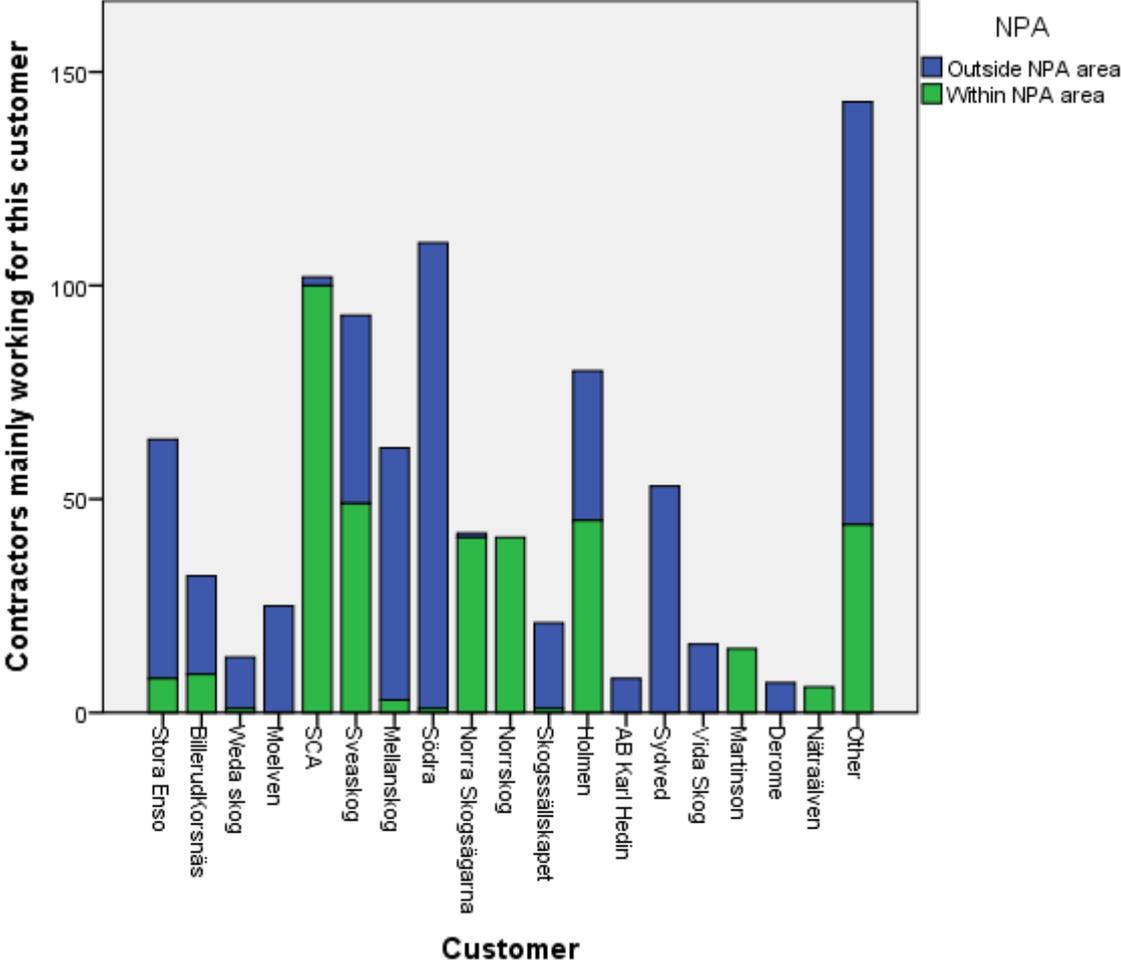


Figure 7. Number of contractors mainly working for respective service buying organization in Sweden.

4.2.2 Ireland

The wood processing industry in Ireland consists of a number of large, medium and small sawmills with a wide geographical spread. In addition, there are three large panelboard plants; two owned by Coillte which produce MDF and OSB, and one plant producing MDF door skins (Fig. 8). Coillte dominates the industry providing the vast majority of roundwood to the processing sector – with over 76% supplied in 2017 –, and with the balance supplied by private forest owners (Knaggs and O’Driscoll, 2017).

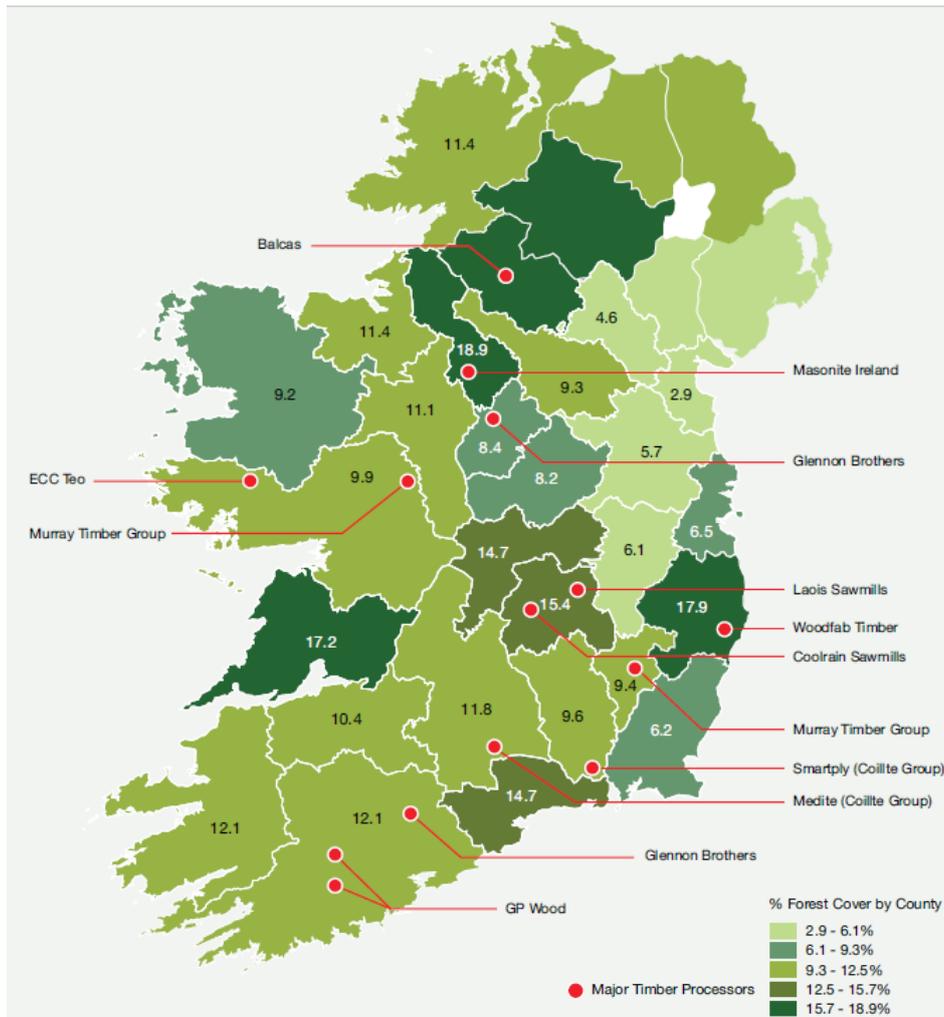


Figure 8. Major timber processing industries in Ireland (Forest Industries Ireland, 2018).

Harvesting operations in Ireland are almost entirely outsourced to harvesting contractors. The majority of contractors interviewed provide services nationwide to all Coillte, sawmills, and private forest owners. However, eight of the contractors considered Coillte as their main customer (53%), while six provided services mostly to sawmills (40%). One of the contractors was specialized in harvesting broadleaf and indicated that their only customers were private forest owners (7%) (Fig. 9; Table 7). It is expected an increase in business relations with private forest owners, as the forecasted increase of wood supply will from this sector. The number of customers per contractor ranged from 1 to 10 with an average of 4.4 customers.

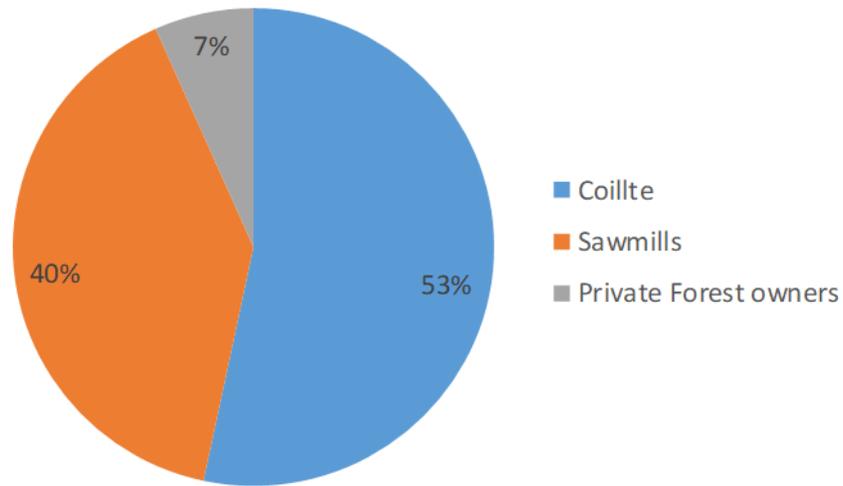


Figure 9. Main customer for the harvesting contractors interviewed.

Table 7. Number of customers per company interviewed.

	Coillte (semi-state)	Sawmills	Private forest owners	Total
Main customer	8	6	1	15
Secondary customer	5	6	4	15

4.2.3 Finland

The wood harvesting enterprises included in the interview data had 1 to 4 customers. For small-sized enterprises, other harvesting enterprises constituted the most important customer segment, while private forest industry companies, independent sawmills, forest management associations (FMAs) and Metsähallitus (state-owned forest enterprises) were typical customers of their prime contractors (Fig. 10). Metsähallitus and FMAs bought harvesting services especially from the medium-sized enterprises. Large-sized enterprises were prime contractors who had direct contracts with private forest industry companies or FMA, and they had in most cases several subcontractors. As the size of the enterprise grew, the number and diversity of customers increased, and the enterprises formed either formal or informal networks with each other. The contractors considered that there is no need for marketing since contracts are long-term, and during the contract period there is no capacity to serve other customers. In many cases the cooperation with a certain customer had continued for many decades.

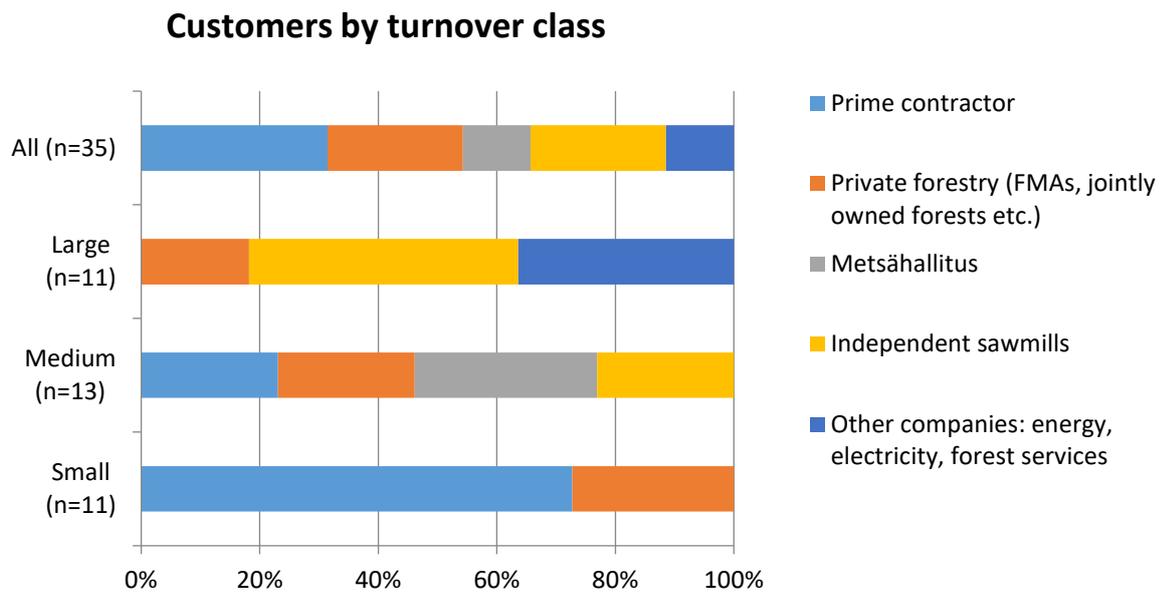


Figure 10. Type of customers in different sized wood harvesting enterprises in Finland.

4.2.4 Scotland

There was no information about customer base through the public registers, so information was gathered through interviews and an online survey. For the most part long-term contracts from the Forestry Commission (Scottish Forestry) were sought, as they were considered good employers that paid on time and contracts usually resulted in multiple years of work. Thus, it can also provide opportunities for capital investments. However, there are very few contractors equipped to take on jobs this size. Therefore, a small number of large contractors and private forestry companies compete for the same long-term contracts. Large private forestry companies normally keep an in-house staff or a list of approved contractors to cover their jobs, which limits other contractors competing for certain jobs and restricts the potential expansion of burgeoning companies. Types of contracts include long-term, medium-term, direct awards and tendering under frameworks and informal routes (most involving an element of competition and evaluation through price, feasibility and capacity). Most small to medium-sized contractors will bid for a range of jobs lasting from a few days to a few weeks under the Scottish public procurement system. The jobs will come from a mixture of private estate owners, community owned forests, NGO owned land, as well as government forests managed by the Forestry Commission. In Scotland, the private sector owns around one million hectares making them the majority forest owner.

Around 70% of contractors only worked within 90 minutes travel from their home. Thus, they travel home most days after the job or at the very least at weekends. Most contractors experienced that they could generate enough work within a 100 miles radius, or 90 minutes to 120 minutes travel time of their home.

Scotland has a clear-cut distinction between managerial and operational business streams with low involvement of forest owners. Private forest owners, apart from NGOs and community forestry, are usually not part of the typical clientele of contractors. Forest management (Tilhill/Scottish Woodlands) or rural land management (Galbriath, Bidwells and Bolts, etc.) companies employ harvest managers or timber sales managers, which oversee forest operations provided by contractors.

4.3 Machinery

4.3.1 Sweden

Larsson (2019) found that it is common among NPA area contractors to use large-size machines, as 54% of harvesters had a weight of 16 tonnes or more and 57% of forwarders had a maximum bearing capacity of 14 tonnes or more. The other machines were primarily of medium size (harvesters weighing 11–16 tonnes, forwarders’ bearing capacity 11–14 tonnes), and less than 10% were small-sized machines. The machines’ average age was 4.7 years for harvesters, and 5.7 years for forwarders. On average, a harvesting machine used by harvesting contractors for final felling produced 44 000 cubic meters of timber per year, and a forwarder (used in final felling) transported 45 000 cubic meters per year.

SE’s register contained information about possession of machinery for 731 companies, of which 663 had at least one machine. It was most common that contractors had one or two machines (Fig. 11), and this was the case both within and outside the NPA area.

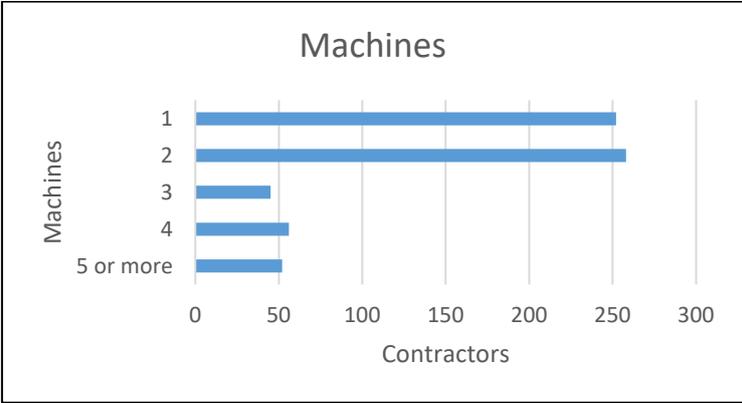


Figure 11. Number of machines per contractor in Sweden.

Most machines were owned by harvesting companies. Silvicultural companies with certification (n = 88) had on average 0.2 machines, ranging between 0 and 3 machines. For certified harvesting contractors (n = 703) the mean was 2.3. Contractors in the NPA area had on average fewer machines than those in other parts of the country (2.1 vs. 2.5). Those who had specified the type of machinery had on average 1.4 harvesters (n = 559) and 1.4 forwarders (n = 584). In addition, 54 contractors stated that they had excavators and 93 had other types of machines.

The balance sheet data available for contractors in the NPA area showed that the mean book value of machines and inventories in 2016 was approximately 409,000 euros for harvesting

contractors and 67,000 euros for silvicultural contractors (median values 312,000 and 25,000 euros, respectively). A negative trend was identified in the book value of machines and inventories (Fig. 12).

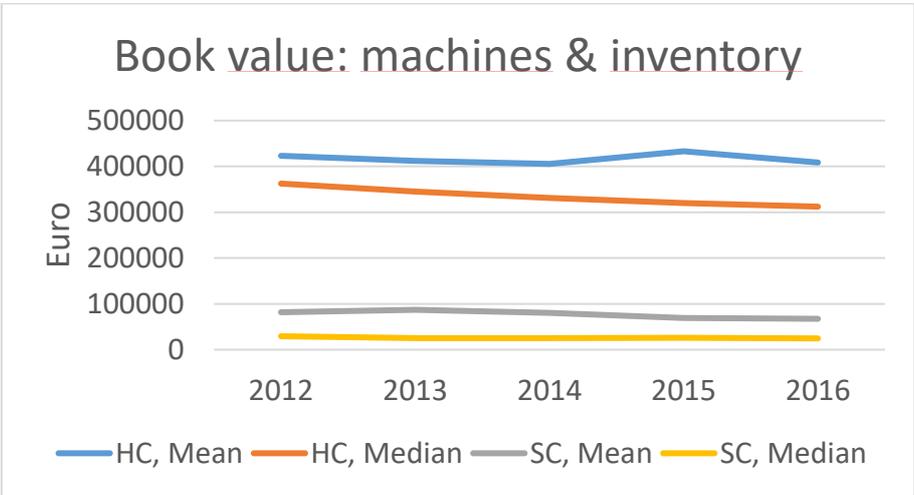


Figure 12. Book value for machines and inventory reported by contractors in Sweden for the period 2012–2016. HC = Harvesting contractor; SC = Silvicultural contractor.

4.3.2 Ireland

Up to the early 1990’s felling was mainly carried out with chainsaws. Manual felling is still an option in smaller plantations and where machine access is limited (Teagasc, 2018). However, currently more than 95% of Ireland’s forest harvesting is fully mechanized, using forest harvester and forwarding machines. There is not official public record on the number of machines used by harvesting contractors. Results from the interviews showed that one of the companies interviewed only used chainsaws as part of their operations (for broadleaf harvesting), while the equipment inventory for the rest of the companies varied from 1 to 22 harvesters and 1 to 23 forwarders (Fig. 13), with 45% of the companies owning 2 harvesters and 2 forwarders. One bundler and one cable yarding system were reported on the interviews, these are niche markets in Ireland. The main machinery brand acquired by the contractors are John Deere and Komatsu. The main reasons for choosing either of these brands were a strong commercial presence of the providers in their local area, as well as satisfaction with back up and the after-sales services. Other machinery included excavators, disc drenchers, a biomass bundler, and trucks for haulage.

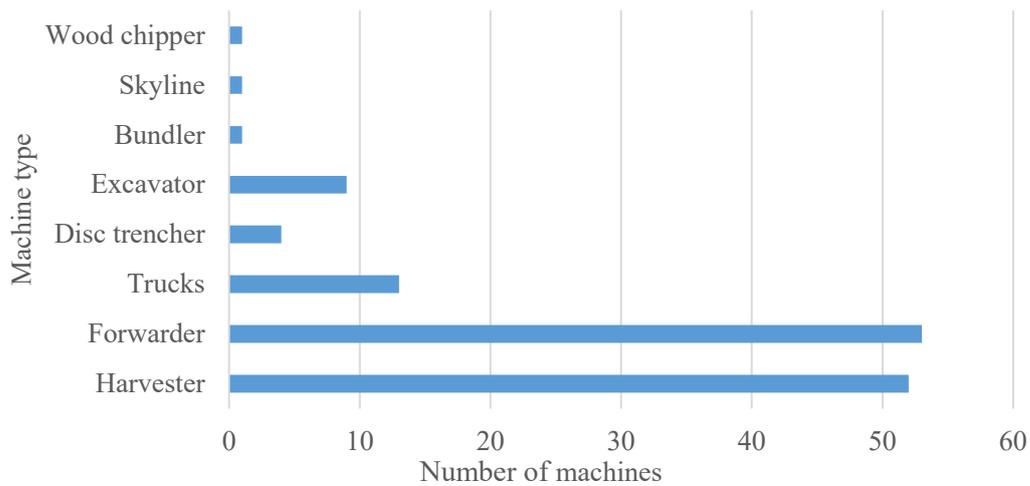


Figure 13. Number of forest machines for the 15 companies interviewed in Ireland.

4.3.3 Finland

Rummukainen (2018) estimated that in 2014 the average number of machines per enterprise in Finland was 2.6. More than half (56%) of Finnish wood harvesting enterprises had only one forest machine in 2017 (Fig. 14).

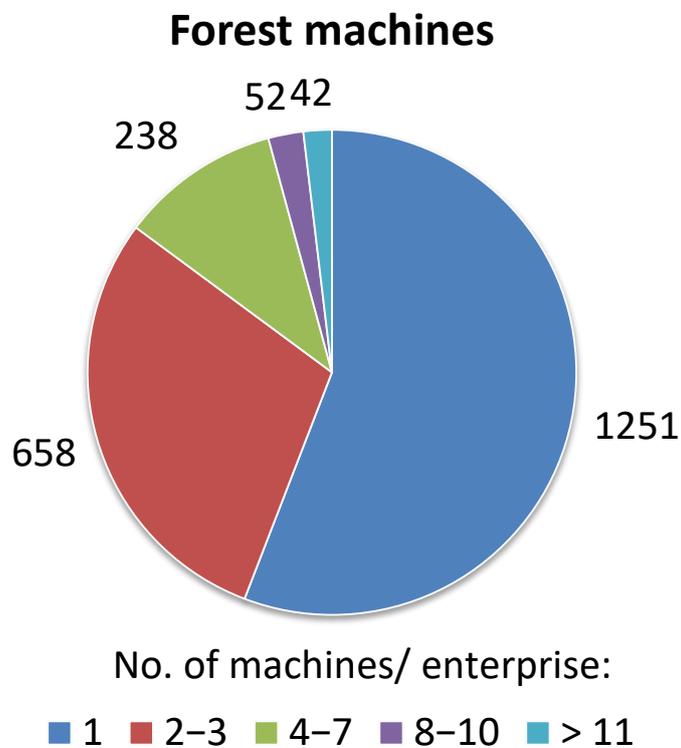


Figure 14. Number of forest machines per wood harvesting enterprise in Finland (Metsätrens 2018).

The number of machines is related to the size of the enterprise. In the interview data (n = 19), the smallest companies had only a couple of machines (including both harvesters and forwarders), while the largest ones had 10–15 machines (Table 8). The average age of harvesters was four years, and that of forwarders six years. The average number of annual operating hours (engine hours) was 2,900 hours for harvesters and 2,500 for forwarders. The smallest companies had older machines and the number of their operating hours was lower.

Table 8. Number of machines and personnel by company' turnover class in Finland.

	Small (n = 8), turnover < 500 000 euros	Medium (n = 7), turnover 500 000 – 2 mill. euros	Large (n = 4), turnover > 2 mill. Euros	All (n = 19)
Machines				
Harvesters				
Number	1–2	2–5	5–8	3
Mean age, a	6	3	4	4
Mean operating hours/a	2,600	2,900	3,100	2,900
Mean harvesting volume m ³ / a ¹⁾	39,000	42,000	45,000	42,000
Forwarders				
Number	0–2	2–4	5–6	3
Age, a	9	5	4	6
Mean operating hours/a	2,300	2,300	2,900	2,500
Personnel				
No. of personnel	3 (0–5)	10 (7–14)	16 (7–22)	8 (0– 22)
¹⁾ Solid over bark				

4.3.4 Scotland

A 2016 harvesting machine census stated that lowest respondent rate was from Scotland, which therefore was underrepresented in this area of UK forestry, as Scotland is one of the most active regions for forestry (Jones et al., 2017). In the machine census 62 harvesters were recorded whereas in the Scottish FOBIA survey 80 harvesters were recorded. However, this included two individuals owning 60 harvesters between them, and one respondent sub-contracted the harvesters. Contrary to this, 80 forwarders were recorded by the machine census and 71 by the FOBIA survey. Demonstrating that there is an almost matching forwarder presence to that of harvesters. Contractors had a lot of chainsaws and sprayers for felling and establishment work. Only one cable-yarder was noted in the survey, and four in the census. However, cable-yarding is a niche market in Scotland. Despite the steep terrain in many parts of the Highlands only two contractors are known to offer cable-yarding services. Only eight skidders were reported by the survey, while 14 were reported by the census.

Machine count

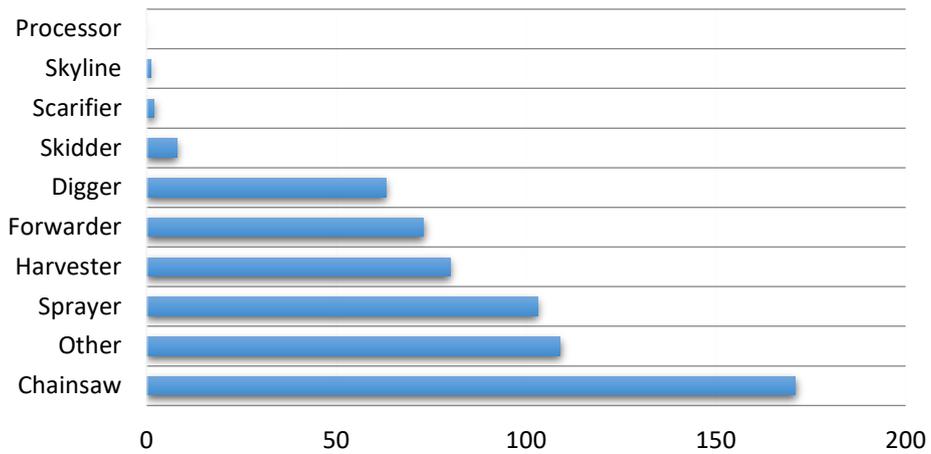


Figure 15. Machines used by contractors in Scotland.

Beside the normal equipment displayed above (Fig. 15), many contractors listed other equipment that is used and owned:

- Quad bikes
- Tractors with ploughing extensions
- ATV's
- Planting and fencing equipment
- Brushcutters
- Stump grinders
- Dendrometric analysis equipment
- Continuous moulder
- Bulldozers and other trucks

Contractor assets value

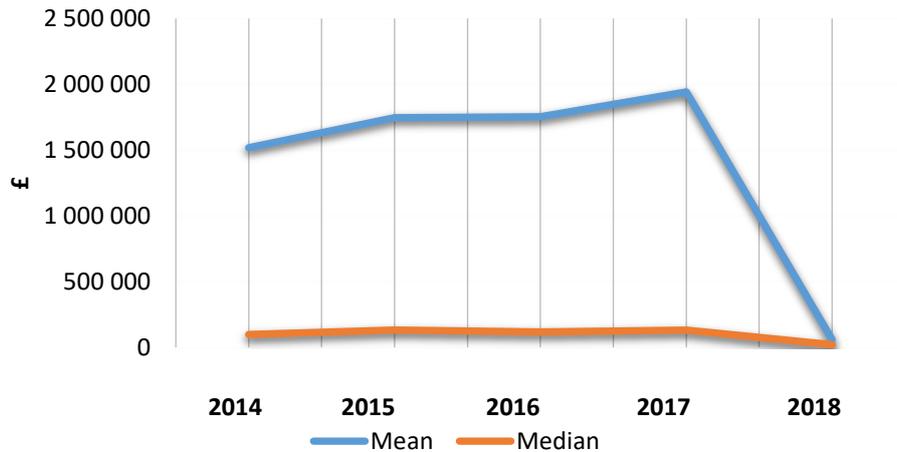


Figure 16. Value of contractors' assets in Scotland.

No direct costs attached to machines were calculated. From the public records yearly asset value was collected and both the mean and median of those values were calculated for the period 2014 – 18 (Fig. 16). The value of assets rises from 2014 and onwards and on average a 28% increase was recorded during the period 2014–2017. Year 2018 appears to be an outlier showing an almost 100% decrease, which indicates that financial information for this year had not been filed by the contractors at the time of data collection for this study. The median value shows a large deficit compared with the mean value, indicating a few contractors holding very large financial assets while the majority hover around the £100,000 – £200,000 area.

4.4 Personnel

4.4.1 Sweden

The forestry service contractors in the Swedish NPA area had on average 3.4 employees, and on national level it was 3.1. In SE's registers, harvesting companies had significantly more employees than silvicultural contractors in both categories. On the other hand, based on the financial statements of limited liability companies for 2016 the harvesting contractors had on average 4.8 and silvicultural contractors 6.7 employees. The differences might be related to seasonal variations or different reporting standards. According to Larsson (2019), the contractors primarily recruit local staff but silvicultural contractors also recruit from other EU-countries. This was the case in particular for contractors with a high number of employees.

Table 9. Average number of employees per contractor in Sweden.

Employees	SE register			Financial statement 2016		
	NPA	Non-NPA	Total	NPA	Non-NPA	Total
Harvesting contractor	4.2	3.6	3.9	5.0	4.6	4.8
Silvicultural contractor	0.6	0.5	0.5	5.9	7.7	6.7

4.4.2 Ireland

Based on the figures from the Company Registration Office, harvesting companies in Ireland are small- and medium-sized enterprises (SMEs). Most of the companies are family owned businesses with 2 to 45 employees (Fig. 17), all Irish, working full time and with ages ranging from 30 to 55 years (avg. 37 years). Approximately 10% of the personnel is female (Fig. 18), and the majority are family members (spouses, sisters and daughters). Their main role within the company is administration.

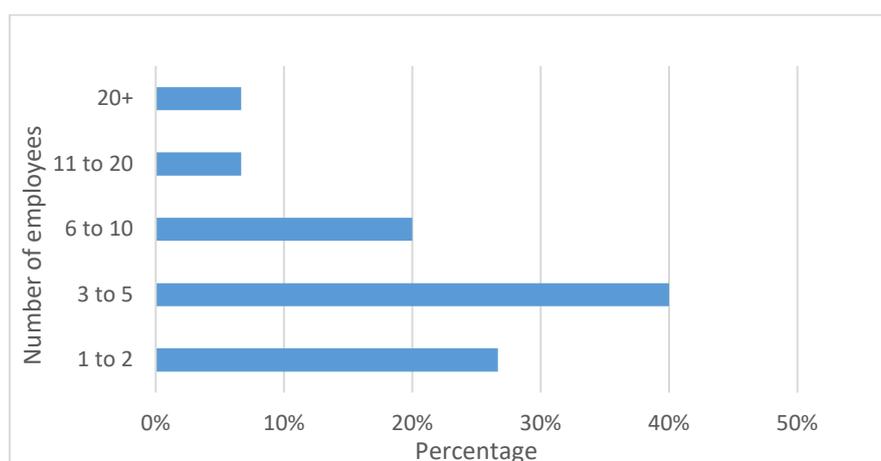


Figure 17. Number of employees per contractor in Ireland.

In Ireland, there is a low level of formal education for many harvester operatives and business owners in the industry. A common issue highlighted in the interviews was the lack of trained operators. Currently, there is one actor providing this training for forest operators.

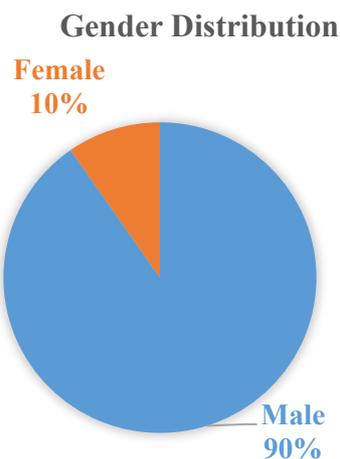


Figure 18. Gender representation on harvesting companies interviewed in Ireland

4.4.3 Finland

Among the interviewed companies, the number of employees varied from 0 to 22 (Table 8). In large enterprises a higher share of the employees had formal education for harvester or forwarder operator than in smaller enterprises. The lack of skilled and motivated employees was a common problem to all enterprises. The respondents found the skills of newly graduated operators inadequate for a professional harvester or forwarder operator.

Poor bearing capacity of terrain and forest roads often limit harvesting and access to the sites. High seasonal variation causes both overtime and lay-off periods. However, according to respondents, during the past couple of years there has not been much seasonal variation in Finland due to good weather conditions (dry summer, sufficiently frozen soil in winter) and high demand for roundwood.

4.4.4 Scotland

In the public registers of financial accounts only owners and managing directors of the companies were noted. These were usually between 1 to 3 persons, which often changed over the years. The majority of companies (51%) had between 3 and 10 employees (Fig. 19). 12% of the respondents stated that they had more than 50 employees, which was a surprising figure. This could be explained by a series of large enterprises including long-term subcontractors as employees. However, 15% of the survey respondents stated that they were self-employed and either worked as a sole trader or sub-contracted with another company.

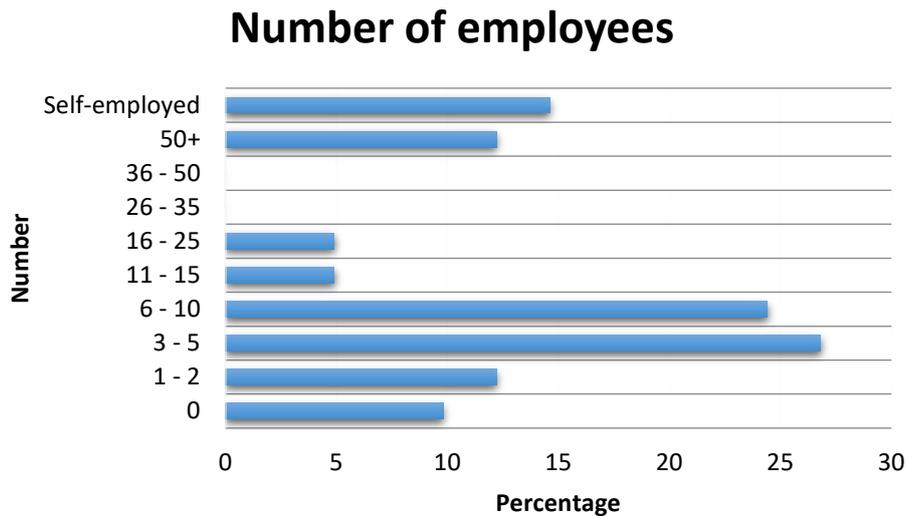


Figure 19. Number of employees per contractor in Scotland.

The interviews indicated that workforce availability is a common issue among large- to medium-sized contracting businesses. Self-employed machine operators seeking more favorable working conditions, in particular higher payment by tonne, were reported to change frequently between harvesting companies. These issues reflect a common sentiment in the south of Scotland that demand for harvesting services is sufficient. However, staff availability and retention is a major issue. Increasing wages for machine operators reduces the margins of contracting businesses and reduces their capacity for capital investment and thus long-term profitability. Average age of the survey respondents was between mid-late forties with the highest age group between 56-65 years-old (30%). 2% of all respondents were female and only two identified as another nationality (Canadian and Indian) than British/Scottish.

4.5 How services are priced

Pricing of services was found to be dependent on the customers' preferences and requirements. It was also related to service type. In Sweden, the two dominant pricing methods applied to harvesting services in the NPA area were based on piecework rates, either by mean stem size or through a calculation model (Larsson, 2019). With the latter method, the price is determined in a standardized way depending on mean stem volume and other factors affecting productivity (e.g. forwarding distance and terrain conditions). Piecework rates are usually applied also to silvicultural work contracts. For example, based on the area treated or the number of planted seedling. In the case of short-term contracts with private forest owners or small companies, pricing per assignment may be used. In specific cases, the contractors may price the service per working hour (Benjaminsson, 2018; Larsson, 2019).

In Finland, harvesting fares and annual volume are defined in the contract between the wood harvesting enterprise and its customer. The terms of contract are agreed in negotiations, or the price is based on competitive bidding. The latter applies especially for contracts with

Metsähallitus that is obliged to follow public procurement rules. The harvesting fare per cubic meter is determined according to type of harvest (e.g. clear cutting or thinning), mean stem volume and the distance from forest to roadside storage. In addition, the wood harvesting enterprises are paid hourly rate for some “extra” tasks, such as working in exceptional conditions.

Similar to the other NPA countries, contractors in Scotland will normally price a job by the mean stem measurement for standing timber with consideration given to site and any extraneous job factors. For example, terrain, remoteness, current infrastructure and distances for forwarding operations that would affect timeframes and efficiency. In addition, pricing may include retrofitting and building a bespoke machine to fit the purpose of the job to operate more safely and efficiently. Forest management contractors often work with single job pricing for a single piece of work (e.g. ground preparations, rhododendron removal and forest management planning). Planting contractors will normally price per seedling or at times on the entire job. The latter occurs especially when a job becomes multi-faceted, such as a multifunctional forest objective that requires planting of a range of species in specific areas. However, the pricing culture has often been described as “*a race to the bottom*” wherein contractors will intentionally try to undercut the cheapest possible price for the job to secure the work, even if lacking the capacity to complete the job at such a price. This often screens out contractors offering realistic and quality work plans and has a knock-on effect to the confidence, reputation and trust in the industry as a whole. This results in a lot of maneuvering by the contractors to anticipate outcomes that will secure the job rather than offering a feasible assessment and price. This culture is created by the economics that dominate job evaluation, so much so that any lower price will win a contract usually negating any past references, additionality for wider benefits including training of a younger workforce, well-planned and thorough job assessment. This is a direct response to the institutional structure created to sell contracts.

4.6 How services are sold

How contractors sell their services is to large extent dependent on the type of service and the type of customers they serve (Table 10). In Sweden, the harvesting contractors have usually long-term contracts with a duration of more than one year. The silvicultural contractors most frequently apply contracts for periods ranging between six months and one year, or sell services in the form of single assignments (Larsson, 2019).

Table 10. Contracts types applied by the contractors in Sweden (1 = not at all, 5 = exclusively) (Larsson 2019).

Contract length	Harvesting contractors	Silvicultural contractors
Single assignment	1.5	2.7
Less than 6 months	1.3	1.3
6 to 12 months	1.7	2.7
1 year	2.8	2.7
More than 1 year	3.1	2.1
Until further notice	2.3	1.4

According to Benjaminsson (2018), also harvesting contractors working for large forest companies in Finland and Ireland most often sell their services on long-term agreements by which customers guarantee the contractor an annual harvesting volume specified in cubic meters (Table 11). Scottish harvesting contractors also apply long-term contracts when dealing with larger customers. However, as contractors themselves often trade with timber their customers can agree to purchase a certain volume of roundwood that the contractor harvests in the customer's or other clients' forest. Silvicultural contractors may also work for single customers on long-term basis, but often the contracts are seasonal. However, when silvicultural contractors sell their services to private forest owners, which is common in Sweden and Finland, the contracts are usually made for single assignments.

Table 11. Common approaches for the sales of forestry services (Benjaminsson 2018; Larsson 2019).

Finland	Sweden
Long-term contracts (1-5 years)	Long-term contracts (1-5 years)
Single assignments (services to PFOs)	Single assignments (services to PFOs)
Ireland	Scotland
Long-term contracts (1-5 year)	Long-term contracts (for timber purchases)
Short-term contracts (smaller customers)	Tendering (single projects)

Tendering is commonly applied by customers in order to find the right service to the best market price. In most countries, customers apply this purchasing method primarily when they are to sign new long-term contracts. However, in Scotland tenders are also frequently used for single assignments (Benjaminsson, 2018).

In Ireland, timber can be sold standing, at the roadside or at the gate. On standing sales, timber is sold to a buyer (contractor/sawmill/boardmill) as standing trees in the forest at an agreed price per tonne prior to harvesting. In this case, the buyer is responsible for harvesting and delivery of the timber. In the case of roadside sales, the contractor delivers crosscut timber stacked to the roadside with an agreed price per tonne. The forest owner pays for harvesting to the contractor, and the buyer is responsible for removing the timber from the forest and for the haulage costs. This option requires a medium level of input by the forest owner – but entails additional upfront costs. On mill gate sales the buyer pays for the timber delivered to their yard or sawmill at an agree price per tonne. With this option organization, management and monitoring of a delivered sale is very intense as the forest owner or his/her manager undertakes all aspects from measurement and harvesting to haulage. It also entails high upfront costs to the forest owner. As the cost of harvesting falls to the forest owner and not the customer, timber sold at the roadside commands a higher price than timber sold standing (IFA, 2015; Forest Service Ireland, 2006). A percentage of the estimated value of the sale is commonly paid upfront as a deposit before felling begins. After this, payments may be made at regular intervals based on the volume of timber removed. In a sale by weight system, the weight of timber removed is based on records from the weighbridge at the processing plant.

In Scotland timber is also sold standing, roadside or at gate. As highlighted above the timber is normally bought per tonne, which is a key issue for contractors and British forestry. Not only does it deviate from normal practice around Europe and elsewhere, this approach distorts within the supply chain favoring those buying and processing the timber rather than those that cut the timber. Often contractors will not be paid for the job until the timber has been collected at roadside and weighed, between which a few days or more likely a few weeks may have passed. Depending on season and weather a significant amount of moisture content can be lost within a single week, therefore reducing the monetary value of the timber, job and contractor's services. For example, the recent peak in timber prices that has been expounded as extremely beneficial for the growth and development of the forestry industry will not impact or filter through to the contractors. They will continue the "race to the bottom" and any profit will usually be kept by the seller and buyer. The work carried out is mostly undertaken by medium and small and contracts are advertised in the Scottish Public Contracts website under the Scottish Public Procurement Framework. This web-based procurement system is one of the biggest challenges for contractors to navigate, understand and use effectively without wasting a lot of time and energy on applications. The complicated nature of the public procurement system prevents small to medium scale contractors from tendering. Therefore, forest management companies tender for large contracts, which are sub-contracted to the self-employed contractor base. The numerical prevalence of these practices is unrecorded. However, the interviews suggest that sub-contracting is standard practice in Scotland.

In circumventing the loss of profit through forest management overheads, Scottish contractors increasingly employ forest managers for tendering processes as evidenced by the interviews. Further, large contracting companies service their contracts through either employed staff using in-house machinery (see personnel section), or by contracting self-employed machine operators using either their own machines or provided machines. The division of managerial and operational streams of work may create a complicated net of management, contracting, and sub-contracting. For example, FC as a landowner contracts a forest management company for a large harvesting operation, which is further sub-contracted to a medium-size contracting business who further sub-contracts to self-employed machine operators.

4.7 Use of subcontractors

In Sweden, Larsson (2019) found that one out of five (21%) harvesting contractors buy forwarding services and 16% had performed forwarding as sub-contractors to other firms. Of those contractors who had reported the number of subcontractors in SE's registers (n = 1148), 12% had one, 3% had two, and 1% had between three to five subcontractors. Subcontractors were used mostly by harvesting contractors. In Finland, the smallest enterprises were typically working as subcontractors to larger enterprises providing both harvesting and forwarding services. Further, Finnish harvesting contractors increasingly subcontract silvicultural services as customers more often are demanding full-service agreements (Benjaminsson, 2018). In Sweden and Finland, it is also more common to have long-term agreements with subcontractors than in Scotland and Ireland.

Sub-contractors are also commonly used in Scotland and most of the survey respondents stated that sub-contractors were regularly used. Either to top-up the employee short-fall for bigger jobs, or for more specific task such as harvesting, planting or establishment work. A significant proportion of the respondents also stated that they used sub-contractors for every single job rather than employing people full-time and creating more strain on the business having to employees that might not work all the time. Sub-contractors were used regularly for harvesting, forwarding, motor-manual operations, excavation, civil engineering, planting, forest management, fencing and maintenance services. The median use of contractors from the survey was 12 annually but specific numbers ranging from 1 or 2 to over a hundred annually. As mentioned elsewhere in the report, sub-contracting is fundamentally the contracting culture of Scotland.

In Ireland, very few harvesting companies use sub-contractors. Only one of the respondents stated that his company sub-contract chain saw operators in certain occasions but not very often.

5 Status and development needs

5.1 Development

Contractors in Sweden identified the availability of skilled personnel, profitability of the services and challenges to achieve a good work situation (both number/size of contracts as well as work relationships with customers) as the main obstacles for their business development (Table 12). Of the 84 contractors who regarded availability of personnel an obstacle, more than 60% found the economy as an obstacle for their development. Further, almost one out of four contractors expressed concerns relating to their personal situation (e.g. lack of time or energy to work more, the family situation, or problems in finding someone to take over the business when they retire).

Table 12. Obstacles for business development expressed by Swedish contractors.

Obstacles for business development	Respondents	% of those who answered the question
Personnel	84	59.6
Economy (excl. availability to financing/loans)	82	58.2
Work situation (service demand & customer relationships)	50	35.5
Entrepreneur's personal situation (health, family, worktime, firm succession)	33	23.4
Employer responsibilities	24	17.0
Requirements from authorities, NGOs, certification schemes	22	15.6
Financing of investments	12	8.5
Machines/technology	8	5.7
Other (e.g. climate/weather, urbanization, private forest owners' knowledge about forestry)	13	9.2

Finnish harvesting contractors recognized the small size of their business, the lack of skilled employees, and the need for large investments as the major weaknesses. Inadequate size of an enterprise limits the acquisition of direct contracts with big customers, and therefore small enterprises are dependent on prime contractors. In these cases, some subcontractors feel that contracts are based on unilateral decisions or even dictation. In addition, unfair allocation of harvesting sites between the prime contractor and subcontractors was considered a problem. The competition among the contractors is mainly based on price, which makes in particular the success of small enterprises challenging. Small enterprises are vulnerable if something unexpected happens to the few employees or the sole entrepreneur, or if there are only few potential customers. Moreover, funding for investments has been easily available but contractors are unwilling to take big loans. Especially if there is no one who is willing to take over the business after retirement.

A major issue expressed by the Irish contractors was the lack of experienced operators. A forest harvesting training program was developed in 2016 by the Agriculture and Food Development Authority (Teagasc), but contractors with a small number of machines considered that their productivity and profitability would be negatively affected by recruiting operators who just finished the course. Other concerns expressed by the contractors include low profitability, and the long waiting times for the approval of felling license, which are granted by the Forest Service to the forest owners.

In Scotland contractors expressed a clear skills gap relating to finances and economics of businesses. Most notably, writing applications for tenders and Scottish procurement was the biggest skills gap. However, this creates a sub-contracting market for forest management contractors and agents who are often employed to handle these areas. In addition, identifying and accessing funding, which includes communication with banks, is described as a difficult

task and takes contractors outside their comfort zone. This is also the case for business skills and accountancy, as well as marketing. These skills are often seen as add-ons or outside the core skillset of a contractor. Technical skills are still perceived as core skills to be constantly developed and refined, including machine operations, planning and adaptable site knowledge. Leadership and management is a recognized skillset for many contractors, especially those that employ staff and interact with a range of other contractors. Still many admit to underestimating the need and importance of such skills, as they are not completely aware of their purpose and application until highlighted by external factors. Surprisingly, environmental regulation awareness, risk assessment, first aid and engineering skills were seen as less important skill gaps despite interviews identifying these skill areas as highly important for many contractors. This could be explained by the difference between self-employed contractors and those that managed employees and sub-contractors, as responsibilities and scope of operational thinking will vary.

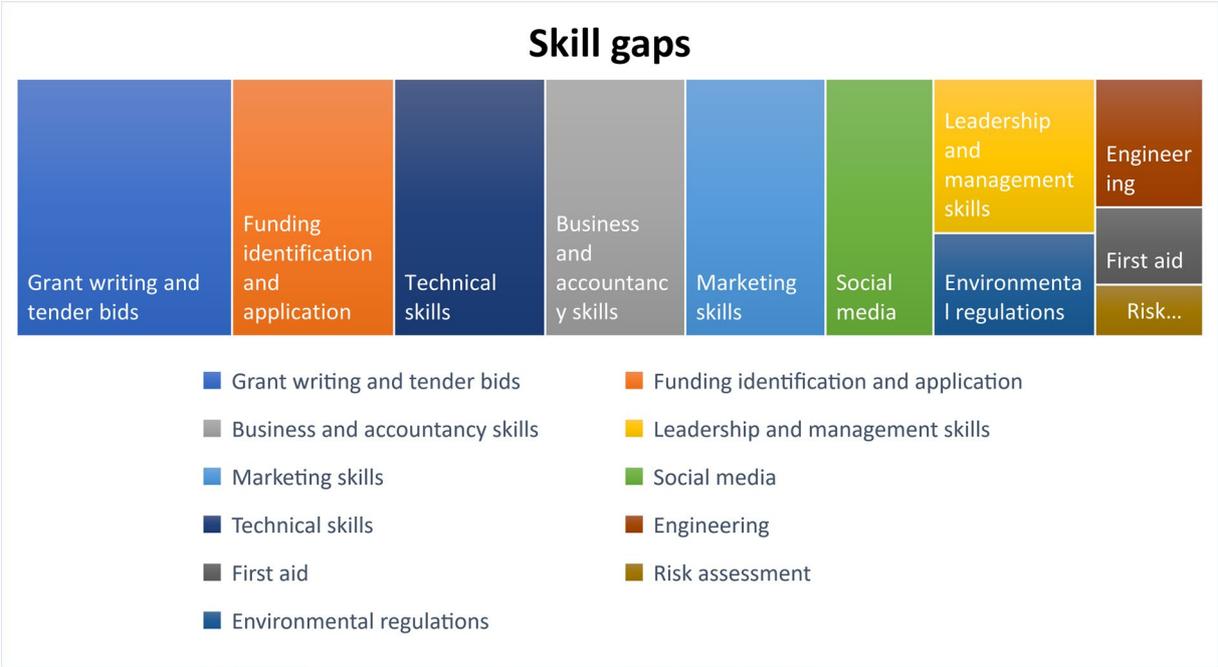


Figure 20. Most significant skills gaps in Scotland.

Many contractors further elaborated that the most important industry gap was the lack of operators. This has pushed up the price that the few “quality and reliable” operators can command. Further, some emphasized that tree planting has no funding and is the beginning of the timber development chain. Therefore more training, time and development should be dedicated in tree planting to add value to the rest of the supply chain. Additionally, many skills are being lost as forestry workers (both machine operators and planters) are moving into other sectors before knowledge is being captured and passed on to others. A minority believe that all the above factors are covered in the organic operation of small management companies. However, a few contractors mentioned that it is hard to find workers with a greater knowledge of forestry in general that can be applied through their work. GIS and surveying were highlighted as useful skills for all contractors, not only forest management contractors. Above

all, concerning skills, the message was loud and clear: tenders and procurement applications created the most difficulty across the board and all other skills were of medium importance. Furthermore, the factor that undermined all of these considerations was the declining number of operators and tree planters without whom the industry would cease to function.

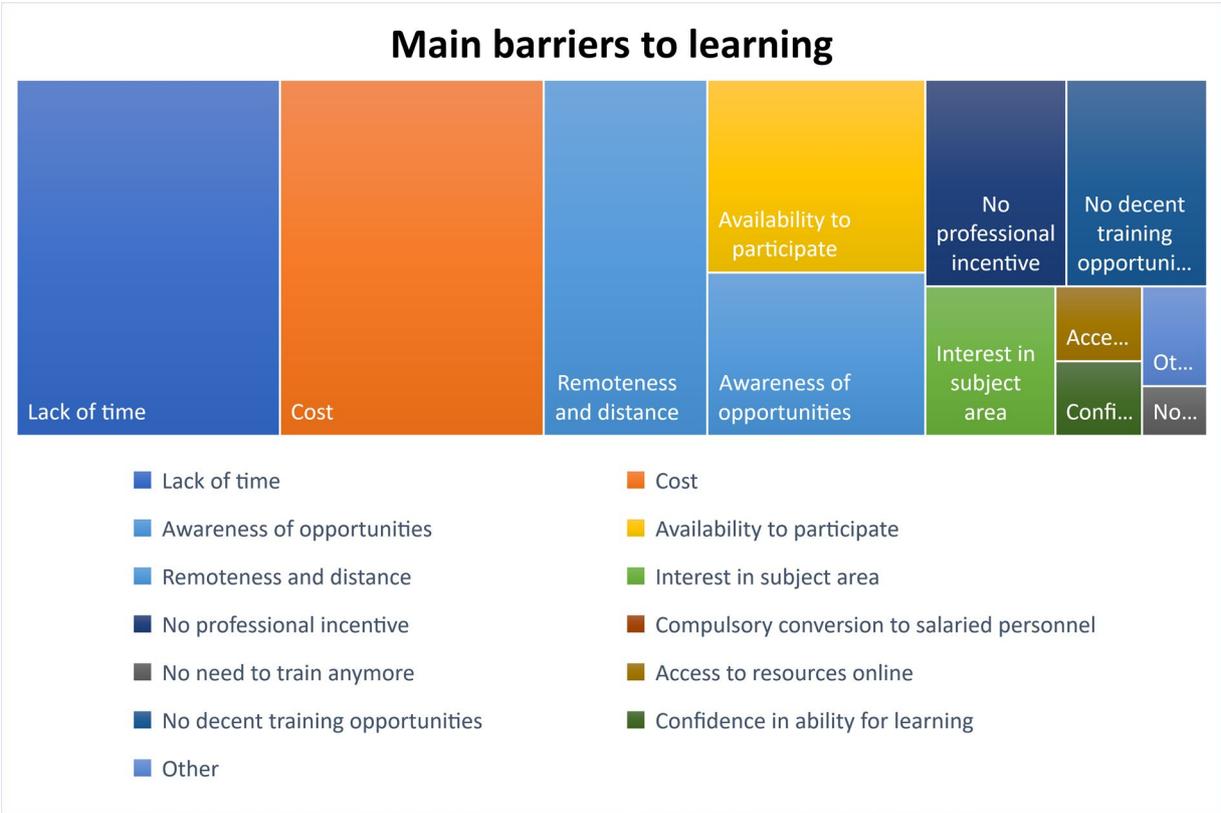


Figure 21. Main barriers to learning for contractors in Scotland.

Main barriers to learning were quite clear again with lack of time and cost. Costs are related to both the training itself and the loss of income through attendance and time spent on the learning activities. Remoteness and distance is the next limiting factor, which highlights the working hours and conditions of many contractors who work long hours in remote locations. Areas that not only has poor mobile and internet connection, but also restricts the individual’s ability to participate in any type of training in person. Awareness and existence of relevant training opportunities is the next limiting factor with most contractors unaware of specific training designed for contractors by contractors, as their preferred medium for learning is peer-to-peer, in-person and onsite. As highlighted by one of the interviewed contractors, there is no real professional incentive to enhance one’s skillset, no pay increase associated, no recognized accreditation or industry/colleague ”kudos” factor. Both confidence in ability and no need to train anymore due to professional competency and age, such as learning and knowledge barriers, were the least relevant barriers to learning.

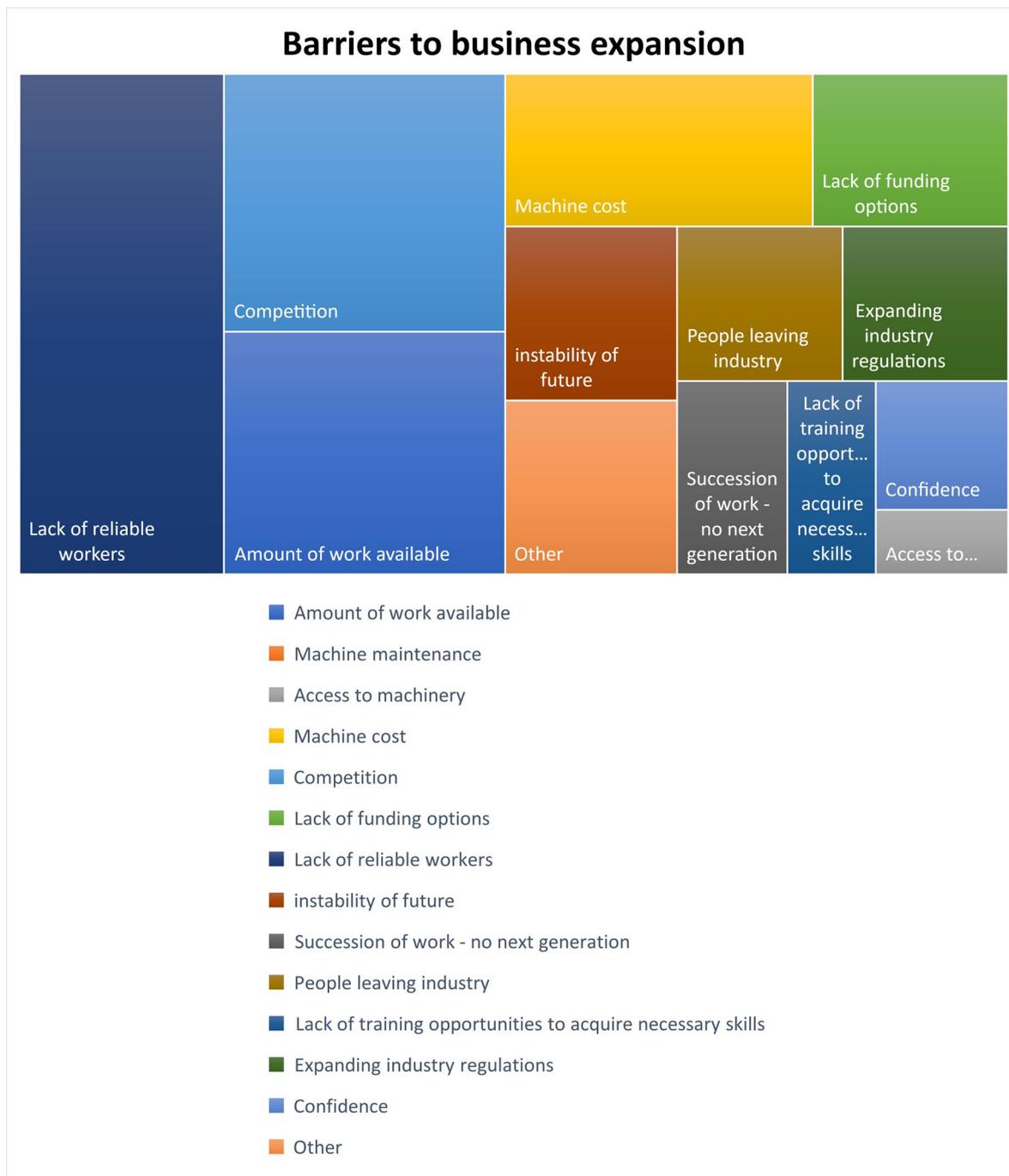


Figure 22. Main barriers to business growth for contractors in Scotland.

The lack of reliable workers was overwhelmingly perceived to be the main barrier to business expansion. This includes being able to trust workers to produce work, adapt and self-manage themselves where necessary. Amount of work available and competition were viewed as the second most likely barriers to business growth, followed by machine cost and lack of funding opportunities. These latter are inextricably linked to one another; the prohibitive costs of buying and maintaining forestry machines, especially for entrants and young operators, were considered as extremely challenging by some contractors. Several contractors highlighted the detrimental impact that the lack of funding has on the industry and one contractor expressed that "The mills and the estates get grants to buy machinery and plant, manage and tax relief

when the trees are sold. The contractors have never got any grants or financial help”. Access to machinery and lack of training opportunities were the lowest ranked barriers to business growth with only 2% of contractors considering these important. However, slightly more important are succession of workforce, people leaving the industry, increasing environmental regulations and instability of the future. Many of the concerns and barriers to growth from the perspective of contractors identify the underlying culture and institution of contracting that are both restrictive and undermined by disproportionate economics along the supply chain.

5.2 Economic status

5.2.1 Sweden

The Swedish contractors’ economic status was evaluated based on their financial statements for the period 2012–2016. In 2016, the average turnover for harvesting contractors in the NPA area was 693,000 euros (median 546,800 euros) and for silvicultural contractors 476,800 euros (median 315,600 euros). The turnovers were rather stable during the period (Fig. 23). In 2016, the median net profit margin was 2.1% for harvesting contractors and 3.2% for silvicultural contractors. However, approximately one out of four companies had a net result that was zero or negative. After dividing harvesting contractors into four groups based on the size of their turnover, it was found that the smallest enterprises (turnover < 250 000 euros) had the lowest profitability (0.8%). The two groups in the middle, turnover 250 – 500,000 and 500,000 – 800,000 euros, had the best profit margins: 2.6% and 3.2% respectively. The group with the largest firms (turnover > 800 000 euros) had a profit margin of 1.7%.

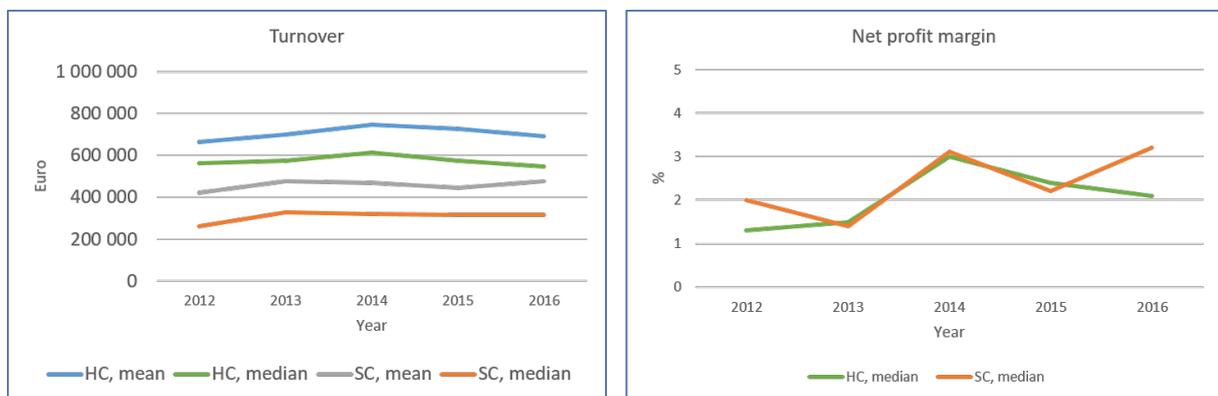


Figure 23. Turnover and net profit margin for contractors in the Swedish NPA area. HC = harvesting contractor; SC = Silvicultural contractor.

The contractors’ financial stability was investigated by calculating their liquidity and solidity ratios. Liquidity shows the firm’s short-term ability to pay for its liabilities. A liquidity ratio above one (or 100%) means that the liquid assets (cash and other assets that easily can be converted to cash) exceed the firm’s liabilities. If current liabilities exceed current assets (i.e. a ratio < 1), then the company may have problems meeting short-term obligations. However, a high liquidity ratio is not always good as it may indicate that the company is not utilizing its

cash efficiently (the business is holding cash that could be invested in areas that generate higher returns than a bank account or similar).

Solidity (equity ratio) shows how much of the firm’s assets that are funded with shareholders’ own capital. In Sweden, silvicultural contractors were found to have higher liquidity and solidity than harvesting contractors (Fig. 24). A slightly positive trend was identified in the contractors’ solidity, and in 2016 the median solidity for harvesting contractors was 33% and for silvicultural contractors 46%. The liquidity ratios for respective contractor categories were 1.1 and 2.0. Thus, on aggregate level the economic stability appear to be good. However, when investigating the four contractor groups based on turnover size, it was found that the largest harvesting firms only had a liquidity ratio of 0.9 in 2016 and that the ratio had been below one through the whole period.

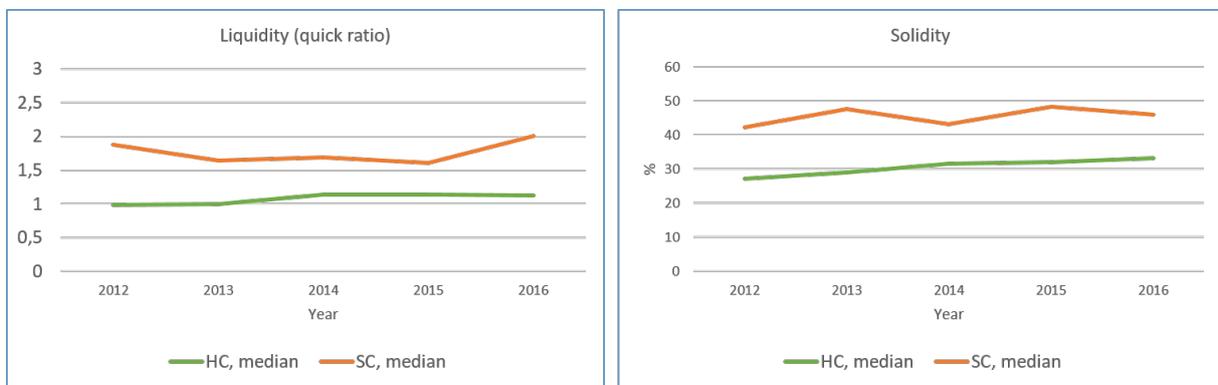


Figure 24. Liquidity and solidity of contractors in the Swedish NPA area. HC = harvesting contractor; SC = Silvicultural contractor.

Their profitability was also assessed based on the return on investment and return on equity. The silvicultural firms generated higher returns on both indicators (Fig. 25). In 2016, the median return on equity was 7.7% for harvesting companies and 12.0% for silvicultural companies. Their return on investment (own and borrowed capital) were 3.3 and 7%, respectively.



Figure 25. Return of investment and on equity for contractors in the Swedish NPA area. HC = harvesting contractor; SC = Silvicultural contractor.

5.2.2 Ireland

Depending on the size of the company, a variety of financial statements may be available from Irish harvesting contractors. All companies provide a balance sheet and income statement; while large companies may also provide the Company Registration Office with a cash flow statement as well as a stakeholder's equity statement. In this study, the profitability and solidity information of harvesting companies was not available. Therefore, balance sheets were the only financial information analyzed. With this information, the liquidity ratio was calculated in order to assess if the companies are in a comfortable position to cover its short-term debts (Fig. 26). As shown, the contractors with five years or less in the business had the poorest liquidity with a ratio below one. All other age categories were found to be on satisfactory levels.

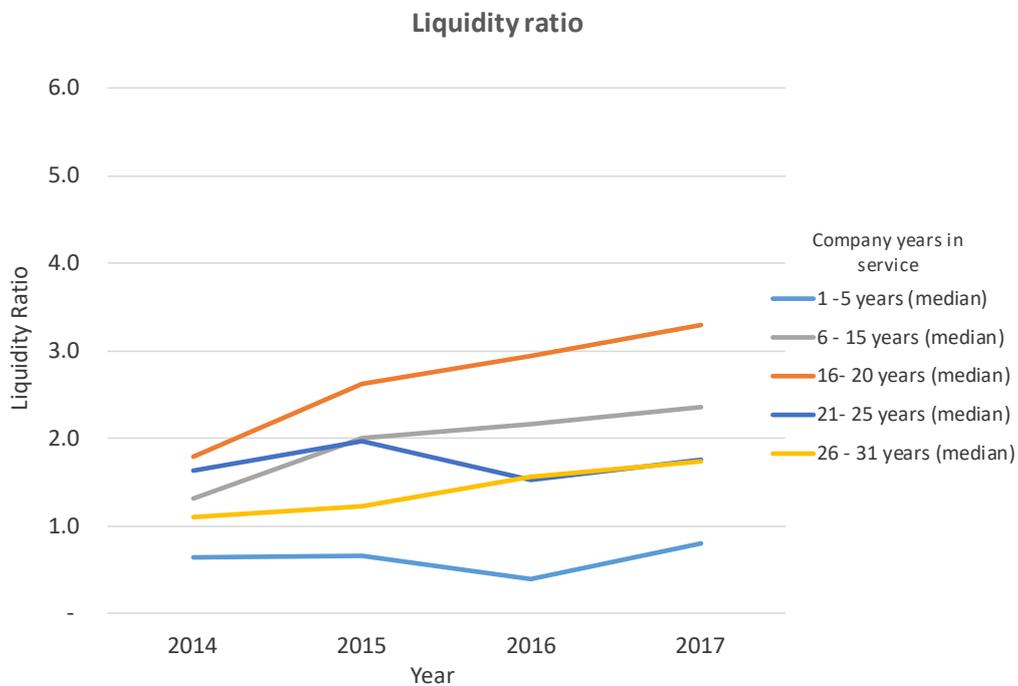


Figure 26. Liquidity ratio of Irish forestry service contractors per company age class.

5.2.3 Finland

The economic analysis of the Finnish wood harvesting enterprises was based on public financial statement data from the period 2012–2016, with the focus on profitability, solidity and liquidity. The economic status of the companies within wood harvesting branch (n = 1109) is summarized in Figure 27. However, some contractors may also run other businesses.

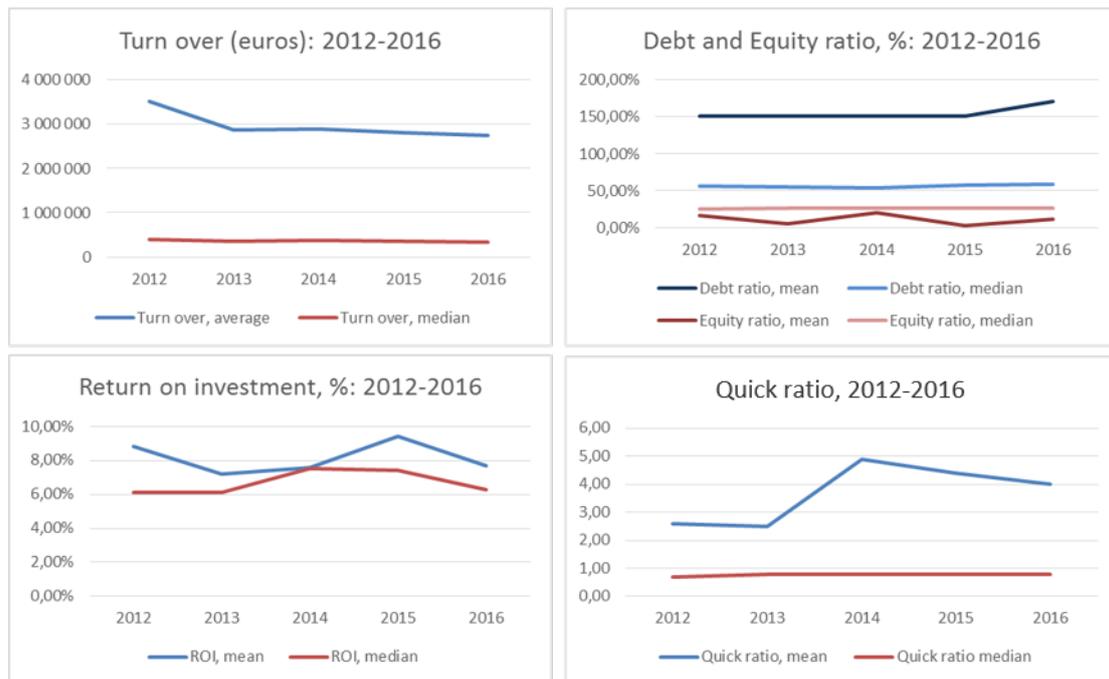


Figure 27. The economic performance of the Finnish wood harvesting companies located in the NPA area.

In a sample of 84 companies located in the NPA area, the turnover had increased only in the largest companies (G1 and G2) between 2012 and 2016 (Fig. 28). The overall profitability was on a satisfactory level based on return on investment (ROI), which was on average 7%. In groups G1 and G2 the profitability was on a good level (an average ROI 9% between 2012–2016), but especially the small companies (G4) were struggling with poor profitability and fluctuations in analyzed ratios.

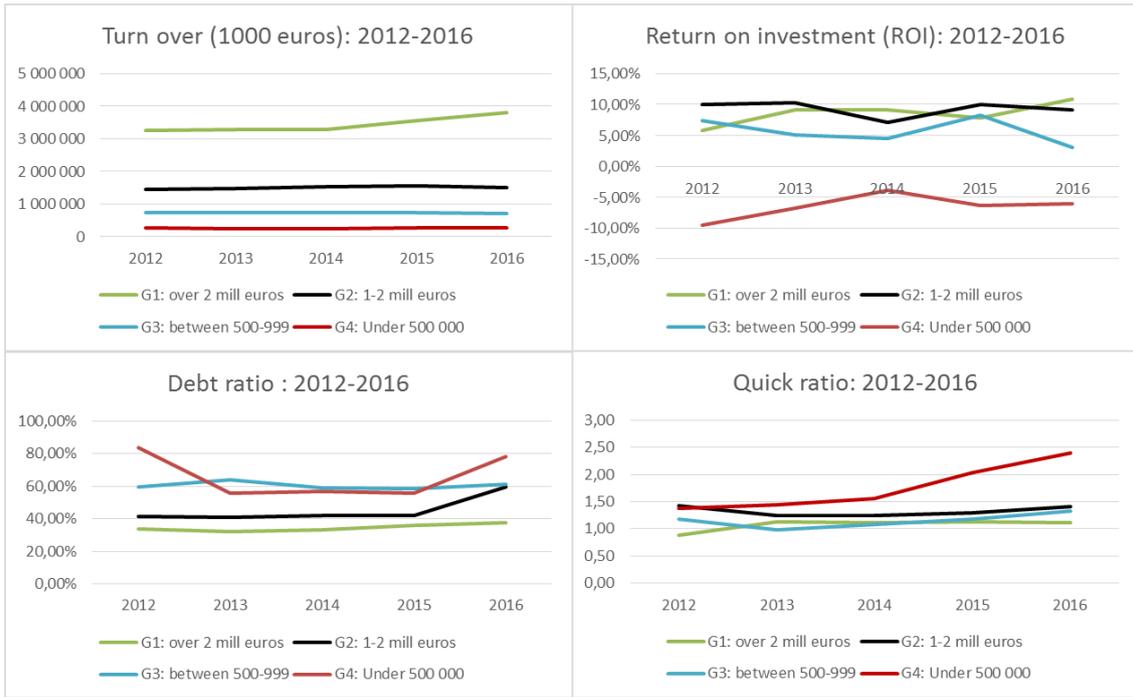


Figure 28. Economic figures for Finnish wood harvesting companies divided into four groups based on turnover ($n = 84$).

5.2.4 Scotland

Due to the lack of transparency of profit and loss accounts for contracting companies (except for four companies, which would not be a fair representation), data for economic status has been extrapolated from interviews and the survey (Fig. 29).

Distribution of profit percentages

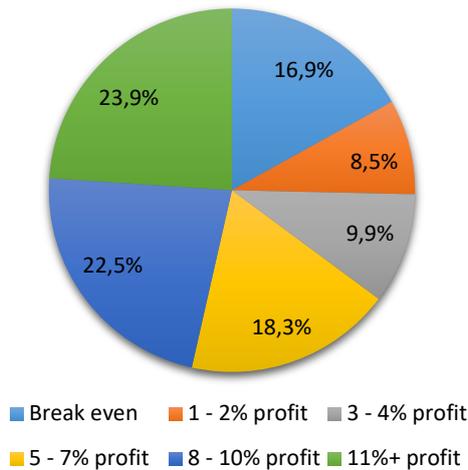


Figure 29. Distribution of profit margins for contractors in Scotland

Data captured by the survey indicated that 46.4% of contractors achieve over 8% profit and 36.3% achieve between 0 and 4% profit, with 18.3% achieving between 5 and 7% profit. During a presentation of these results to a range of industry experts and other contractors they admitted to be surprised, as these results appeared to put a very optimistic interpretation on current profitability of contracting. A greater number of profitable contractors may have been more inclined to respond to the survey, or the survey may have only reached certain segments of the contracting industry. For example, those more engaged with their email, websites, social media, and with a greater interest about the wider issues of the industry. During interviews, typical profitability was cited as around 4% (average) for contracting companies. Evidence gathered from the data mining of financial accounts demonstrated that in the last few years 14.5% of companies have stopped operating due to financial difficulty (Table 13). Surprisingly, there were 39.1% of companies without any financial information available, which meant only partial visibility of 43.8% of the industry to assess the status.

Table 13. Demonstration of business uncertainty in Scotland.

No longer in business	14.5%
Uncertain or business shift	2.5%
Currently operating with no financial information available	39.1%
Currently operating with financial information available	43.8%

Several contracting managers who were still profitable, and more of the successful side, stated that 7–8% annual profitability was required for a sustainable business. Even a very large contractor admitted that profitability was extremely vulnerable no matter the size and scale of business, as profits had been witnessed to drop from 12% to 4%, within a few years. Interestingly the contractor highlighted that the 12% year (and other profitable years) had been boosted by the abnormal amount of plant health felling orders placed on larch due to the spread of *Phytophthora ramorum*. However, this does not account for such a dramatic drop in profits. Other respondents in the survey supported this trend. Over 70% of respondents expected their income to increase over the next ten years although the majority were less certain about the growth of their profit margins.

6 Key similarities and differences between the countries

The key business model characteristics of forestry service enterprises in Finland, Sweden, Ireland and Scotland presented in this report show that there are several similarities between the countries, but also clear differences. To ensure as good comparability as possible between countries, the framework for business model characterization developed by Benjaminsson et al. (2019) guided the work process. However, due to cultural, legislative and other contextual differences it was not possible to apply the same data collection method in all countries. This implies that comparisons of some business model components are possible only on a general level. In addition, some results are based on interviews with a limited number of contractors

and may therefore not give a fully representative view of the specific business model component or market situation.

6.1 Business model characteristics

The results indicate clear similarities in contractors' service offers. In Sweden and Ireland, almost two out of three contractors offered harvesting services for final-felling or thinning operations. Also in Scotland harvesting services were the most commonly offered service, although it was only one out of four contractors that offered this service. Compared against Sweden, it was found that the share of Scottish contractors offering ground preparation and planting services was approximately twice as high. This could merely be an effect of sampling, but it could also indicate, for example, contractors' different degrees of specialization in the two countries or the current state of the forest landscape. In Finland the companies that offer harvesting services and other silvicultural services (planting, pre-commercial thinning, and other manual services) are typically separate companies, and in this case the sample was restricted to harvesting contractors. This implies that the distribution between harvesting and other services in the Finnish market could not be identified from the collected data. However, the number of forestry service enterprises identified by Suomen Metsäkeskus (2014) and Metsätrens (2017) suggests that the situation is similar to Sweden and Ireland, i.e. a clear majority of the firms is focusing on harvesting services. The results from Sweden and Scotland also indicate that there are no major differences in the service offers between contractors operating within or outside the NPA area.

The customer component of the business model was identified to include a few differences related to the contractors' local market situation. In Sweden, harvesting contractors of all sizes primarily work directly for forest industry companies and sawmills, and were often strongly dependent on one specific service buyer. In Finland, the results indicate that the type of customers served is to a higher extent connected to the size of the contractors' business. In Ireland, one single service buyer (Coillte) stands out as a very important customer for a large share of forestry service contractors. Based on the results of this study, contractors in Scotland seem to have the most diverse customer base. However, similar to Ireland the state, in this case through the Forestry Commission, was also here considered to be an attractive customer due to the stable economic terms and work conditions they offer to service providers. Still, this customer is only in reach for larger contracting firms that hold the necessary recourses for fulfilling all their requirements. In general, large enterprises can thus focus on serving a few large customer, while smaller contractors have a more diverse customer base.

An identified similarity between the markets is that contractors often serve customers within a rather small geographical area. In Scotland it was identified that contractor rarely take on assignments that are situated more than 1.5–2 hours from their home, which is in line with the operating radius Mäkinen (1997) reported for contractors in Finland. That contractor primarily sell their services to buyers in the local or regional market could also be identified in the results from Sweden, as the contractors' main customers to high extent were those forest industry companies that have the main share of their own forests and mills located in the same area.

Comparing the resources managed by contractors (machines and personnel) it was found that the firms are of similar sizes in all countries. In Scotland, about half of the contractors had zero to five employees, and less than a quarter of the firms had more than 10 employees. In Ireland, an even smaller share (13%) had more than ten employees. Further, firms with five or fewer employees were also here in a clear majority (almost 70%). This is also in line with the Swedish results, where the average number of employees was found to be five for harvesting contractors and seven for silvicultural contractors. Due to the nature of the sample, the Finnish results do not reveal the average or distribution for the whole sector. However, considering that a majority of wood harvesting enterprises only have one machine, it is likely that the structure is the same as in other countries. That is, there are a few large contractors but small firms dominate the forestry service industry.

Results from Ireland and Scotland shows that the business is still highly dominated by male workers. This is similar to the situation in other countries. In 2017, only 4% of the employees in Swedish forestry service enterprises were females (Swedish Forest Agency, 2018), and similarly in Finland the share of female workers in forestry was less than 10% (Natural Resources Institute Finland, 2019a). Thus, increasing the interest among females to work with forestry services should be a prioritized issue for the industry in order to increase the recruitment base. Further, as results show that contractors primarily recruit in their geographical proximity, a different recruitment strategy (e.g. widening the search area) may also be helpful. At least for the individual enterprise, although the pool of potential employees might remain the same on the industry/national level.

Just like in Finland, Swedish forest machine contractors predominantly have one or two machines. Further, the yearly production per harvesting machines (42,000 m³) and the age of the Finnish machines (four year for harvesters and six for forwarders) are also similar to harvesting machines in Sweden, where Larsson (2019) showed that the average production was 44,000 m³ per year, and the average age of harvesters and forwarders were 4.7 and 5.7 years respectively. The same study showed that the number of harvesters and forwarders had an almost one to one relationship in Sweden, which matches the presented results from Scotland, Ireland and Finland. Ireland deviated from the other countries concerning the average number of machines per contractor, which was twice as high as in Sweden. However, the figures may not be fully comparable as the study includes only 15 Irish harvesting contractors.

Regarding how services are priced and sold by contractors, a key similarity was that it is normally the timber buyer who determined which pricing methods that are applied. Contractors in all countries thus have limited possibility to come up with own sales or pricing methods. Further, in all countries long-term contracts is commonly applied by harvesting contractors, while silvicultural contractors have shorter contracts as their work is to higher extent seasonal. In addition, both public and private service buyers in all countries frequently apply tendering, which contributes to strong competition in the service market. However, Ireland and Scotland differs from the Nordic countries by having contractors that are paid according to the weight of the harvested timber. A practice that is non-existent for timber in Finland and Sweden, although chipped wood can either be paid by weight or volume. Hiring experts for accomplishing

tendering processes, which results indicates to be increasingly practiced in Scotland, is rarely done by contractors in Sweden (Larsson, 2019).

The results show that sub-contracting of services is common in all countries except Ireland. However, while it in Sweden mainly were harvesting contractors that bought or sold services to other contractors, the services traded in Finland and Scotland appears to be more diverse. Another difference that was found is how sub-contracting is organized. While sub-contractors in Scotland often are hired for single assignment rather than on long-term contracts, the latter is a more common practice in Finland and Sweden.

6.2 Development needs

In all countries, the availability of skilled and motivated personnel was identified as a major concern for contractors. Both for the enterprises' current operation, and in a long-term perspective as it limits the contractors' possibilities to develop their businesses and plan for the future of the firm. Further, as the results from Scotland show, it may not only be operators that need training, but also the business owners were identified to lack vital skills that affect their possibilities to secure new contracts and run the company efficiently. The results do not reveal whether the same applies to other countries. However, an indication of similar needs for more business education was identified in Sweden where contractor perceived customer relationships, firm economy and the demand for their services to be major obstacles. Thus, for example, the focus of the education could be on marketing activities or the construction of business proposals.

In addition, the business owner's personal situation and the responsibilities that need to be fulfilled as an employer were seen as significant hinders for business development in Sweden. Also Scottish contractors perceived that they were lacking time for personal development, and thereby also their business. However, while the availability of financing for investments was considered by Scottish contractors to be among the top five of barriers to business expansion, less than ten percent of the Swedish contractors mentioned this as one of the three most important issues for development. In both countries, and also in Finland, the low profitability of the business was considered problematic. Strong competition for contracts and the service procurement procedures applied by buyers were perceived to favor larger enterprises that have all the necessary resources and expertise for successfully completing both the tendering process as well as service delivery. For example, this was evident in the results from Finland where the large forest service enterprises to higher extent had direct contracts with the major forest companies while smaller contractors took the role as sub-contractors, which often leave the latter group in a weaker financial position.

The analyses of contractors' financial statements revealed that in Finland, Sweden and Ireland, many contractors have problems to keep the amount of cash and other liquid assets that equals the amount of their liabilities. That it was mainly larger (Sweden) and younger (Ireland) contracting enterprises that showed poor liquidity, indicates that it may be related to high investment costs. Poor liquidity increases the contractor's risk of bankruptcy as any unforeseen

disturbance in the operations, and thereby the cash flow, will immediately jeopardize the entire business. In addition, it decreases the contractors' ability to finance new investments and makes them more dependent on the good will of banks and other lenders to finance investments.

Comparisons between Finland and Sweden indicates that there is a relationship between harvesting contractors' business size and profitability, since in both countries the smallest firms had the poorest profitability. However, here it should be noted that the categorization was made with different turnover intervals, as Finnish harvesting enterprises in general were larger than in Sweden. Therefore, the weak profitability might to a higher extent be related to the enterprises' relative position and strength in the particular market rather than their actual business size. Still, when comparing the return on investments in the two countries, Finnish harvesting contractors generally generate a higher return. Concerning debt and equity ratios, no major differences could be identified.

As financial statements were not fully accessible in Ireland and Scotland it was hard to identify whether contractors in these countries perform better or worse in economic terms. However, considering the results of the interviews performed in Scotland it can be noted that also here a significant share of the firms struggle with their finances. The average profit margin was also perceived to be at similar levels as in Sweden and Finland, since 40% of the contractors reported to have a profit margin between 0 and 4%. It is also apparent that there are large differences between individual enterprises in the same country. In other words, some that are performing extremely well and some that fail to create a sustainable revenue.

7 Concluding remarks

The characterizations of business models applied by the forestry service contractors which have been presented in this report contributes to an increased understanding of the current situation of the industry, and its existing development needs. Based on the work undertaken for this report, some potential future trends have also been identified. This knowledge can be useful in the future innovation of new, and potentially more profitable, business models for forestry services. By highlighting the differences and similarities between the studied countries, of which some are pinpointed in Table 14, also the awareness that there are many who experience similar types of problems and needs can be raised among contractors and other important stakeholders. For example, one area that could be of special interest for future international collaborations is how to increase the visibility and attractiveness to find persons interested to work in this sector. Finally, it also shows the need and potential for more research into the area of forestry related business models.

Table 14. Key similarities, differences and future trends identified in the study

	Similarities	Differences	Future trends
Contractors' services	<ul style="list-style-type: none"> • Harvesting (final felling and thinning) is the most common service offer. • Concentration on either harvesting or silvicultural services most common (especially in Finland and Sweden). 	<ul style="list-style-type: none"> • Higher increase of planting contractors in Scotland • Lack of central representation for Scotland and Ireland 	<ul style="list-style-type: none"> • Increased thinning and adaptable machines
Customers	<ul style="list-style-type: none"> • Larger companies with fewer but very large contracts/customers. • Smaller contracts with a more diverse range and number of clients 	<ul style="list-style-type: none"> • Family forestry in Sweden and Finland (mainly direct customers of silvicultural services). • Large private estate forestry in Scotland 	<ul style="list-style-type: none"> • Large customers increasingly hire larger contractors, who in turn sub-contract smaller service providers
Machinery	<ul style="list-style-type: none"> • Use of mostly medium to large harvesters and forwarders. • High investment needs • Equal harvesting production per machine in Finland and Sweden 	<ul style="list-style-type: none"> • Scotland shifting toward smaller more versatile machines • Dominant use of chainsaws in Scotland and Ireland 	<ul style="list-style-type: none"> • Increasing diversification of machines
Personnel	<ul style="list-style-type: none"> • Aging workforce • Male dominated • Few contractors with > 10 employees • Difficult to recruit skilled workers 	<ul style="list-style-type: none"> • Swedish silvicultural contractors employ foreign workers to a higher extent than other groups in this study 	<ul style="list-style-type: none"> • Aging workforce – high competition in recruiting skilled operators
Services priced	<ul style="list-style-type: none"> • Customers determine pricing method • Piece work rates commonly applied 	<ul style="list-style-type: none"> • Tonnage (Ireland & Scotland) versus euros per cubic meter (Sweden & Finland) 	<ul style="list-style-type: none"> • Price pressure will continue to be high • No major shifts related to pricing methods are expected in the near future
Services sold	<ul style="list-style-type: none"> • Long-term contracts for harvesting • Short-term contracts for silvicultural services • Tendering 	<ul style="list-style-type: none"> • More explicit use of external expertise for tendering in Scotland 	<ul style="list-style-type: none"> • Increasing use of experts to handle tendering processes
Use of sub-contractors	<ul style="list-style-type: none"> • High rate of sub-contracting 	<ul style="list-style-type: none"> • The services that are sub-contracted 	<ul style="list-style-type: none"> • The trend to have large prime contractors who serve forest industry companies through smaller sub-contractors is likely to continue, and could also be spread to other countries (e.g. Sweden)
Development needs	<ul style="list-style-type: none"> • Lack of competent work force • Contractors experience a lack of time for development • Contractors worry about the future of their business (e.g. low profitability, insecurity about firm succession after their retirement, future work situation, etc.) 	<ul style="list-style-type: none"> • Availability/need of external funding for investments 	<ul style="list-style-type: none"> • Lack of operators increases the need for automation in harvesting operations • If few are willing to take over the enterprise after the current owners retirement, increasing consolidation of firms in the forestry service market • Increasing use of digital tools and services
Economic status	<ul style="list-style-type: none"> • Low profitability • Liquid funds are scarce for certain groups of contractors 	<ul style="list-style-type: none"> • Less transparent in Scotland and Ireland • Contractors are larger in Finland compared to Sweden 	<ul style="list-style-type: none"> • Decreasing productivity and decreasing work

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