



SMART Forest

Bringing Industry 4.0 to the Norwegian forest sector

Annual Report 2020

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Summary

For SmartForest, 2020 marked the beginning of an ambitious and exciting journey as we were selected to receive funding as an SFI by the Norwegian Research Council. We start this journey with great ambitions for applying technology in the forest sector in order to support sustainable forest management in Norway. We believe that the intersection of forest and technology is key for the development of a green and sustainable world and is an exceptionally interesting field of research.

In short, SmartForest aims to improve the efficiency of the Norwegian forest sector by enabling a digital revolution transforming forest information, silviculture, forest operations, wood supply and the overall digital information flow in the sector. The digital transformation will be enabled by a series of innovations that will form the foundation for the development of a strong Forest-tech sector in Norway.

The SmartForest consortium consist of the most important actors in the Norwegian forest sector covering the value chain from the planted seedling to the mill gate combined with leading research institutions in Norway and abroad. Given the support from the Norwegian Research Council and the centre partners, SmartForest is beyond doubt the largest R&D initiative ever launched for the Norwegian forest sector.

SmartForest had its formal startdate on November 1st 2020 and the initial months were mainly spend setting up the administrative and formal structures of the Centre. We are very much looking forward to accelerate the R&D activities in 2021 and hope that you will follow us on this exciting journey through our social media channels. ●



Vision and objectives

SmartForest impacts in a NUTSHELL:

SmartForest will result in a long-term, world-leading, industry-focused R&D environment centred around the application of enabling technologies for digital transformation of the forest sector.

The intended impacts are to:

1. Ensure that the Norwegian forest sector will be managed using leading edge digital technologies.
2. Apply the emerging enabling technologies in the forest sector to create a series of innovations that can be operationalized and commercialized by the SmartForest partners.
3. Improve information, increased production efficiency, improved environmental efficiency, and overall increased value production from the forest-based value chain.
4. Improve the recruitment of professionals and young researchers in forestry.
5. Contribute towards the required green shift in the Norwegian industry by:
(1) facilitating increased value creation and international competitiveness of the Norwegian forest sector, and
(2) create the foundation for a Forest-tech sector in Norway.



Primary objective

The primary objective of SmartForest is to improve the efficiency of the Norwegian forest sector by enabling a digital revolution transforming forest information, silviculture, forest operations, wood supply and the overall digital information flow in the sector. The digital transformation will be enabled by a series of innovations that will form the foundation for the development for of a strong Forest-tech sector in Norway.

In order to operationalize the SmartForest primary objective, 10 verifiable secondary objectives have been defined.

The secondary objectives are formulated with focus on innovation, value creation, recruitment improvements, and efficiency gains in the forest sector. Hence, the secondary quantifiable objectives become a direct operationalization of the primary objective's focus on efficiency and innovations in the forest sector. The secondary objectives are:

1. To create an internationally leading R&D environment that utilizes the emerging enabling technologies to increase forest sector efficiency through Precision Forestry.
2. To generate at minimum 30 innovations by applying enabling technologies to key processes in the forest sector and in this way form the foundation for an internationally leading Forest-tech sector in Norway.
3. To create at minimum 10 operational digital services that are commercialized by the SmartForest user-partners.
4. To develop improved cost-efficient operational systems for continuously updated forest information.
5. To develop cost-efficient precision silvicultural practices that can increase the growth rates of Norway's forest by 20%.
6. To develop digital approaches that reduce the cost of forest harvesting by 20% and reduce the environmental impacts by 50%.
7. To develop precision wood supply approaches that reduce costs of logistics by 5-10%, reduce seasonal fluctuations in wood supply by 20%, and increase the value creation of the harvested wood by 10%.
8. To enable full traceability of wood from the stump to the end product and enable digitally supported certification procedures.
9. To enable a fully digital flow of information between the key private and public actors in the forest sector by development and application of a minimum of 5 different systems with open APIs that connect at least 6 different actors in the value chain.
10. To increase the recruitment of technology minded students (master level) and young researchers (PhD and post docs) into the Norwegian forest sector by 50%.

Research plan and strategy

Working hypothesis:

SmartForest is the next leap in efficiency and environmental performance of the forest sector and will be enabled by digitalization and knowledge-based management.

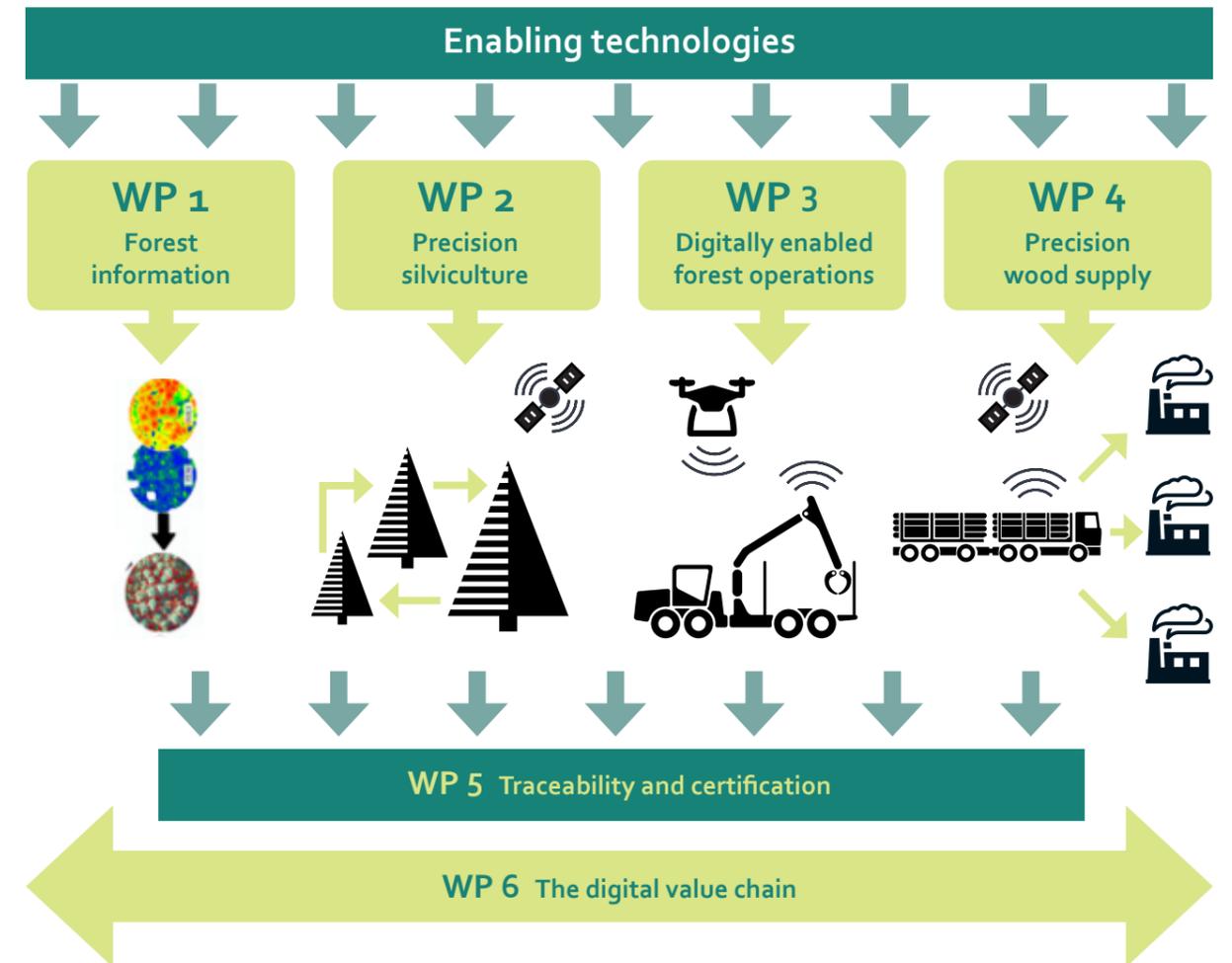
SmartForest is divided in six workpackages, and within each we will have defined tasks which will be annually updated.

WP1: Forest information

Focus in WP1 is the development of improved forest information. Combining data from emerging technologies can lead to significant improvement in forest information and create continuously updated and improved forest information for a much broader spectrum of variables than in today's forest inventories.

WP2: Precision silviculture

WP2 focuses on cost-efficient precision silvicultural practices that can increase the growth rates of Norway's forest. Through application of the emerging technologies precision silviculture will provide operationally feasible and cost-efficient production gains.



WP3: Digitally-enabled forest operations

Main focus in WP3 is the improvement of forest operation efficiency and avoidance of environmental damage through application of emerging technologies.

WP4: Precision wood supply

WP4 focuses on the development of precision wood supply approaches that reduce costs of logistics, reduce seasonal fluctuations in wood supply, and increase the value creation of the harvested wood. Through the application of the emerging technologies of precision wood supply, where supply and demand are matched, both with respect to time and quality can be optimized.

WP5: Traceability and certification

Using machine data, traceability technologies, and sensors along the value chain in combination with block chain technology will allow for full traceability throughout the value chain and enable semi-automatic reporting for certification as well as virtual audits.

WP6: The digital value chain

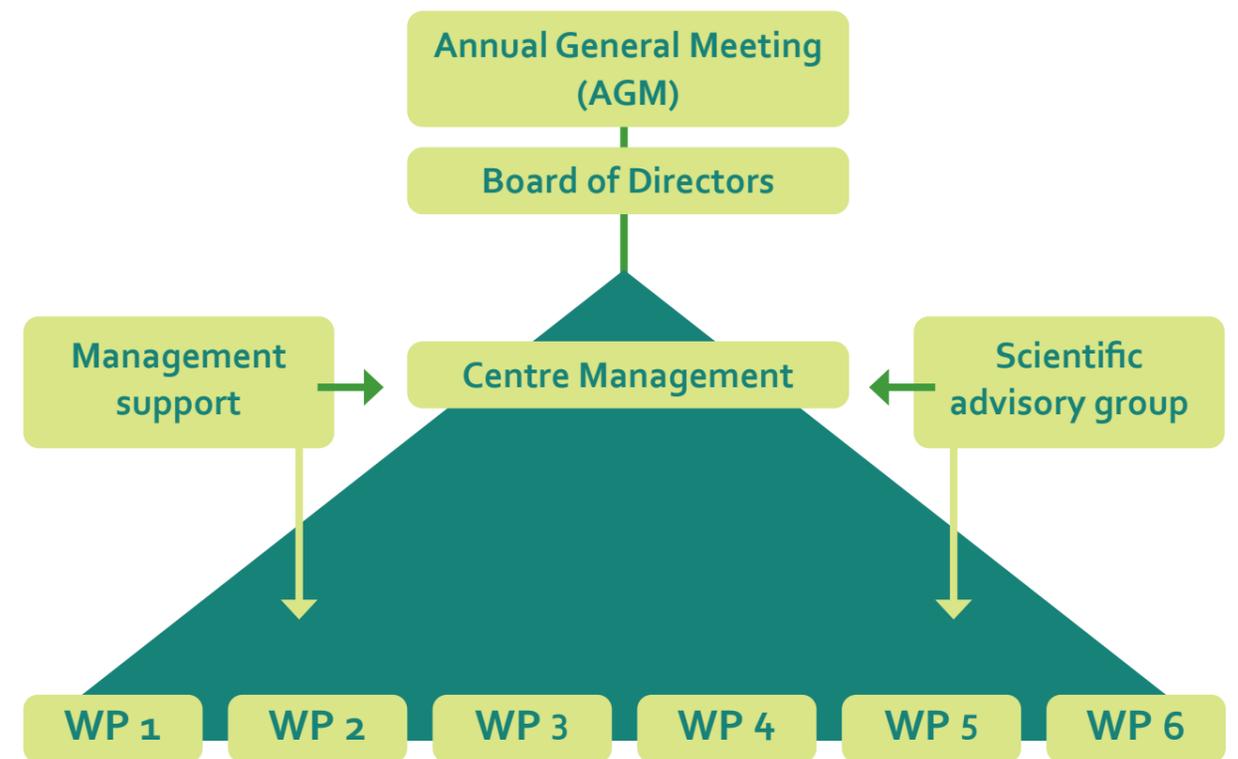
Large efficiency gains can be achieved by enabling the digital value chain. WP6 will enable a fully digital flow of information between the key private and public actors in the forest sector by development of a series of application and APIs that connect the different actors in the value-chain.



Organisation

Organisational structure

The Annual General Meeting convenes once a year to discuss the Centre's activities, present result highlights from the past year and discuss forthcoming plans. The Board is the ultimate decision-making body of the Consortium.



Board Members 2021–2023



Chair
Anders Øynes, CEO AT Skog SA
Monica Grindberg, Forest director Statskog (Deputy)

Board members (from left)
Gudmund Nordtun, CEO Glommen-Mjøsen Skog
Leif Erik Blankenberg, Head of R&D Department Terratec AS
Terje Veblungsnes, CEO Skogdata
Tor Henrik Kristiansen, CEO Viken Skog SA (Deputy)
Arne Rørå, CEO Norskog (Deputy)

Board member NMBU
Hans Fredrik Hoen, Dean NMBU-MINA
Torjus F. Bolkesjø, Section leader NMBU-MINA (Deputy)

Board member NIBIO
Bjørn Håvard Evjen, Division leader NIBIO
Per Stålnacke, Research Director NIBIO (Deputy)

Centre Management Group



Centre Director
Rasmus Astrup, NIBIO

Vice Director
Terje Gobakken, NMBU

Centre Coordinator
Carolin Fischer, NIBIO

Administrative Support
Kristian Fæste, NIBIO
Eva A. Haugen Johnson, NIBIO

Innovation Manager
Magnus Frydenlund, Ard Innovation

Partners and partners' role in SmartForest



Forest management and owners' associations

Viken Skog, Glommen Mjøsen Skog, AT Skog, Norskog, and Statskog represent over 35 000 forest owners and are the primary implementers of inventory, silviculture, forest operations and timber sales (90% of the Norwegian timber production). In SmartForest, these organizations will be responsible for identifying bottlenecks or areas needing R&D focus and implementing the SmartForest innovations in the forest-based value chain. The forest managers and owners will simultaneously be responsible for providing access to study sites and existing data streams generated in the value chain. **The Norwegian Forest owners' federation (NFF)** will be responsible for a large part of the communications activities targeted at the sector as well as towards the policy system.



Machine manufactures and contractors

Komatsu Forest will support the project with access to machine data which is a key enabling technology applied heavily both in the forest information WP as well as in the digital operations WP. Komatsu Forest will support in integration of new sensor and automation systems in actual operational forest machinery but also allow for some of their R&D engineers to collaborate on aspects related to automation of key forest operations.

The machine owners are represented by **MEF** in SmartForest. The machine owners' role in the project is to give access to machine captured data but also play a central part of developing the digital value chain by making the existing machine data system SilviSmart into a central part of the digital value chain as well as to test and evaluate innovations related to digitally enabled forest operations.



Technology, data and service providers

Terratec, Skogdata, Norsk Virkesmåling and **Skogbrand** play an inherently active role in the Centre. Terratec is a leading remote sensing company and will participate in data capture as well as the development of novel implementations of drone and remote sensing for improved forest information. Today, Skogdata facilitates the digital flow of information between buyers, sellers and transportation organizations and will participate in development and implementation of the digital value chain. Skogdata will be central for getting access to existing data streams but also to implementing

innovation in the digital value chain. Norsk Virkesmåling which is the organization responsible for measurement of harvested timber, will participate actively with the ambition of completely revolutionizing the way that timber is measured (volume and quality) in Norway. Skogbrand is the only insurance company specializing in forests in Norway and will focus on utilizing of continually updated forest information obtained through remote sensing and drones to better assess damages for insurance payments and as utilization of the generated data to better estimate risk.





International cooperation

Sawmilling industry

Moelven Virke will represent the timber buyers and mills in SmartForest. Moelven Virke will play a central part by ensuring that we can link the individual tree in the forest to the actual products and value that is output from the mill. This will be done by facilitating access to data from X-ray frames in the mills as well as product breakdown of the individual logs. Further, Moelven will be central in evaluating how better information on quality and production can be utilized to better match demand and supply, and in this way increase the value creation given the same timber production.



Public sector

The public sector plays a central role in the digitalization as public and private systems must develop and correspond to make for a seamless integration of monitoring and re-reporting. In SmartForest, the public sector will be represented by NAA, who will participate through development of the public systems to match the digitalization of the private sector.



Research partners

The classic forest research partners (**NMBU-MINA** and **NIBIO**) are complemented with researchers from the newly established **NMBU Data Science program** (NMBU Faculty of Science and Technology) to support technical developments, Big Data handling and advanced analysis. Further, statisticians from the **UiO research centres OCBE/BigInsight** are included in SmartForest to provide internationally leading methodological competence on advanced analysis, big data and machine learning.



The digitalization of the forest sector is a global and fast-moving phenomenon where it is key to stay oriented on the state-of-the-art and developments from around the world.

Hence, the main objective of the international collaboration in SmartForest is to ensure that the Norwegian forest sector both gains and stays at the absolute forefront of the international research frontier, and at the same time uses the platform to attract some of the most promising R&D talents.

Therefore we have included three international research partners that are leading in different aspects of industry focused R&D related to digitalization of the forest sector in SmartForest. The three partners are:

1. The Swedish **Mistra Digital Forest** program, collaborates with focus on topics related to traceability from the forest and through the mill and how to use this information for increased value production.
2. The **Forestry 4.0** initiative by Canadian **FPInnovations**, cooperates with focus on digitally enabled forest operations as well as on automation of forest operations.

3. The virtual forest project established by the robotics department of German **RIF Institute for Research and Transfer e.V.**, cooperates with focus on digital twinning in forestry, and the design and implementation of industrial sensors in forestry.

All three international partners are committed to facilitating researcher exchange and co-organization of meetings and workshops. This will ensure that the SmartForest researchers & user-partners more rapidly arrive and remain on the research frontier. Further, the international partners will contribute with key competences in selected R&D activities that will improve the overall quality of the innovations developed.

Furthermore, SmartForest encourages international collaboration also with international researchers outside of the partner organizations through our existing large international network. ●



Communication and dissemination

Webpage:
smartforest.no

Social media:

-  SmartForest4.0
-  SmartForest4.0
-  SmartForest4.0
-  SmartForest4.0



Personell

NAME	INSTITUTION	MAIN RESEARCH AREA
Rasmus Astrup	NIBIO	Centre Management
Clara Antón Fernández	NIBIO	Forest Modelling
Simon Berg	NIBIO	Forest Operations and Technology
Carolyn Fischer	NIBIO	Wood Quality
Kjersti Holt Hansen	NIBIO	Precision Silviculture
Joachim Heppelmann	NIBIO	Forest Operations and Technology
Stephan Hoffmann	NIBIO	Forest Roads
Csongor Horvath	NIBIO	Sensors and Robotics
Weria Khaksar	NIBIO	Sensors and Robotics
Paul McLean	NIBIO	Precision Silviculture
Stefano Puliti	NIBIO	Remote sensing and Forest information
Johannes Rahlf	NIBIO	Remote sensing and Forest information
Ole Martin Bollandsås	NMBU	Remote sensing and Forest information
Terje Gobakken	NMBU	Remote sensing and Forest information
Lennart Noordermeer	NMBU	Remote sensing and Forest information
Erik Næsset	NMBU	Remote sensing and Forest information
Hans Ole Ørka	NMBU	Remote sensing and Forest information
Oliver Tomic	NMBU	Machine Learning
Arnoldo Frigessi	UiO	Statistics/Machine Learning
Manuela Zucknick	UiO	Statistics/Machine Learning

Accounts

FUNDING		Amount (NOK)
The Research Council		418300
The Host Institution (NIBIO)		190992
	Sum	609292

COST		Amount (NOK)
The Host Institution (NIBIO)		560920
Research Partners		48372
	Sum	609292





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