DIGITAL SOLUTIONS IN THE FORESTRY SERVICE BUSINESS

State of the art report (Fobia project / Deliverable T3.1.1)

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This report will synthesise the results of the surveys made in Fobia project's partner countries. The data consists of digital inquiries and interviews made in Finland, Sweden, Scotland, and Ireland during January – October 2018. The results of the survey can be used in comparing the state of digitality among contractors in partner countries, as well as forecasting the development of the markets for digital solutions in trading and skills development among the SMEs running forestry service businesses. This report will be published in digital format, including interactive and video material.

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Background

The concept of *digital* describes electronic technology that generates, stores, and processes data in terms of two states: positive and non-positive. Positive is expressed or represented by the number 1 and non-positive by the number 0. Thus, data transmitted or stored with digital technology is expressed as a string of 0's and 1's. Each of these state digits is referred to as a bit (and a string of bits that a computer can address individually as a group is a byte). *Digitization* is the process of converting information into a digital format. (https://whatis.techtarget.com/definition/digital)

Digitality is used to mean the condition of living in a digital culture, derived from Nicholas Negroponte's book Being Digital in analogy with modernity and post-modernity.

What is then a *digital platform* by definition? There are several ways to describe digital platforms, two examples of definitions are presented below.

"Digital platforms refer to information technology systems upon which different actors — that is, users, service providers and other stakeholders across organizational boundaries — can carry out valued-adding activities in a multi-sided market environment governed by agreed boundary resources. Typically, these actors create, offer and maintain products and services that are complementary to one another. Platforms quintessentially lure and lock in various types of actors with their network effects and economic benefits." (https://www.etla.fi/wp-content/uploads/ETLA-Raportit-Reports-47.pdf)

According to another definition "A (digital) platform is a plug-and-play business model that allows multiple participants (producers and consumers) to connect to it, interact with each other and create and exchange value." (https://platformed.info/platform-stack/)

It has been estimated that the impact of digitalisation will continue to grow in the future. Obviously, the *platform economy* will have a remarkable effect on the competence of Finnish enterprises. Despite that, many of the enterprises have not yet taken digitality into their strategies. In Finland, there are plenty of opportunities to make use of the digital development, but the transfer to digital business models can arose fears among the enterprises. (Järvinen 2018)

In this study, we have used a wider definition for digital platforms, consisting of various *digital tools and applications* the forest service entrepreneurs use in their businesses for communication, marketing, management, knowledge transfer, networking, and cooperation. Thus, digital platforms include in this study, e.g. cellular phones and computers, virtual learning environments, various social media applications, data management, and applications of business economics.

This report is divided into three main chapters: one dealing with digital platforms among forest service enterprises, second chapter focusing on e-learning and virtual learning environments in the respective enterprises, and the third one handling utilisation of data driven from harvesting operations in managing forest service enterprises.

The study material consists of digital inquiries and interviews made in Finland, Sweden, Scotland, and Ireland during January – October 2018.

During 11/2017 – 1/2018 TTS interviewed eight experts representing Finnish forest service enterprising. Main objective of interviews was to collect views and opinions of digitalisation of forest

service businesses. Interviews were targeted to professionals related to forest service enterprises. These professionals included also local forest service entrepreneurs. The interviews were thematic in nature, handling mostly the above mentioned three themes.

Next a digital survey was launched in Finland, aiming at investigation of the digital skills and the use of digital services among Finnish forest service entrepreneurs. Moreover, the survey was targeted to find out the knowledge gaps in the enterprises, and the potential benefits of management training for the entrepreneurs. In a separate section of the survey, harvesting contractors were asked about usage of data derived from harvesting machines.

Third round in data collection was a survey among partner countries. The digital questionnaire was sent to the forest service entrepreneurs in Sweden, Scotland and Ireland. Relatively short questionnaire consisted of the analogical themes as the two preceding surveys. "Digitalization and use of machine data among forest service entrepreneurs" survey was implemented by asking respondents to express their views representing the state of this field in general.

Questionnaire was distributed in partner countries and in total 37 answers were collected, from which 24 from Ireland, 7 from Sweden and 5 from Scotland. Entrepreneurs and contractors represented 43 %, research / development / education-sector 30 % and administrative officers 19 % of respondents. Survey was carried out during late summer and early fall in 2018 by electronic inquiry (Annex 1).

Forest service enterprises in Finland

In Finland there are some 650 enterprises offering forest services. They are usually separated from harvesting enterprises, i.e. contractors, because they normally don't work with forest machines, but offer services based on manual work, such as manual planting, tending of seedling stands, pre-commercial thinnings, forest management planning and advisory services for landowners. Usually these enterprises have 0-10 employees, and small size often limits the development of their businesses.

There are approximately 2 200 harvesting enterprises in Finland. Despite the tendency to grow their businesses, these enterprises are still relatively small – up to 85 % of the enterprises have 1-3 harvesting machines. Despite the big investments in Finnish forest industries, and the increase in timber demand, the average profitability of harvesting enterprises has remained low. In 2017, the net profit of the median enterprise was 1,26 % of turnover which was alarmingly low. It seems that the historical profits of forest industries have passed by the Finnish harvesting enterprises. (Penttinen et. al. 2011)

Wood sourcing of forest industries has outsourced wood procurement tasks to harvesting enterprises, which enforces some of the enterprises to grow. In spite the increasing responsibilities the harvesting fees have not risen, and the profitability of these enterprises has often remained low.

Forest service enterprises in Sweden

In Sweden, there are approximately 3 600 contractors offering forestry services. Of these, 1 100 are contractors who only occasionally work in forestry (less than 25 % of their yearly work time)

and thus combine their operations with work in other sectors. The Swedish contractors are typically specialized on either harvesting or silvicultural services and about 60 % of the contractors are mainly working with harvesting services, 30 % work with silvicultural services and the remain 10 % perform a combination of services. Usually, these are one-man or small-sized enterprises with 1 to 4 employees. However, although large-size enterprises (with 9 employees or more) are few in numbers (less than 4 %), they employ a relatively large share of the persons working in forest contractors' firms (23 %). The larger firms are typically silvicultural contractors which is more dependent on manual labor, while harvesting contractors which have more mechanized operations typically are small-sized enterprises.

The main customers of harvesting services are forest enterprises and forest owners' associations, while silvicultural contractors also work directly for private forest owners. Private forest owners rarely buy harvesting services directly from contractors as this service is most often included in the deal with the timber buyer. (Häggström et al. 2013)

Forest service enterprises in Scotland

Forest service providers or contractors, as they are most commonly known, are separated into three main types in Scotland:

1. Establishment (ground preparation, planting and inputs)
2. Harvesting (machine operators including some manual cutting)
3. Forest Management (Planning and tendering)

Approximately 288 exist in Scotland, some of which include arborist or farming enterprises with diversified suite of services, 180 of these are members of the Forestry Contracting Association (FCA), however there is no common register for all contractors with associated business and financial information. The majority of these contractors are either self-employed or have between 1 – 10 employees but a relative high number of enterprises have in excess of 50 employees, which takes them out of the Small-medium business enterprise range (SME's). There is high dependence on sub-contractors and sole traders to perform many functions of forestry contractors from ground prep, planting, cutting (manual and machine) to management. Private owners are the main customers for a range of jobs however long-term Forestry Commission contracts are the most desirable.

In spite of high timber prices and growing recognition of forestry, as a key part of the national economy, contractors are seeing diminished profitability, averaging around 4% for the majority and 10 - 12% for the most successful enterprises. Some of these figures have seen a dramatic decline in the last two years to 1% profitability, which creates a precarious situation when conditions fluctuate from year-to-year inhibiting long-term planning and investment. However, optimism is relatively high that profits will rise in the next ten years due to increasing demand and diversified activities but many contractors are concerned that their businesses will be continuously under threat without any reprieve of stability – this can be mentally wearing. Larger profits are realised further down the supply chain toward the processing and end products, which stems from the system to pay upon tonnage received at collection rather than cubic metres cut. New public procurement system is a hindering factor for most contractors, as is the general process of tendering for contracts. Inordinate amount of time is spent developing tenders or forest management are contracted to perform this task at significant cost. An uncertain future awaits contractors in Scotland in the current climate of political upheaval and increasing competition from industries, such as renewable energy. Harvesting operators, and to a wider extent forestry con-

tractors, view themselves as underrepresented and marginalised both culturally and economically but at the core of their principles is a motivation to work in and shape future landscapes. (Bowditch 2019).

Forest service enterprises in Ireland

Ireland has an emerging forest state, the national forest covers 11% of the total land area, with over half (50.8%) of forests publicly owned and managed by Coillte Teoranta, a semi-state enterprise established since 1989. A substantial move to increase the level of afforestation by private landowners occurred in the 1980s and today, 49.2% of the forests are privately owned.

In response to the increase of private planting, the number of forestry services enterprises has increased significantly in recent years. There ae around 50 consultancy enterprises in Ireland providing private forest owners services such as grant application, insurance, forest establishment, forest management, forest road design and construction, etc.

Most sawmills, forest management enterprises as well as Coillte outsource the harvesting and transport operations. There are approximately 186 independent forest harvesting contractors in Ireland, and the scale of these businesses can be small, the majority of them are family run businesses that operate a small number of machines (1-3 machines). More than 95% of Ireland's forest harvesting fleet is fully mechanized, using modern forest harvester and forwarding machines. Most businesses have therefore made a significant investment to enter and remain working in the industry.

Currently, forest harvesting enterprises are facing different challenges: there is lack of an effective forestry contractors association that can provide support for business and professional development, as well as knowledge transfer. These enterprises require significant timber volumes in felling areas to justify their investment and the transfer of these specialised machines. Small, scattered and fragmented harvest areas, employment uncertainty and short-term contracts with customers, and the current contracting system impulses contractors to offer their services nationwide, incurring in high costs, which in turn limits their profitability.

Most of the private forests were planted over the past 20 years, consequently, many are now approaching thinning stage and the output from these woodlands is set to increase significantly in the coming years. However, there is also a lack of skilled machine operators and people interested in a career in the forestry harvesting and transportation sector, combined with a limited training capacity in Ireland. (Sosa 2019) https://www.teagasc.ie/media/website/crops/forestry/advice/Annual-Forest-Sector-Statistics-2017.pdf)

Digital platforms and applications in forest service businesses

Digitality according to expert interviews in Finland

Finnish experts stated that there's a need for a digital platform for service transactions among contractors. A platform that would include list of services and machinery available, enabling B to B communication and flexible trade of services within digital environment. There is demand for a true digital resource bank, which still would require personal contacts among entrepreneurs to work efficiently.

Some contractors in the Middle Finland offer joint services even today. According to experts, economy based on shared resources and co-creation of value is beneficial, but it needs new business models and an attitude change among contractors.

Are Finnish entrepreneurs prepared to the increasing demand of harvesting services? Some joint ventures have emerged, but the cooperation in the use of the equipment and machinery should in any case be intensified as demand for wood grows. Big investments in individual enterprises mean a substantial economic risk. There is still much to do in this field.

Digital marketing is needed already now, but skills for that are limited. Only few entrepreneurs have digital skills to plan and launch marketing in Internet – not to speak about social media. Marketing is an essential part of the enterprise image and PR. Not all the entrepreneurs realise that this is valid also for customers of their customers (i.e. entrepreneur is also a representative of the forest enterprise he/she contracts for). Digital marketing has also a growing role in recruiting skilled employees.

Social media is not yet popular in marketing, and few harvesting entrepreneurs even have homepages. Those using Face Book are more active, which is a necessity to be credible (regular postings and attendance).

For harvesting entrepreneurs, digitalisation has evolved through obligation: big customers have brought automatic measuring and machine data as compulsory operations. As a consequence, Finnish harvesting contractors have taken more steps in digitality compared to other types of contractors, e.g. in earth moving business.

In Finland, public access to nationwide forest resource data is open to all parties. This will bring a variety of digital applications in the market. Some of new applications will be targeted to professionals, and thus can add value to forest service entrepreneurs as well.

To summarise, true digitality is still a promise more than reality for most of the harvesting and forest service entrepreneurs. Already now and even more in the future, the customers will be in the distance from their properties, which forces the entrepreneurs to take serious steps in digital marketing and communication. Most digital services and applications can be outsourced, but it still leaves the responsibility for the entrepreneur to provide contents to applications.

Digitality and potential growth of enterprises (according to Finnish survey)

Ageing of entrepreneur and lack of skilled workers were the two main obstacles to enlarge the enterprises in the future. Approximately 16 % of respondents were planning to terminate their business during the next 5-10 years. Despite that, some 42 % of entrepreneurs were willing to grow their business in future. The main obstacles to growth of business were listed as age of the entrepreneur, lack of skilled employees, high costs of investments, and severe competition on prices.

When asked about the obstacles related to the use of digital tools, two major factors were mentioned: lack of time (43 %) and high costs of implementation (39 %). Other obstacles mentioned were lack of advisory services, complexity of digital tools, small business, and "mental laziness". Despite that, 27 % of respondents had not met any problems in applying digital tools. In addition, 30 % of entrepreneurs expressed that they had not had any benefit from digital tools. This is important fact if it reflects the low rate of utility of e.g. machine data, which in turn is the key factor in ICT based management among harvesting enterprises.

Most respondents used email daily, and many of them frequently used various media services, such as WhatsApp and Messenger (Figure 1). Moreover, the GIS applications were used by most entrepreneurs either daily or randomly. The respondent that were not engaged with these applications were usually over 50 years of age. One fifth of the respondents was not familiar with the applications using data from harvesters' measuring device, of them 63 % were aged over 50 years.

Applications of Customer Relationship Management were the least known among respondents. More than half of them didn't know those products at all, and only some 4 % used them daily. Remarkable observation of the stage of digitality among Finnish enterprises is that less than 15 % of the respondents had enterprise's web pages and digital billing in daily use.
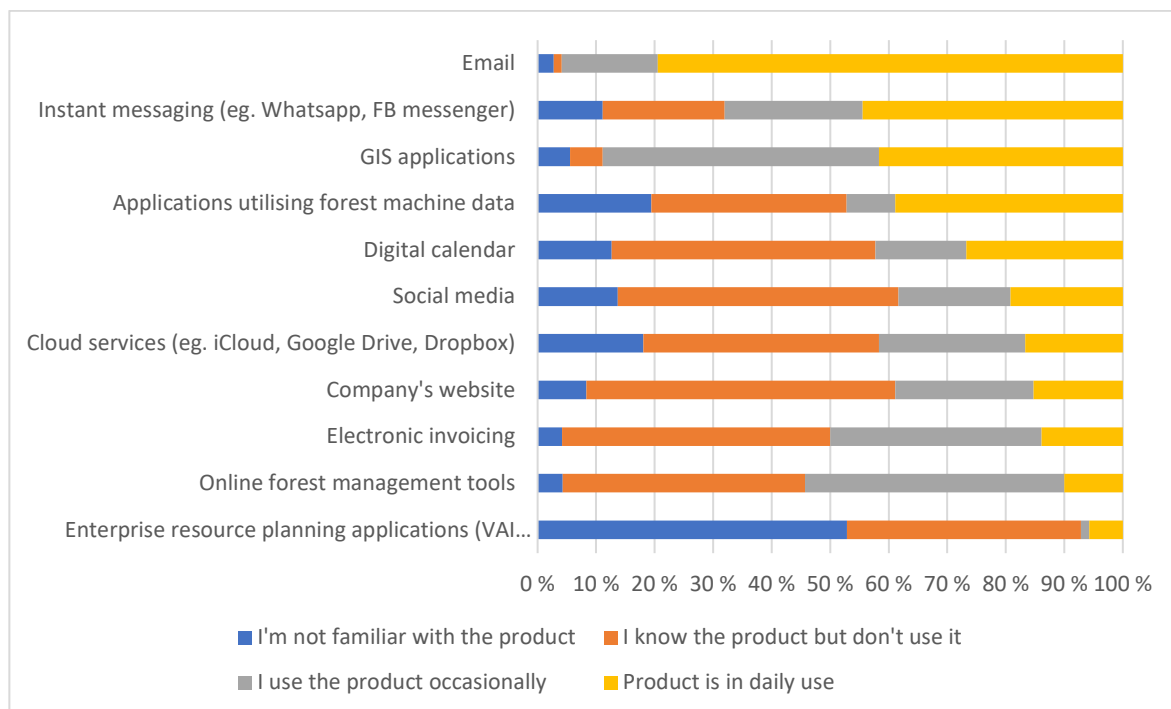
Figure 1. Identification and frequency of use of some digital services and applications among entrepreneurs.
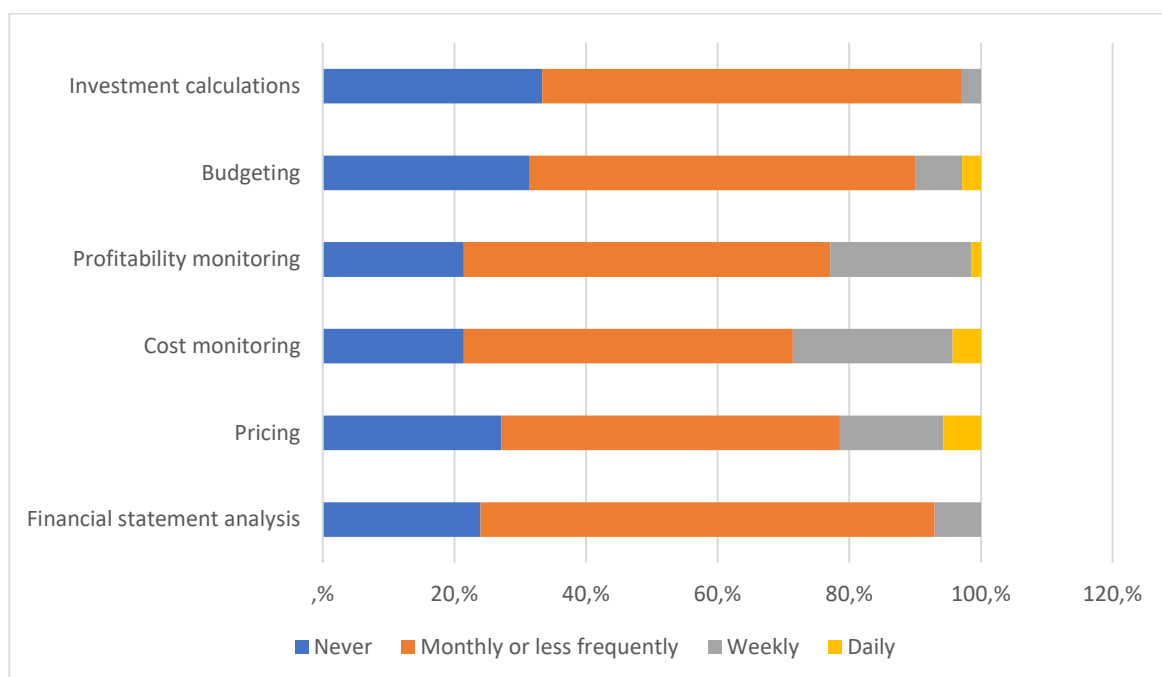

Figure 2. Use of various digital applications for financial management among Finnish entrepreneurs.

When asked about the use of digital applications for financial management (Figure 2), depending on application, 21 - 33 % of the respondents expressed that they never use such applications.

Digital solutions in the forestry service business

Most of those respondents were over 50 years of age. Most used activities in accounting applications were pricing, cost surveillance, and profitability monitoring – 16 - 24 % of entrepreneurs used them at least weekly.

In the future, the entrepreneurs will increase their use of digitalisation (60 %). Correspondingly 8 % of are not planning to intensify digitality in the future, and 32 % were uncertain about their thoughts of the forthcoming digitality (Figure 3). Entrepreneurs were willing to use more digital tools, particularly in general management (46 %), development of productivity and enterprise level performance (46 %), and documentation and mensuration of forest work (41 %).
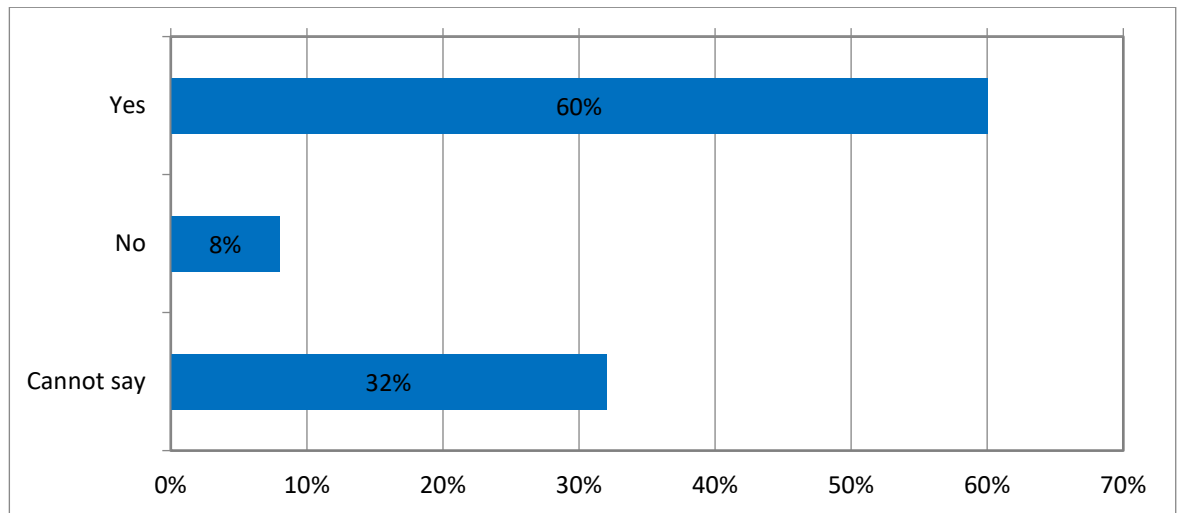
Figure 3. Entrepreneurs' intentions to utilise digitalisation more than currently within the next 1 – 3 years.

Digital platforms in survey to partner countries

In general, not many found that businesses in forestry sector are fully engaged with and use digital products and services. The distribution of replies with a scale 1 corresponding "not engaged at all" and 10 "fully engaged" is represented in Figure 4. Swedish respondents found the level of engagement being significantly higher (mean 6.4) than Scottish (mean 4) or Irish (mean 4.8).

Figure 4. Distribution of the answers for the question stated as "based on your experience, how well do businesses in the forestry sector engage with and make use of digital products and services?".
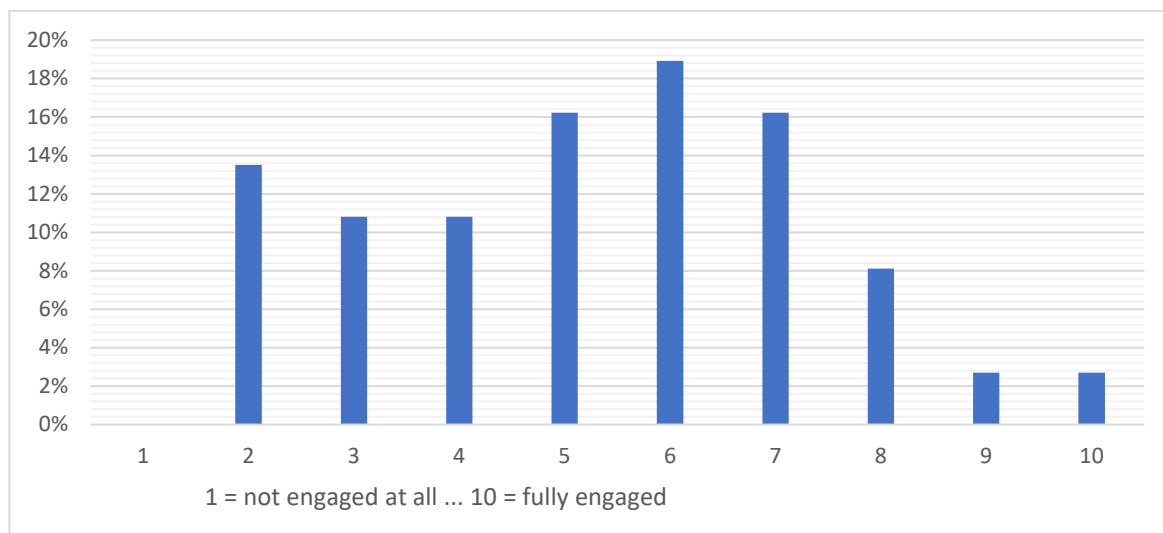
Among listed digital applications, emails were found very common in all countries in communication. Administrative software and applications using forest resource related spatial data were common as well. Countries differed what comes to utilization of machine data; all respondents from Sweden evaluated that machine data is commonly or very frequently used for collecting and evaluating operational efficiency data from harvesters and other machines. In Ireland 60 % and in Scotland 100 % replied that they see that machine data is used almost never or only sometimes by forest service entrepreneurs. Own website was not found as a standard communication channel since less than 40 % evaluated that it is at least "commonly" used by entrepreneurs in Sweden, Ireland and Scotland. In general, the lack of time and skill gaps were found the most important limiting factors for introducing new software, digital services and platforms.

For the open question on "How do you estimate that the significance of the digitalisation in business in forestry sector will develop in next 3 - 5 years in your country?" only one respondent was skeptical about the increase of the importance of the digitalization in Ireland. Respondents commented for example:

"It will increase in the coming years as it will be demanded by customers, especially for monitoring productivity. The remoteness of the business will make necessary to use digital technologies."

"It will become very significant as the use of ITC technology will become the norm, also in communicating with state and local authorities."

"Easier management of larger fleet of machinery. Forestry is all about time. It takes a long time to do anything. For classroom training purposes it is essential to educate new drivers in a classroom rather than a machine worth €250,000."

"The digitalisation will grow in the next 3-5 years. The limiting factor will be lack of skills and training to use effectively and the cost of establishing new technology."

"With the broader availability of online material to stakeholders it will aid greatly in educating people to the benefits of forestry."

In Scotland the attitude was somewhat less positive. Respondent reacted for example like in following quotes:

"Quite slowly, some will adopt it, others won't there is a general resistance to this type of learning and is hard to create something meaningful that can be maintained in a relevant manner."

"Acceptance of software such as maxi-fleet. Greater digitalisation uptake if broadband/4g services were better."

"Entirely dependent on the development of related business including state sector and the level to which infrastructure improvements support this development."
"slowly"

In Sweden respondents evaluated that the significance of digitalization will increase. One respondent underlined the increasing importance the cloud data management:

"More cloud-based interactions Higher spatial, spectral and temporal resolution on satellite images, more drones and better use of laser data. Better forest apps for mobile phones..."

E-learning and virtual learning environments

By definition, *e-learning* or "*electronic learning*" is an umbrella term that describes education using electronic devices and digital media. It encompasses everything from traditional classrooms that incorporate basic technology to online universities. E-learning in a traditional setting may include educational films and PowerPoint presentations. These types of media can provide students with content that is more dynamic and engaging than textbooks and a whiteboard. *Edutainment*, or content that is designed to be educational and entertaining, may be used to keep students' attention while providing knowledge about a particular topic. A documentary film, for example, may be both engaging and informative. (https://techterms.com/definition/e-learning)

Expert interviews in Finland

It was pointed out in the Finnish expert interviews that E-learning environments are part of the "unavoidable" future in skills training. Distance learning is efficient and flexible, but it does not – and it should not replace the human contacts and socialising provided by traditional class room teaching. Of special interest for entrepreneurs is to get acquainted with fellow entrepreneurs, and to create networks and receive peer support.

In the Finnish expert interviews, the following requests came up concerning e-learning and virtual learning environments:

Organisation and methods of training
- practical cases and examples of lines of business they represent
- personalised structure of studies, peer support, good motivation and a little pressure from coaches / teachers

- e-learning, recorded / streamed lectures and webinars are welcome as long as digital skills of students are sufficient
- tailored studies / efficiency and high hit-rate in training. Clear and concrete objectives ☐ increase motivation among students

Duration of studies
- short, one to two-day courses for important and topical themes
- tailored training that prepares for special degree and / or formulates a certain entity of themes, such as "Management training". These studies could last several months, combining e-learning and contact teaching.

Contents of courses
- remote sensing / GIS applications
- book keeping and financial management
- digital applications in forestry (e.g. forest resource management and planning)
- social media and digital visibility skills → motivated by customers' expectations
- homepage creation and management, ICT skills in general
- pricing, marketing, and legislation
- management and leadership, productivity in forest operations
- basic issues (e.g. how to calibrate and maintain measuring device) can be trained virtually → independent and repeated training, easy to update contents
- wood sourcing enterprises regularly use virtual training in operator / contractor skills updating

E-learning and virtual learning environments (according to Finnish survey)

In the Finnish survey, entrepreneurs were asked about knowledge gaps in their profession, and their opinions on e-learning and other learning methods. Figure 5 summarises the training needs by topic, expressed by respondents. Most frequently mentioned topics were development and surveillance of the productivity of harvesting (35 %), use of GIS information and data on forest resources (33 %), and enterprise level management and business development (34 %). Questions in other parts of the survey showed that 49 % of the entrepreneurs were interested to engage training on the use of machine data. On the other hand, 19 % of respondents announced that they were not interested in any kind of training.
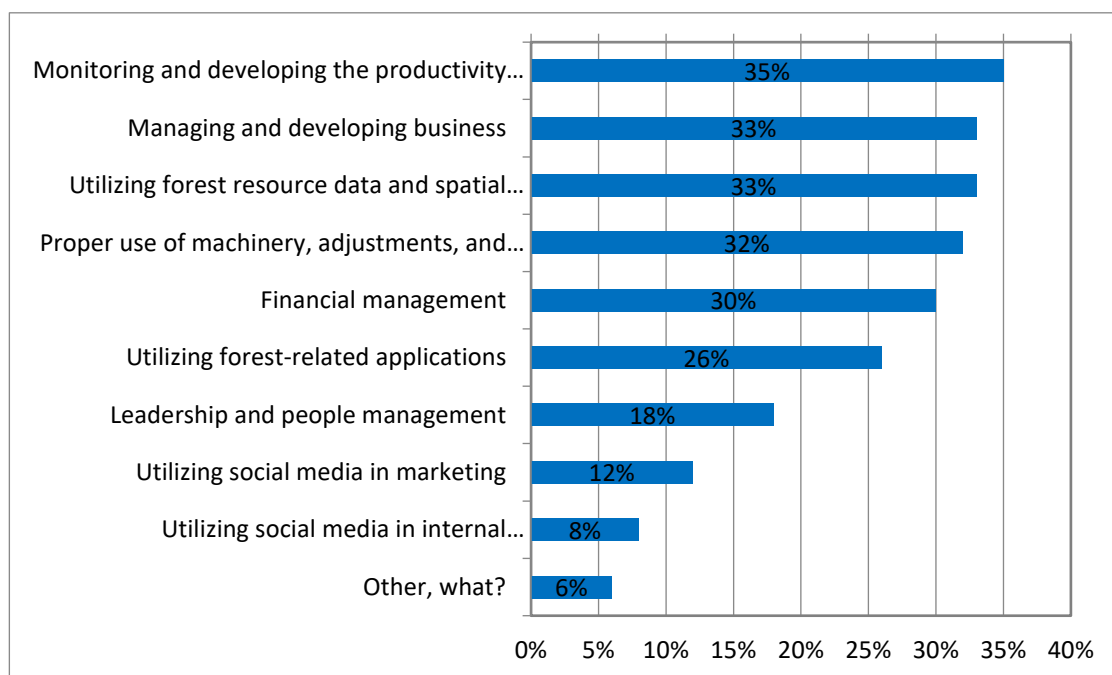
Figure 5. Professional training needs according to Finnish entrepreneurs.

The entrepreneurs were asked about the preferred learning methods. Blended learning (combining contact teaching and virtual learning) was estimated to be the most preferred method (55 %). Furthermore, traditional teaching in classroom was preferred by 39 % of respondents. One third of the entrepreneurs had experiences on virtual learning, and 29 % preferred it most.

Almost one third of the entrepreneurs had participated at least one training course. Topics mentioned were business management, leadership, forest certification, and wildlife management. Worth mentioning is that 55 % of the harvesting contractors had not participated in any training at all. Those participated were mainly satisfied with the training (78 %).

E-learning and virtual learning environments (survey to partners)

In all partner countries leadership and people management skills were placed high when asked to rank listed skills needed to expand and sustain forest service business. Moreover, productivity monitoring and development was found as an important skill. Irish respondent added "machine computer familiarity and competence" to the list of needed skills in question 8 (Annex 1).

Some respondents gave comments underlining the potential of the e-learning in improving the capabilities to benefit machine data, and business management skills in more general:

"For e-learning and digital applications to be used there needs to be a strong reason to engage in the first place and to keep coming back - this will not come from a static, repetitive, grey environment but from something interactive, dynamic and interesting. Something that fits into forest businesses schedules, something that comes from a voice they trust and want to listen to."

"E-learning could be very beneficial for upskilling"

"Levels of business and administration training availability are low in Ireland"

When asked to mention features in operating environment that limit the growth of forest service sector in their country, all Swedish respondents who answered referred to the challenge to find workforce. The same phenomenon was recognized in Scotland in addition which several respondents mentioned absence of relevant education. One respondent referred to, among other issues, Brexit:

"Amount of harvestable woodland and planting rates, mandatory contracts, health and safety, BREXIT".

Also in Ireland, the lack of skilled operators was the most common limiting factor mentioned. Especially in Ireland short contracts, excess bureaucracy and need of training and education was mentioned. In Ireland, several respondents also raised the failings in silviculture and general acceptance of forestry in their replies:

"Main obstacle is the low afforestation rate, as well as the fragmentation of forest ownership. Also, the only recently introduced proper training programme for machine operators is going to take time to impact on operator skills in relation to machine data."

"Operator training programs and funding for said programs. Planning legislation regarding forest road entrances. Overall attitude towards forestry from government bodies and residents of certain counties."

"Get younger people interested in the harvesting business."

"Understanding and acceptance of forestry from general public"

"There is a limited amount of land available new forest establishment. The work force there is few if any new entrance into the forestry work force. There will be shortage of workers in forest establishment, harvest machine operations and transportation. Current legislation is onerous and time consuming. Forest planning application have to made to one body and information passed to various other state bodies prior to approval. The general public have the right to object at various stages with frivolous objections with the appeals panel taking weeks to make a decision."

"There is a huge need for more people on the ground. As in a broader contractor base and also qualified foresters"

Utilisation of data driven from harvesting operations in managing forest service enterprises

The wood measuring device of modern harvester produces accurate data on trunks harvested. Besides that, harvesters record spatial information of their movements, and other parameters can be fed in the computer by the operator. These data are widely used, e.g. for payment of wood and labor, and for surveillance of harvesting operations. All machine manufacturers offer

fleet management software for entrepreneurs, and the major wood buyers use their own control systems for wood procurement. Despite all the development in ICT, the forest machine data is underused among harvesting entrepreneurs.

Opinions of Finnish experts on machine driven data are described in the following.

Utilizing information / managing with knowledge is a real problem. Entrepreneurs do not know how to use the information produced by a forest machine.

Operators' skills are varied - utilization of production data is needed to develop machine performance and productivity. For example, in one study operators could not take STM files from harvesting machine`s memory.

Advanced drivers can utilize machine driven data independently – this gives a competitive advantage if result based / incentive pay system is used.

Small enterprises would benefit clearly, if an easy-to-use interpreter / tool were created between machine data and acts of daily management.

Do enterprises have tools for data driven management? Unfortunately, they still much go with the gut feeling. A variety of tools for performance management is available, but they are seldom used in enterprises. For example, in tariff negotiations entrepreneur does not always have information needed to negotiate well-matched with customers.

Sufficient information is available on productivity and on the harvesting conditions. Instead, there is insufficient information on the costing. Machine data does not provide information on where the money is spent in operations. Moreover, the performance of data management and analysis will be critical in the future, while the amount of data and access to it have already been much solved.

Machine data can be used, e.g., as basis for incentive payment system. There are cases where main problem is not in the payment system itself, but more in leadership; some contractors are reluctant to set objectives for their operators – they may feel that they are interfering the operators work by being too curious of their performance level. In many cases these contractors operate the machines themselves, and thus feel more like members of their harvesting team than managers of their enterprise. This scene can be a major obstacle in developing operators' productivity.

Cost calculation can be great advance in negotiations - the client is also interested in cost structure in different operations. An example that take a few steps further is a harvesting enterprise who derives their own cross-cutting matrices and suggests them to their customer. **An example of joint value creation in practice!**

Latest machine data-based applications in Finland are WoodForce and LogForce. They utilise StanForD data and it is assumed that they will soon be largely in use in the biggest forest enterprises. The main advance of WoodForce / LogForce is that they are independent of forest enterprises' information systems, thus enabling multiple customers for one harvesting enterprise.

The new Databank service is being produced for timber harvesting enterprises. It allows the enterprise to monitor its own productivity figures and compare them to the average level of other enterprises that use the same service. The production of the Databank service is scheduled to commence at the beginning of 2018. Databank is produced by Trimble Ltd. and managed by Finnish Forest Contractors' Association.

Utilisation of machine data in managing forest service enterprises (according to the Finnish survey)

In the Finnish survey, the entrepreneurs were asked about the utilisation of data driven from harvesting machines.

One of the most important questions related to machine data is how important role the entrepreneurs consider that data plays in their business management. One fifth of the respondents considered machine data "very important", while half of them ranked the data "somewhat important", and almost one third of the entrepreneurs valued machine data to be "not important at all". This result may indicate that more than 30 % of respondents are not using machine data when managing their enterprises. This, in turn may be a consequence of lack of skills, time or suitable tools to handle machine data.

The entrepreneurs were asked about the uses of machine data and the commonness of the use of data in various purposes (Table 1). In addition to the purposes listed in the table, "accounting harvesting fees" and "billing" were mentioned.

Planning of harvesting was the most common use on daily basis (17 %). Machine maintenance and guidance to operators were the most often uses on weekly basis. The least used target for machine data was budgeting, 65 % of respondents never used data for that purpose. It can be concluded that the frequency of data use depends on the nature of the purpose it is used for. E.g., negotiations for harvesting fees often occur only once or twice a year, however the machine data is quite frequently used for that purpose. Furthermore, machine data is used quite often on weekly basis for forest machine maintenance, which helps to monitor and anticipate the needs for repairs and service.

Table 1. Uses and frequencies of machine data according to Finnish entrepreneurs

	Never used	Monthly or fewer use	Used weekly	Used daily
Budgeting	65 %	32 %	3 %	0 %
Negotiations on harvesting fees	41 %	54 %	3 %	3 %
Planning of harvesting	40 %	29 %	14 %	17 %
Resource management	40 %	43 %	9 %	9 %
Machine maintenance	40 %	34 %	21 %	5 %
Instruction of operators	46 %	26 %	23 %	6 %
Something else, what?	75 %	17 %	0 %	8 %

The use of various applications in managing machine data was relatively evenly distributed among applications. Woodforce ® was the most used application (31 %). Woodforce is a fleet management software that is independent from customers' ICT tools, and it is used simultaneously in several enterprises. Those respondents not using Woodforce had applied software offered by machine manufacturers such as

Ponsse (https://www.ponsse.com/products/information-systems/wood-procurement)
John Deere (https://www.deere.com/en/forestry/forestry-technology/jdlink-telematics/)
Komatsu (https://www.komatsuforest.co.uk/services/maxifleet

More information on fleet management applications, see Ovaskainen et al. (2017). Fleet Management software comparison Ponsse, Komatsu and John Deere. A comparison of characters of forest machines' Fleet Management softwares. (in Finnish). See also Kivilinna-Korhola (2016): https://www.theseus.fi/bitstream/handle/10024/115088/Kivilinna-Korhola_Tiina_2016.pdf?sequence=1&isAllowed=y (abstract in English).

Almost 20 % of respondents didn't use any application, which may refer to the entrepreneurs that expressed they are not using machine data at all in their business management. (Figure 6)
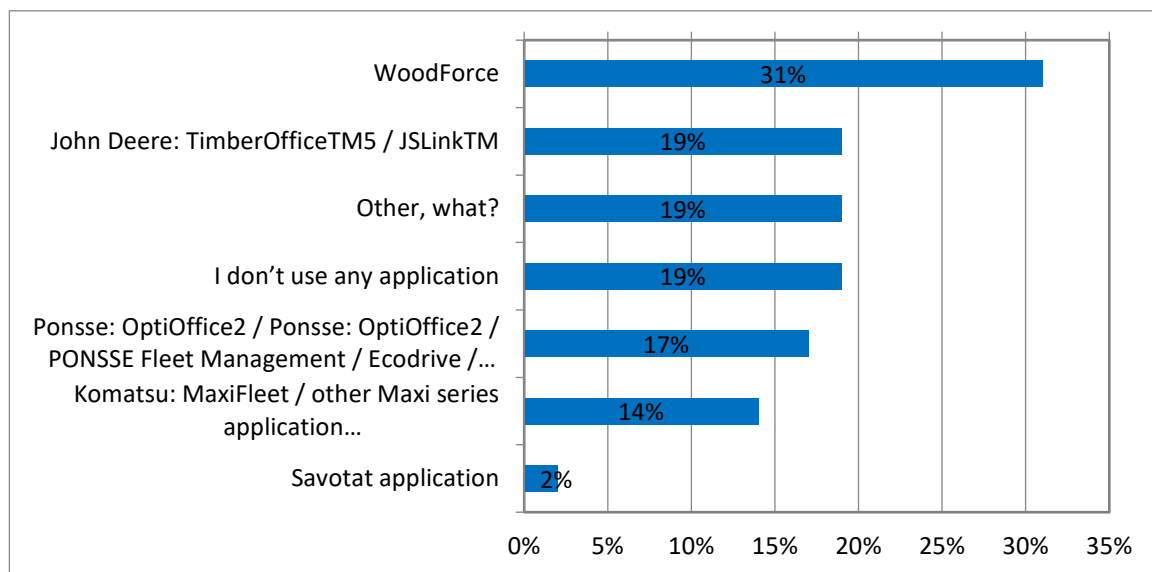
Figure 6. Machine data management applications used by Finnish entrepreneurs.

The entrepreneurs were quite unanimous about the ownership and user rights of the machine data. 90 % of respondents expressed that entrepreneurs were entitled to use the machine data. Part of the respondents reacted that user rights should be given to machine manufacturers and wood buyers as well. There was also given one verbal answer, according to which user rights should be reserved to entrepreneurs only. The recommendation for machine data ownership published in Finland was at least partly known to 53 % of the respondents.

Machine data – Use and level of know-how (according to partner survey)

When asked if they find that machine data is available to all entrepreneurs, majority of all the respondents either agreed or strongly agreed the statement (Table 2). However, in Ireland and especially in Scotland situation was not found that positive; in Ireland about 30 %, and in Scotland 40 % either disagreed or strongly disagreed that statement. The tendency was the same when asked whether machine data was utilized in their country. Further, all respondents in Scotland and more than 75 % in Ireland agreed the statement "There is a knowledge gap that restricts the use of forestry machine data". In Sweden, respectively, only 20 % found that there is a knowledge gap. The same difference was found when asked the availability of training for machine data utilization. In Sweden the training was found to be available, but in Ireland and Scotland the situation was quite opposite. Also, the use of fleet management applications offered by the machine manufacturers were found to be significantly more common in use in Sweden than in Ireland or Scotland.

Table 2. The distribution of the replies regarding the use of machine data.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Machine data is available to entrepreneurs	8%	16%	16%	**46%**	14%
Machine data is widely utilized among forest enterprises	14%	24%	16%	**38%**	8%
There is a knowledge gap that restricts the use of forestry machine data	3%	3%		**43%**	26%
Training is available for machine data utilization in your country	22%	**30%**	27%	19%	3%
Fleet management applications are widely used among contractors	3%	**32%**	46%	19%	%
Fleet management applications are considered to be expensive	3%	14%	43%	**35%**	5%
Fleet management applications are not adapted to the needs of the users	3%	3%	70%	**16%**	8%

Conclusions – questions and answers

What is today's state in digitality among forest service businesses?

Entrepreneurs in all partner countries responded positively to growth of digitality in forest service business in the future. Lack of digital skills, shortage of time, and sometimes lack of broadband data connections were seen as limiting factors in the development of digitality. The Scottish entrepreneurs were most sceptical towards fast digitalisation. Comments from them:

"Quite slowly, some will adopt it, others won't there is a general resistance to this type of learning and is hard to create something meaningful that can be maintained in a relevant manner."

"Acceptance of software such as maxi-fleet. Greater digitalisation uptake if broadband/4g services were better."

"Entirely dependent on the development of related business including state sector and the level to which infrastructure improvements support this development."
"slowly"

The Swedish respondents were more positive to digitalisation. In a citation below, some specific developments of digital services are listed:

"*More cloud-based interactions Higher spatial, spectral and temporal resolution on satellite images, more drones and better use of laser data. Better forest apps for mobile phones...*"

Finnish experts pointed out that harvesting contractors have been pioneers of digitalisation because they have had to follow their main customers' claims for e.g. automatic timber measuring and machine data extraction. Despite this, experts say that true digitality is still a promise more than reality for most of the harvesting and forest service entrepreneurs. In near future, the customers will be more active in Internet, and use mobile tools to acquire services. Forest service entrepreneurs must be responsive to this change and take remarkable steps in digital marketing and communication.

What are the major obstacles in digitality among forest service enterprises?

According to Finnish entrepreneurs, lack of time and high costs of implementation are the major obstacles in engaging with digital platforms and services. Other obstacles mentioned were lack of advisory services, complexity of digital tools, limited resources of small enterprises, and "mental laziness". Many of the expressed obstacles may be conquered by offering suitable training and advice for the entrepreneurs.

Despite the shortcomings in engaging with digitality, it is remarkable that 27 % of the respondents had not met any problems in applying digital tools. In addition, 30 % of the entrepreneurs expressed that they had not had any benefit from digital tools. This may reflect the low rate of utilisation of, e.g., machine data in business management, which was observed in one third of the enterprises.

The above mentioned facts at least somewhat apply to partner countries as well — in general, the lack of time and skill gaps were found the most important limiting factors for introducing new software, digital services and platforms. The Swedish, Scottish and Irish entrepreneurs estimated that their engagement with digitality varied from 4,0 – 6,4 on a scale of 1 – 10. Majority of the entrepreneurs were willing to increase the role of digitality in future.

What are the major knowledge gaps among entrepreneurs; what kind of training they prefer?

The most urgent knowledge gaps among Finnish entrepreneurs were "development and surveillance of the productivity of harvesting", "use of GIS information and data on forest resources", and "enterprise level management and business development". It was also found out that almost half of the entrepreneurs were interested in training on the use of machine data.

Productivity of harvesting operations and enterprise management dominated the training needs, which is logical in striving towards profitable business. Nevertheless, training is not the answer for all entrepreneurs, for one fifth of the respondents announced that they were not interested in any kind of training.

Finnish experts stressed that distance learning is efficient and flexible, but it does not – and it should not replace the human contacts and socialising provided by traditional class room teaching. This refers strongly to blended learning techniques.

Blended learning (combining contact teaching and virtual learning) was estimated to be the most preferred method among Finnish entrepreneurs. Traditional teaching in classroom was preferred by 39 % of respondents. One third of the entrepreneurs had experiences on virtual learning, and 29 % preferred it most. It seems that a variety of learning methods should be applied in training, applying them according to customer needs and type of the training events. Virtual learning is already quite popular, and it is likely to increase in the future.

In all partner countries leadership and people management skills were placed high when asked to rank listed skills needed to expand and sustain forest service business. Moreover, productivity monitoring and development was found as an important skill.

Some respondents gave comments underlining the potential of the e-learning in improving the capabilities to benefit machine data, and business management skills in more general:

"For e-learning and digital applications to be used there needs to be a strong reason to engage in the first place and to keep coming back - this will not come from a static, repetitive, grey environment but from something interactive, dynamic and interesting. Something that fits into forest businesses schedules, something that comes from a voice they trust and want to listen to."

"E-learning could be very beneficial for upskilling"

"Levels of business and administration training availability are low in Ireland"

What is the role of machine data in business management of forest service enterprises?

Entrepreneurs were asked about the use of machine data both in the Finnish survey, and in the survey targeted to partner countries.

According to the Finnish survey, some 70 % of the respondents considered machine data at least somewhat important in their business, while the rest 30 % valued machine data to be not important at all. It is likely that those not using machine data (30 %) may have encountered lack of skills, time or suitable tools for interpretation of the data.

Entrepreneurs were also asked about the uses of machine data and the frequency of the use of data in various purposes. According to the Finnish survey, the respondents used machine data most for "negotiations on harvesting fees" on monthly basis. When focused on weekly basis, "machine maintenance" and "instructing operators" were the most common uses. Respectively, "timber extraction planning" was the most frequent use on daily basis. Of the uses listed, the least used target for machine data was budgeting. As a conclusion, the data uses seem to reflect logically the nature of the harvesting business, and they depend on the purposes they are used for.

Among the Finnish entrepreneurs, WoodForce® harvest planning application was the most used machine data tool. Moreover, the fleet management applications of the biggest machine manufacturers (Ponsse, John Deere, Komatsu) were used by 14 – 19 % of respondents. Some of the

fleet management applications will be presented on videos, later connected to this report. Almost 20 % of respondents didn't use any application, which may indicate the responses of those entrepreneurs not using machine data at all in their businesses.

In the partner survey, majority of the respondents reflected that they have access to machine data, except that in Scotland and in Ireland the opinions were not so positive (30 % - 40 % of respondents either disagreed or strongly disagreed that statement). Furthermore, entrepreneurs from Ireland and Scotland indicated that machine data is not utilized in their countries to same extent as in Sweden and Finland. Irish and Scottish respondents communicated that there is a need for training for machine data use, and they reported a lower level of use of machine data applications than in Sweden and Finland.

General observation: Lack of skilled workforce limits the growth of forest service businesses

When asked to mention features in operating environment that limit the growth of forest service sector in their country, all Swedish respondents who answered referred to the challenge to find workforce. The same phenomenon was recognized in Scotland in addition which several respondents mentioned absence of relevant education. One respondent referred to, among other issues, Brexit.

Also in Ireland, the lack of skilled operators was the most common limiting factor mentioned. Especially in Ireland short contracts, excess bureaucracy and need of training and education was mentioned. In Ireland, several respondents also raised the failings in silviculture and general acceptance of forestry in their replies:

"Main obstacle is the low afforestation rate, as well as the fragmentation of forest ownership. Also, the only recently introduced proper training program for machine operators is going to take time to impact on operator skills in relation to machine data."

Data sources
- Expert interviews (Finland)
- National inquiry (Finland)
- Partner inquiries (Sweden, Scotland, Ireland)
- Literature
- Relevant web pages

References

Bowditch, Euan 2019. Forest service businesses in Scotland. Manuscript.

Häggström C, Kawasaki A, Lidestav G. 2013. Profiles of forestry contractors and development of the forestry-contracting sector in Sweden. Scandinavian Journal of Forest Research. 28:395-404

Tomi Järvinen 2018. Star-Up Entrepreneurs as Accelerators of Digital Platform Economy. Master's thesis at Aalto University. 31.5.2018.

Ovaskainen, Heikki & Kivilinna-Korhola, Tiina. (2017). Fleet Management software comparison Ponsse, Komatsu and John Deere. A comparison of characters of forest machines Fleet Management softwares. In Finnish.

Penttinen M, Rummukainen, A. & Mikkola J. 2011. Profitability, Liquidity and Solvency of Wood Harvesting Contractors in Finland. Small Scale Forestry June 2011, Volume 10, Issue 2, pp 211–229.

Sosa, Amanda 2019. Forest service enterprises in Ireland. Manuscript.

Web sites referred:

https://whatis.techtarget.com/definition/digital

https://www.etla.fi/wp-content/uploads/ETLA-Raportit-Reports-47.pdf

https://platformed.info/platform-stack/

https://valtioneuvosto.fi/en/article/-/asset_publisher/10616/alustatalous-suomen-kilpailu-tekijaksi-teollisuus-rohkeasti-mukaan-mallia-kasvuyrityksista?_101_INSTANCE_3qmUe-JgIxZEK_languageId=fi_FI

https://www.teagasc.ie/media/website/crops/forestry/advice/Annual-Forest-Sector-Statistics-2017.pdf

https://www.ponsse.com/products/information-systems/wood-procurement

https://www.theseus.fi/bitstream/handle/10024/115088/Kivilinna-Korhola_Tiina_2016.pdf?sequence=1&isAllowed=y

https://www.komatsuforest.co.uk/services/maxifleet

https://www.deere.com/en/forestry/forestry-technology/jdlink-telematics/

Annex

Questionnaire for the survey in partner countries

Videos of fleet management software, published by major forest machine manufacturers

Digitalization and use of machine data among forest service entrepreneurs

Thank you for taking the time to complete our questionnaire. You will be contributing to the development of digital training platforms and applications for forestry service providers. The survey should take less than ten minutes to complete.

In this survey the term digitalisation refers to the integration of digital technologies with forest service businesses (online learning tool and platforms that operate over multiple devices from desktops to mobile phones).

1. In which country you are mainly working?

◯ Great Britain

◯ Ireland

◯ Sweden

◯ Finland

2. Please, define in which sector of following you work.

◯ Research / development / education

◯ Entrepreneurship / contracting

◯ State or regional administration

◯ Something else. Please, specify _____

3. Based on your experience, how well do businesses in forestry sector engage with and use digital products and services? (Please rank from 1-10. 1 = Not at all engaged, 10 = Thoroughly engaged)

0

not at all ▮━━━━━━━━━━━━━━━ Thoroughly

Digital solutions in the forestry service business

4. In particular, how often is the digital media and services listed below used by forest service entrepreneurs

	Almost never	Sometimes	Commonly	Very frequently
Own website	☐	☐	☐	☐
Social media for marketing	☐	☐	☐	☐
Emails for communication	☐	☐	☐	☐
Instant messaging in communication (i.e. Whatsapp, texting FB messenger)	☐	☐	☐	☐
Machine data applications for collecting and evaluating operational efficiency data from harvesters and other machines (i.e. Timbermatic or Maxi Fleet)	☐	☐	☐	☐
Applications using spatial data related to forest resources (i.e. digital maps and GPS systems)	☐	☐	☐	☐
Administrative software (i.e. for invoicing, e-calenders, payment of salaries)	☐	☐	☐	☐

5. Do you see that following are significant obstacles for introduction of new software, digital services and platforms among forest service entrepreneurs (in harvesting and other silviculture work like planting) in your country?

	Not significant at all	Somewhat significant	Significant obstacle
Reluctance	○	○	○
Skill gaps	○	○	○
Lack of time	○	○	○
High costs	○	○	○
Technical difficulties (absence of broadband, devices etc.)	○	○	○

6. Please, rank the four most important skills that would help expand and sustain forest service businesses.

Business management and development	○	1
	○	2
	○	3
	○	4
	○	5
Leadership and people management	○	1
	○	2
	○	3
	○	4
	○	5
Financial management (e.g. economic analysis)	○	1
	○	2
	○	3
	○	4
	○	5
Use of social media in marketing	○	1
	○	2
	○	3
	○	4
	○	5
Productivity monitoring and development (e.g. harvesting machinery)	○	1
	○	2
	○	3
	○	4
	○	5

7. If there are skills missing in the list above, please elaborate below.

_____
_____
_____
_____
_____
_____

8. In your experience, does e-learning benefit and impact forest service businesses in your country?

◯ Not at all

◯ Slight impact

◯ Some impact

◯ Large impact

9. How do you estimate that the significance of the digitalisation in business in forestry sector will develop in next 3-5 years in your country?

_____
_____
_____
_____
_____

10. Are there any specific obstacles which limit the growth of forest service sector in your country (related to legistlation, forest resources, human resources etc.)

_____
_____
_____
_____
_____

11. Please rate the statements listed below in relation to utilization of machine data in harvesting business?

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Machine data is available to all entrepreneurs	○	○	○	○	○
Machine data is widely utilized among forest entreprises	○	○	○	○	○
There is a knowledge gap that restricts the use of forestry machine data	○	○	○	○	○
Training is available for machine data utilization in your country	○	○	○	○	○
Fleet management applications (offered by machine manufacturers) are widely used among contractors	○	○	○	○	○
Fleet management applications are considered to expensive	○	○	○	○	○
Fleet management applications are not adapted to the needs of the users (i.e. wrong / unreliable information, difficult to use)	○	○	○	○	○

12. Would you like to add any additional information, suggestions or thoughts? All views related to digitalization, e-learning and use of machine data are most welcome!

_____

_____

_____

_____

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