Value added by optimal wood raw material allocation & processing (VARMA)

FINAL REPORT

Title of the research project	Value added by optimal wood raw material allocation & processing
Coordinator of the project	Marika Makkonen

BASIC PROJECT DATA

Project period	1.3.2014- 30.7. 2017
Contact information of the coordinator	VTT Technical Research Centre of Finland Ltd Vuorimiehentie 3 02150 ESPOO +358 20 722111 +358 20 722 7001 marika.makkonen@vtt.fi
URL of the project	http://www.varma-eu.com/

FUNDING

Total budget in EUR	1 507 345 EUR
Public funding from WoodWisdom-Net Research Programme:	1 161 405 EUR by source:

Finland	
Tekes – the Finnish Funding Agency for Innovation	300 000 EUR
France	
Ministry of Agriculture, Fisheries and Forestry Resources (MAAF)	86 806 EUR
French Environment and Energy Management Agency (ADEME)	55 701 EUR

Germany Agency for Renewable Resources (FNR)	384 241 EUR
United Kingdom The Forestry Commissioners (FC)	77 125 EUR

Other public funding:

Saxony-Anhalt Ministry of Agriculture and the Environment, Germany (30%)	90 000 EUR
Natural Resources Institute (LUKE), Finland	30 000 EUR
Institut technologique FCBA, France	137 532 EUR

Other funding:

Federation of the Finnish Woodworking Industries[1], Finland	50 000 EUR
Selection Vosges, France	17 500 EUR
VTT Technical Research Centre of Finland Ltd	120 000 EUR

PROJECT TEAM (main participants)

Marika Makkonen, M.Sc (For.), Research Scientist	(F)	VTT Technical Research Centre of Finland Ltd, Finland	
Hannu Rummukainen, M.Sc.(Tech.) Senior Scientist	(M)	VTT Technical Research Centre of Finland Ltd, Finland	
Pekka Ulvas, Planning Manager	(M)	Koskisen Oy	Finland
Jori Uusitalo, D.Sc. (Agr. & For.) Regional Director, Western Unit	(M)	Natural Resources Institute (LUKE)	Finland
Matti Mikkola CEO	(M)	The federation of the Finnish Woodworking Industries	Finland
Ehrhardt, I., Dr.-Ing. Deputy Head of the Logistics and Factory Systems Business Unit	(F)	Fraunhofer Institute for Factory Operation and Automation (IFF)	Germany
Sonntag, H., Prof. Dr.-Ing. Head of Research Group Transport Logistics	(M)	Technical University of Applied Sciences (TUAS)	Germany

[1] As of 20.10.2015, prior funding organization: Finnish Wood Research Oy (FWR)

Maschmann-Fehrensen, A. General Manager	(F)	Holzindustrie Templin GmbH (HIT)	Germany
Fehrensen, G. General Manager	(M)	Georg Fehrensen GmbH (Fehrensen)	Germany
FENART Philippe Wood specialized graduate studies/agricultural engineer	(M)	Technology Institute FCBA	France
VUILLERMOZ Morgan, Forest engineer, Research coordinator	(F)	Technology Institute FCBA	France
KIENTZ Bernard Wood engineer, manager	(M)	Selection Vosges	France
Shaun Mochan	(M)	Woodilee Consultancy	United Kingdom
David Leslie	(M)	James Jones & Sons Ltd	United Kingdom

DEGREES (if relevant)
Degrees earned or to be earned within this project.

2016	M.Sc.,F,Fitz, M., M.Sc. Otto von Guericke University Magdeburg	Prof. M. Schenk (Uni), Dr. S. Trojahn (Uni), Dr. I. Ehrhardt (IFF)
2016	M.Sc., F,Wichmann, I., M.Sc. Otto von Guericke University Magdeburg	Prof. M. Schenk (Uni), Dr. S. Trojahn (Uni), Dr. I. Ehrhardt (IFF)

PROJECT SUMMARY REPORT

A summary of the project, preferably one page only

In order to foster growth and competitive advantage of the sawmill industry, creative and effective ways to meet increasing customer demands are needed. The wood supply chains should link forest resources, logistics and tree bucking according to the sawmill orders better than it is today. The three-year transnational VARMA project has aimed to bring new knowledge on the issue, approaching the wood supply chain optimization from four different angles in Finland, France, Germany and the United Kingdom.

The transnational VARMA research project investigated technical and business considerations of a wood allocation centre (WAC), defined as: A virtual or real structure (facility or organization) that boosts efficiency of wood raw material supply by centralizing resources, operations and services for actors in the wood supply chain (network). An important aspect of the WAC concept is that centralized wood allocation can direct the available wood to the most suitable customers, with the highest possible value added.

The needs of the national industry determined the objectives of each WAC-concept to be developed, resulting in four different, but related outputs described briefly in this report. Each concept contributed to the common challenge by bringing new knowledge for different parts of the wood supply chain; 1) wood buying action (assisting decision making during wood buying by developing new tools for raw material valuation), 2) wood supply (model for matching daily round wood deliveries with daily orders), 3) processing (raw material efficiency by new tools for stem's optimal bucking) and 4) business models by pooling resources, operations and services. Hence, the project didn't aim to solve all aspects in order to improve wood supply chain efficiency, but it took steps towards solving the key challenges in each country, building foundations for further research.

1.1 Introduction

1.1.1 Background

Describe the background of the project and the basic problem that it sought to address.

During the last 10–20 years European sawmill industry R&D has concentrated on increasing the speed of sawing machines and rotary lathes and increasing the productivity. The industry is characterized by bulk production and inefficient raw material use. This is the case all over the Europe, although some regional variations exist:

- In **Finland**, the sawmill industry is characterized by large number of small and medium sized players with very similar offering in terms of product quality and services. The industry is using cut-to-length method, where bucking is based only on rough human assessment of quality, harvester diameter measurements and control matrices. Wood allocation today is not based on accurate scanning of wood properties, causing economic losses due to mismatch between available wood raw material and products to be manufactured.
- In **France**, a growing share of the sawmills are getting more and more specialized, producing specific products which are generally more demanding in terms of optimal log dimensions, while also additional properties, like knot, strength, durability, surface, aesthetic properties etc. may be of larger or smaller importance depending on the target products. Determining for example which logs to order and process, with which sawing patterns to achieve an optimal result is a demanding problem to solve with conventional methods. Therefore, there is a need for decisions support systems and technology that facilitates accessibility to decisive information.
- In **Germany**, the demand for wood and especially for saw logs has increased drastically due to growing capacity in the saw mill industry and increasing competition from the wood energy markets. Subsequently the raw material prices sharply increased and parallel to this, a relative gain in volume and value recovery is urgently needed from the saw milling sector to be able to run their production at full capacity and to create the necessary revenue out of their operation.
- In **Scotland** (UK), the changes in timber quality, a consolidation towards Sitka spruce and the high demand for wood has forced the sawmill sector to use as much technical advantage as it can find, in order to maximise the utilisation and yield recovery from each log cut. With premature harvesting to meet the current demands and achieve forest rationalisation, the log quality appears to be poorer than other years. There is also an issue with seed stock or genetics in relation to branching and internal wood properties. New technology in the value chain would allow for better decision processes to be addressed giving potentially more opportunities. The sector needs to be able to react with more efficiency to allow for less waste and more productivity, not just at the mill but through the range.

The sawmill industry in the Europe is facing wider range of different customer demands. To meet these demands, all processes from forest to the sawmill and even further downstream supply chain have to be effective with low environmental burden. Among the key challenges, there should be more understanding about the complexity of knowing the wood resource characteristics and how this resource interacts with the many different markets. In addition, new models and methods are needed to improve overall efficiency in forestry operations. Compared to existing processes, critical improvements can be made by adding more flexibility to the wood value chains, i.e. products and product families determine configuration of value chains and production systems. The VARMA project introduces different approaches to these improvements.

1.1.2 Objectives

Describe the project objectives.

The aim of the VARMA project was to develop customer driven wood value chains that link the sawmill's customer's order better with the wood resources. The different national goals were analysed through the WAC-concepts. Figure 1 illustrates the principal idea of the concept. The WAC is a virtual or real structure (facility or organization) that centralizes (different) resources, operations and services to boost efficiency and value added when supplying raw material. In particular, the main goal of the project was to increase understanding of what is the potential of the WAC in improving customer-oriented business models, services and profitability.

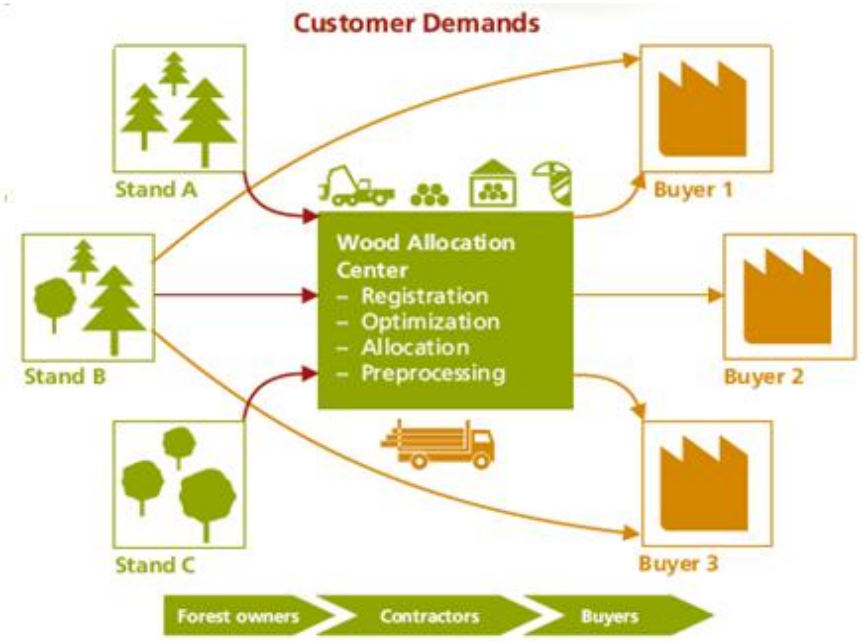


Figure 1 The principle idea of Wood Allocation Centre (WAC) –concept

The project goals were achieved through six work packages (WP):

- WP1: Project management
- WP2: Industrial input for novel business models in woodworking industry
- WP3: Design of novel business models and networks in woodworking industry
- WP4: Modelling, simulation and optimization of wood material flows in business networks
- WP5: Industrial evaluation and testing
- WP6: Dissemination

The goals and achievements by each country are described in more detail in the next section 1.2 "Results and discussion".

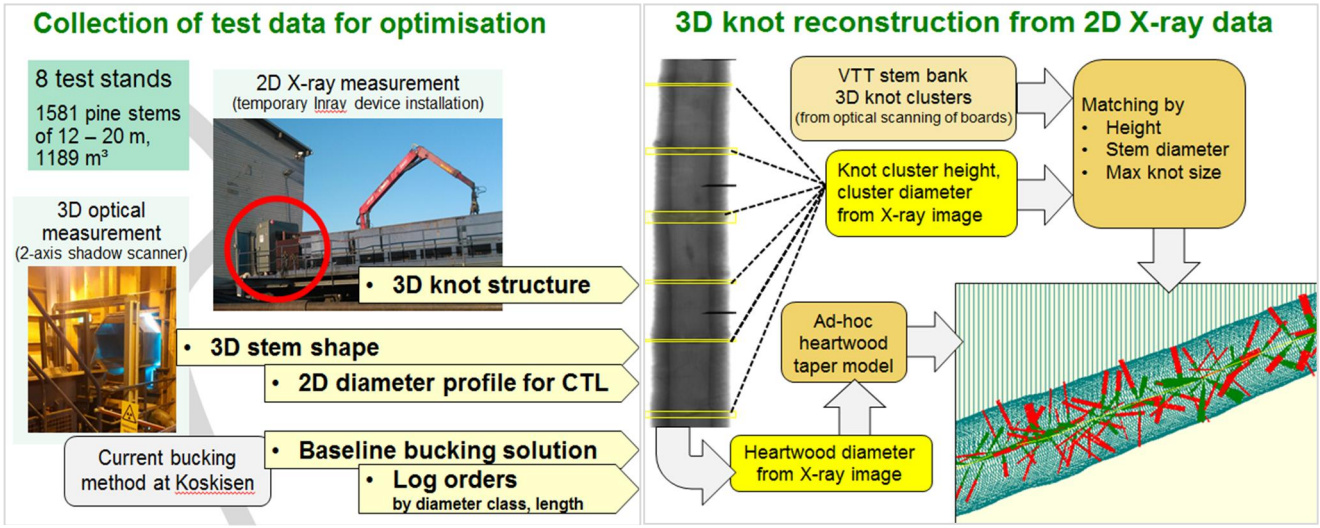
1.2 Results and discussion

Main achievements of the project, quality, innovativeness, industrial relevance and contribution to competitiveness, environmental and societal impact.

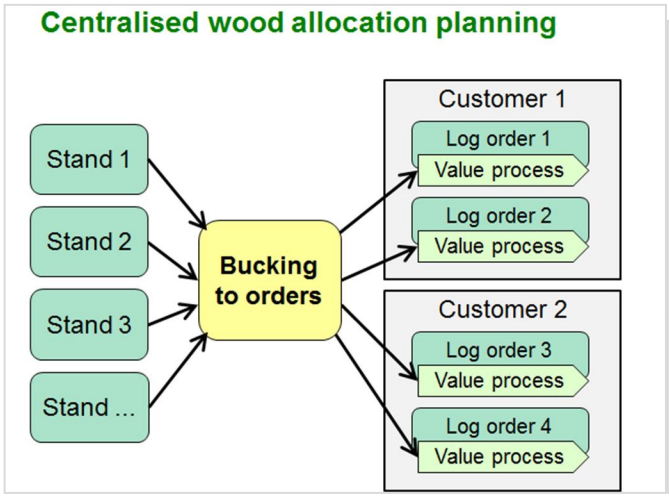
The wood allocation centre concepts were developed in Finland, France, Germany and Scotland. Each of the partner countries set priorities for the concepts to be developed, causing variation between the concepts. However, each follow the main principle, that is, delivering the right products to the right customers in a timely manner with the highest possible value added. The main achievements according to project goals in each country are described below.

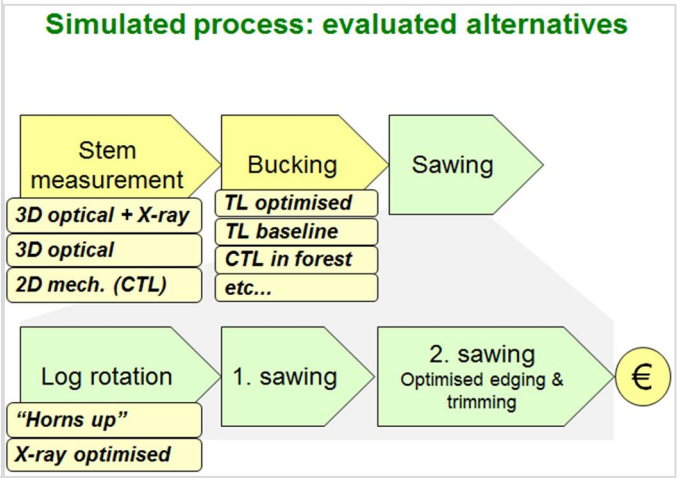
Finland: Optimising stems' bucking to orders

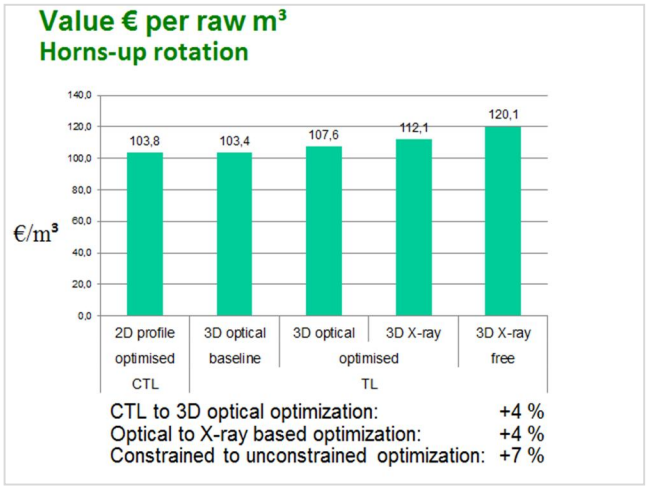
The focus in Finland was to develop and test a research-level bucking optimization model for stems, based on the physical WAC concept. The primary objective was to assess whether improved knowledge on stem's internal quality leads to better bucking decisions and hence, to value added. The Natural Resources Institute Finland (LUKE) provided pre-information on test stands for bucking simulation and optimization purposes and studied accuracy of three pre-harvest inventory methods (EMO software, ALS and Prestima). In optimization, both X-ray scanner data (to detect internal quality) and optical scanner data (to detect external properties) of stems were utilized.

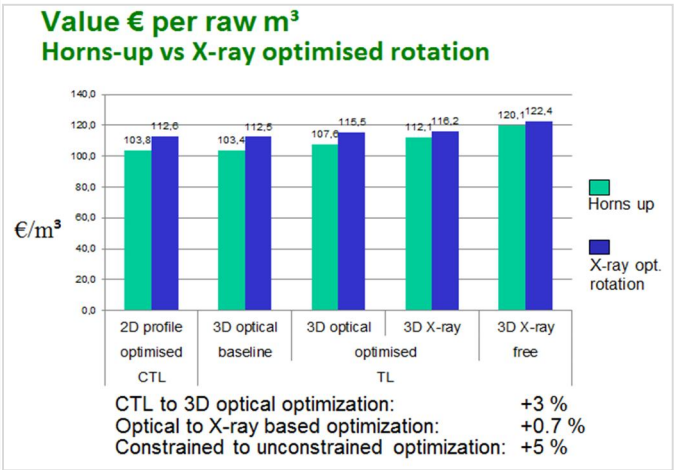


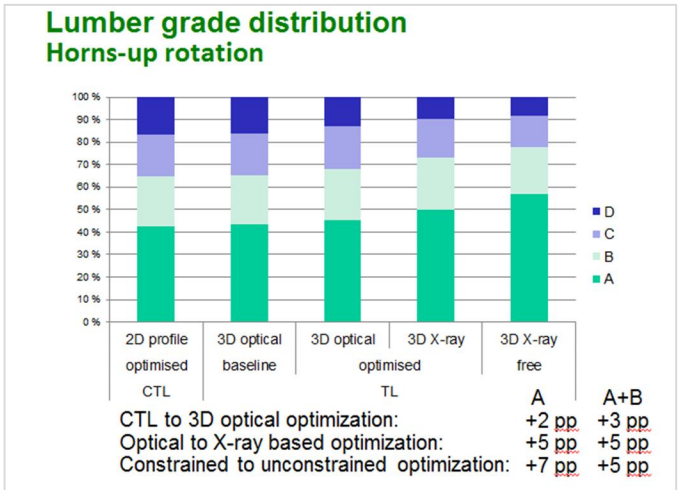
On the basis of these and other input data, the value of sawn timber was calculated with different bucking options. The bucking decisions of stems were based on maximizing the value of production, taking into account a sawmill's orders. According to the results of the case study, bucking with data on 3D stem surface geometry provides a 4 % increase in value recovery compared to the CTL (cut-to-length) method, and bucking with the aid of X-ray measurements provides a further 4 % increase in value recovery. The results also indicate that using X-ray measurement data for log rotation on the sawline can improve value recovery by 8 % when bucking is performed without X-ray data, or by 4 % when bucking already uses X-ray measurements. Industrial experts find the results reasonable.

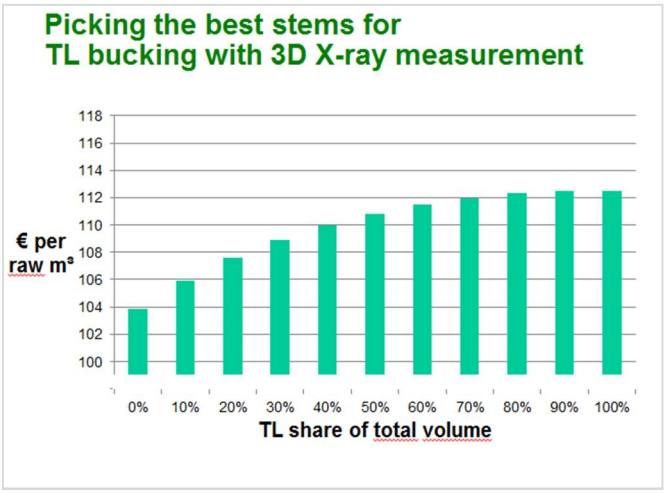

Centralised wood allocation planning
Stand 1
Stand 2
Stand 3
Stand ...
Bucking to orders
Customer 1
Log order 1
Value process
Log order 2
Value process
Customer 2
Log order 3
Value process
Log order 4
Value process


Simulated process: evaluated alternatives
Stem measurement
3D optical + X-ray
3D optical
2D mech. (CTL)
Bucking
TL optimised
TL baseline
CTL in forest
etc...
Sawing
Log rotation
"Horns up"
X-ray optimised
1. sawing
2. sawing
Optimised edging & trimming
€


Value € per raw m³
Horns-up rotation
€/m³
140,0
120,0
100,0
80,0
60,0
40,0
20,0
0,0
103,8
103,4
107,6
112,1
120,1
2D profile optimised CTL
3D optical baseline
3D optical optimised TL
3D X-ray optimised TL
3D X-ray free
CTL to 3D optical optimization: +4 %
Optical to X-ray based optimization: +4 %
Constrained to unconstrained optimization: +7 %

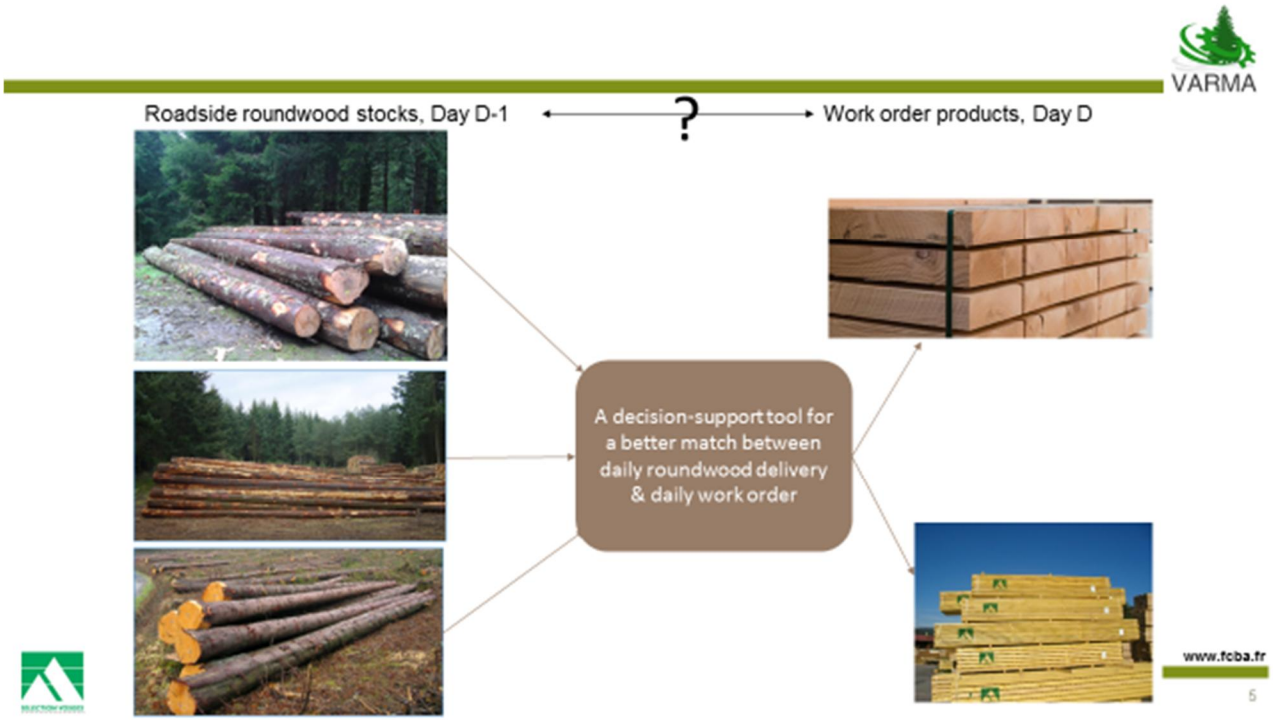

Value € per raw m³
Horns-up vs X-ray optimised rotation
€/m³
140,0
120,0
100,0
80,0
60,0
40,0
20,0
0,0
103,8
112,6
103,4
112,5
107,6
115,5
112,1
116,2
120,1
122,4
Horns up
X-ray opt. rotation
2D profile optimised CTL
3D optical baseline
3D optical optimised TL
3D X-ray optimised TL
3D X-ray free
CTL to 3D optical optimization: +3 %
Optical to X-ray based optimization: +0.7 %
Constrained to unconstrained optimization: +5 %



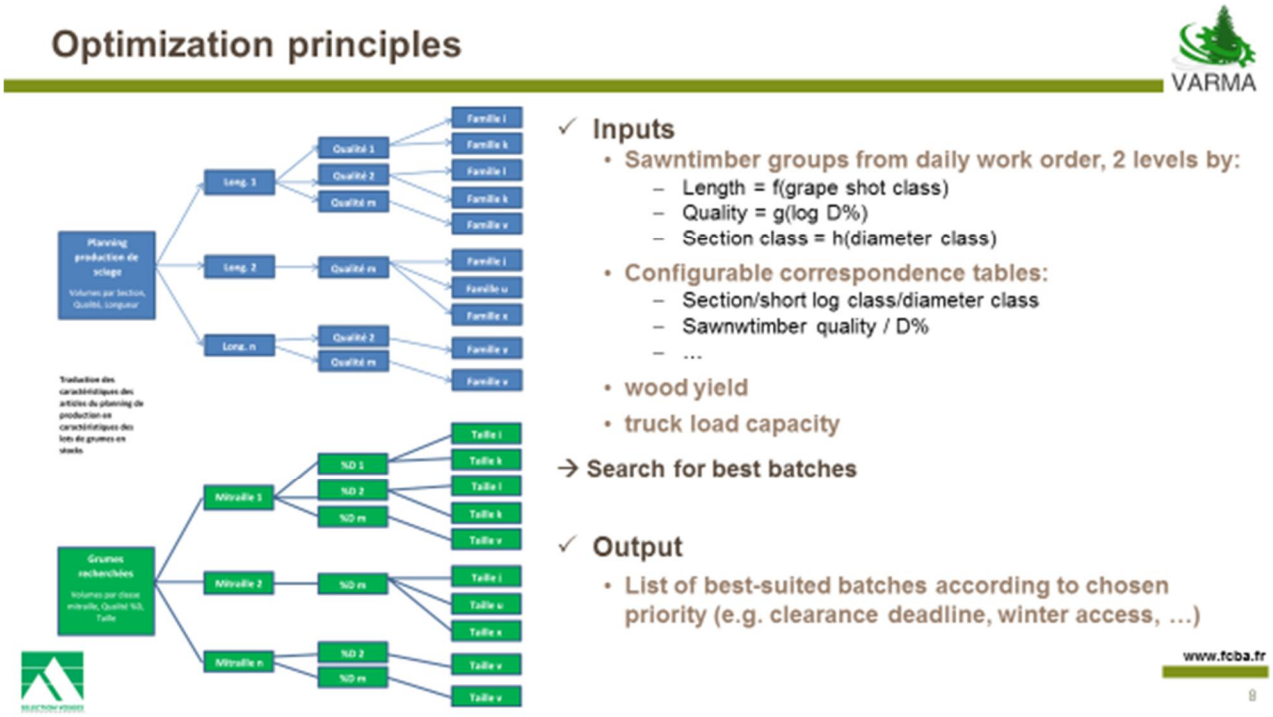


France: Better match between daily roundwood delivery & daily work order

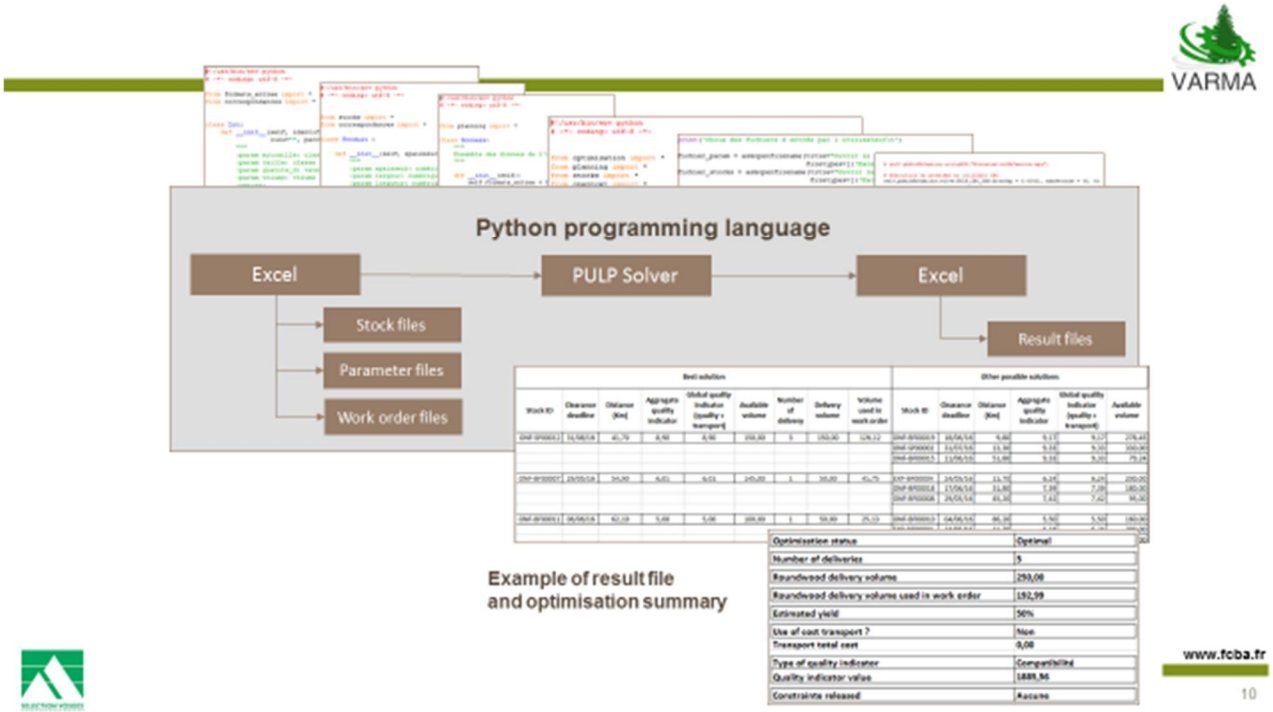
In France, the focus was to develop and test a software to help the choice of the best roadside roundwood stocks to supply to the sawmill in function of the work day order.



This choice depends of sawwoods characteristics like length, section, quality, piece number versus volume and sawing principles to pass of roundwood to sawnwoods as correspondence table. In order to adapt the software to any sawmill or parameter change, these correspondence tables are configurable.



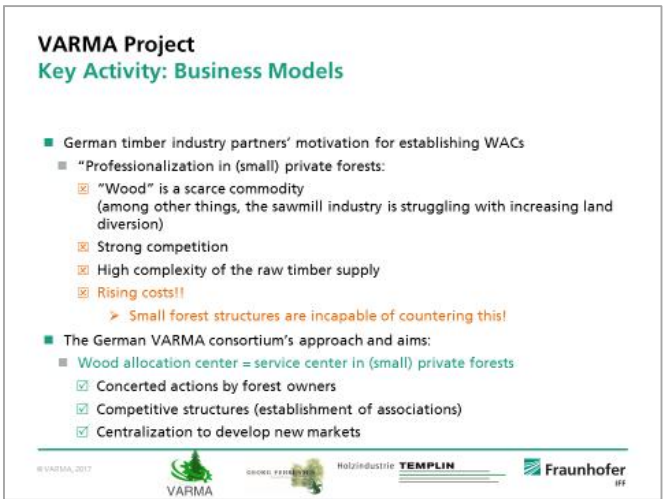
The optimization programme was developed in collaboration with SELECTION VOSGES, SCIERIE ORIEL, INSA Rennes and FCBA in PYTHON programming language. It provides the most suitable batches and equivalent batches to take account of logistical constraints (winter access for example). The prototype tool was installed in the SCIERIE ORIEL for testing since the beginning of December 2016.



The demonstrator gives satisfaction to the user by allowing better yield, productivity, added value while decreasing unnecessary short logs stocks on the sawmill log yard. However, it requires standardization of the data entered in order to function correctly and takes account only 1 wood species.

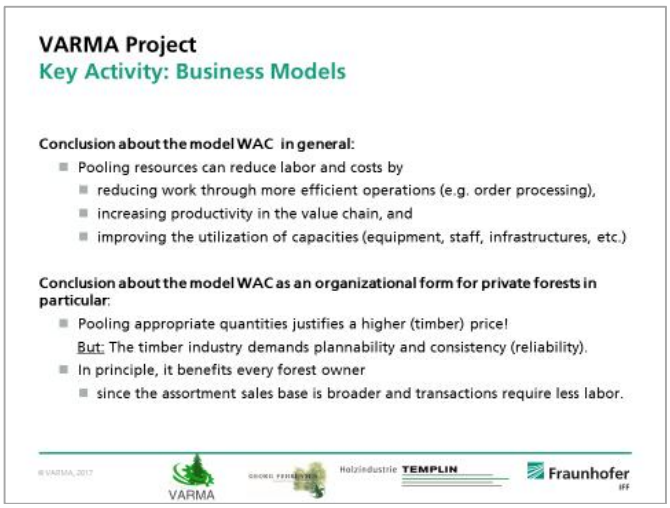
Germany: Pooling resources, operations and services to boost efficiency in the resource supply chain.

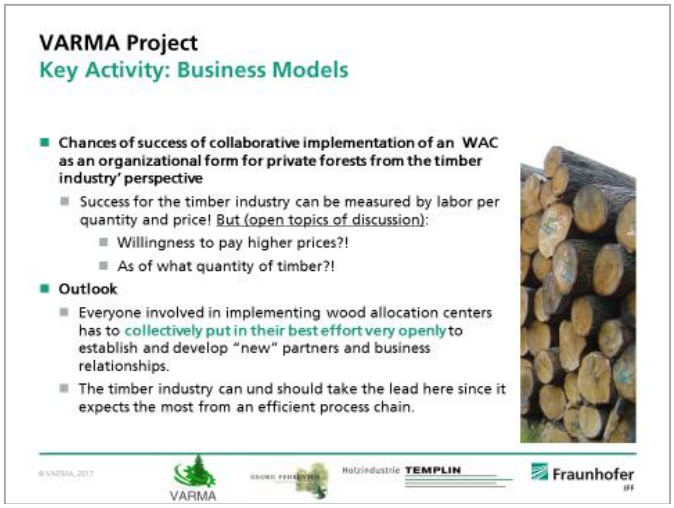
One of the German VARMA Scenario focused on a Wood Allocation Centers as a New Organizational Form in Private Forests. Thereby a **wood allocation center** is a virtual or real structure (i.e. facility or organization) that centralizes (different) resources, operations and services to boost efficiency in the resource supply chain. Essentials for a wood allocation centre are viable plans for structures and processes that meet demand and optimized resource supply structures and processes adapted to demand. The objective for establishing of wood allocation centre is pooling of capacities and thus strengthening individual entities.



German timber industry partners' motivation for establishing WACs was the "professionalization" in (small) private forests. "Wood" is a scarce commodity and among other things, the sawmill industry is struggling with increasing land diversion in Germany. Additional there is a strong competition regarding wood as raw material and a high complexity of the raw timber supply. One result are rising costs. The existing small forest structures are currently incapable of countering this!
The German VARMA consortium's approach and aims are the establishing wood allocation center as service center in (small) private forests. This WAC targets on:

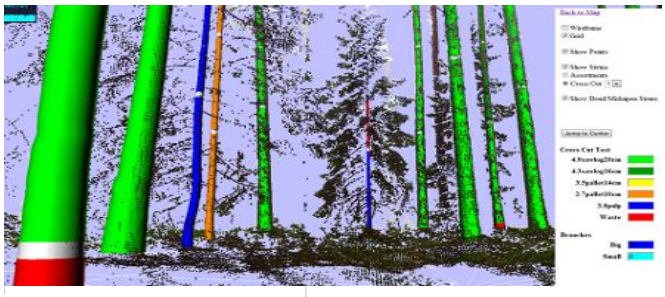
- Concerted actions by forest owners,
- Competitive structures (establishment of associations),
- Centralization to develop new markets.





The potential for implementing WACs as new structures and organizational forms in private forests is very high in Germany. **Business models** have to be created so that the **total labor and costs** to supply wood **remain approximately the same or drop** (for each partner in the process as well). In collaboration with the industry partners, the **performance indicators** were used to demonstrate the existence of **potential savings** and WACs' capability to **boost efficiency** in wood supply operations. The **organization of WACs in the project regions can vary** greatly depending on the particular local conditions and structures. The results obtained in the VARMA project provide decision aids. Regional development of WACs, in turn, only succeeds when all of the stakeholders along the value chain are closely involved and cooperate.

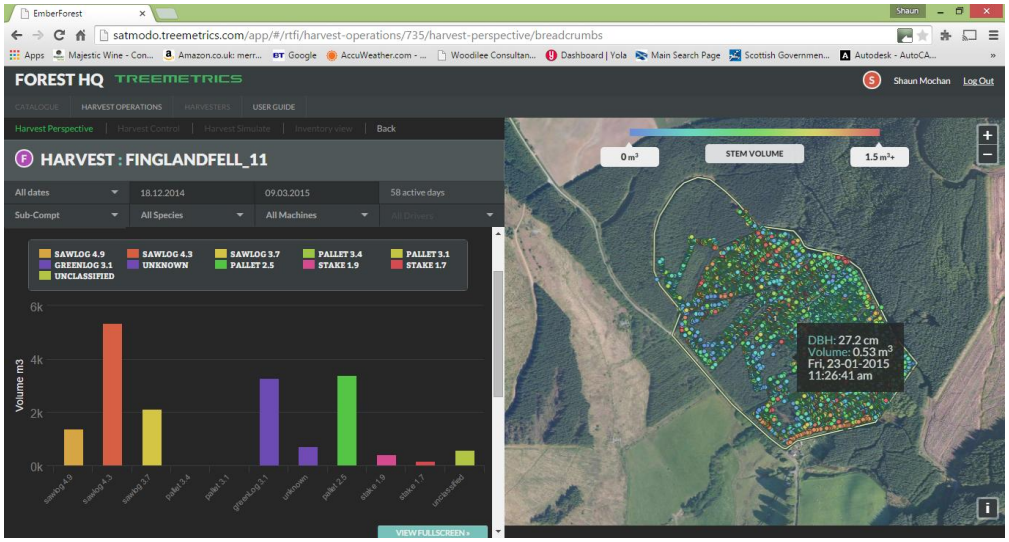
The United Kingdom: Better understanding of the wood resources through quantative variables during a harvesting operation. A standardised methodology to gather forest data before harvesting and matching this with real time market performance. Being able to change manage, on a daily basis, the outputs required for maximum value of the forest resource using 3D scanning and 2D assessment methods.



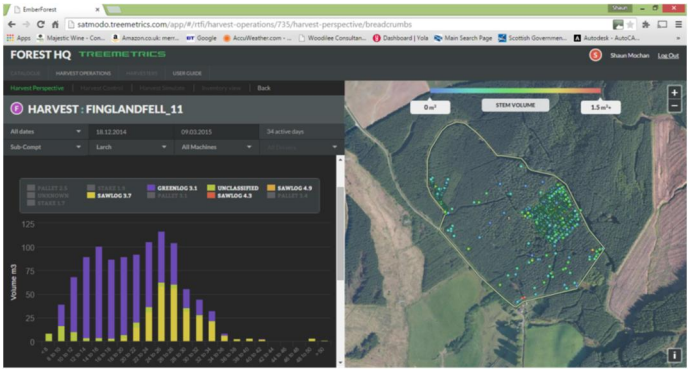
Using data collected from a 3D forest scan to input that data set into a harvester and link this with the sawmill enables the forest machine to match the volume and log size with the sawmills needs or market needs.

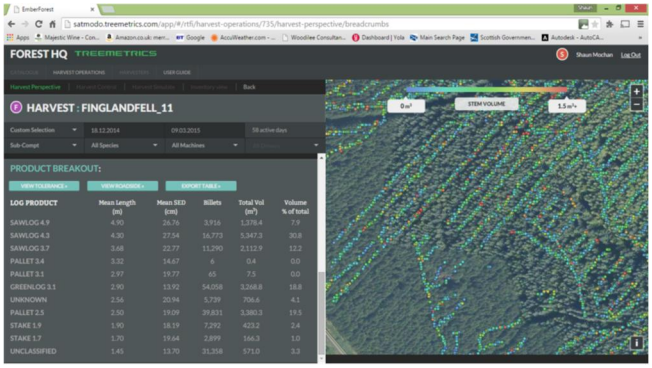
Understanding the data collected and how this can be used to inform other users the best tree form, market price before the log is cut in the forest and how this performance equates to the sawmill outputs.

Using new mapping techniques and data collection in real time the UK was able to understand the forest performance and volume in terms of log breakout, i.e. where are the better logs within the forest at that time of harvesting. Tracking the harvester in relation to volume potential enables the sawmill to understand what is coming into the mill and how this could be cut for end product use based on the current market demand and prices.

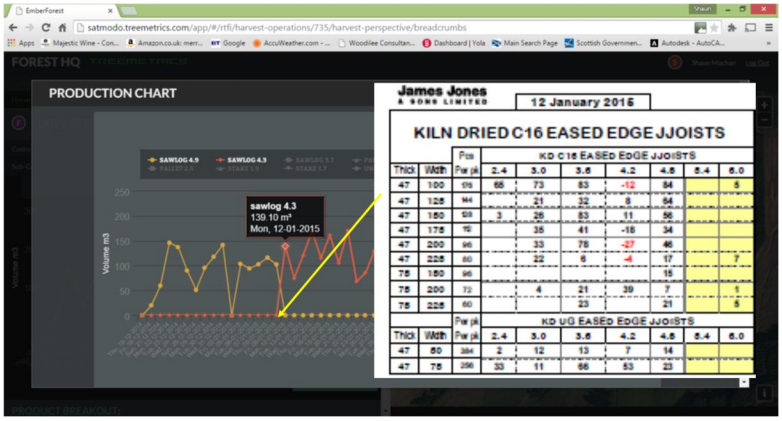


We were able to determine both species and log length being cut in the forest with a graphical display and geo referenced location to determine where each product mix was coming from. A logistical management plan can then be implemented to show time frames, aspects of quality and partial realtime outputs.





Comparing the sawmill automatic stock sheets with current timber flows enables process flows to be better managed. Knowing when the samill is short of wood or specific length and where these partitions can be found easily and logistically allows for better management and easier works flows, maximising forest value and market return.



1.3 Conclusions

The most important contributions to the state-of-the-art, derived from the results and discussion.

The results obtained in the VARMA project provide decision aids showing that the linkages in wood supply chains can be improved. The implementation of WACs in the project regions can vary greatly depending on the particular local conditions and structures. Despite of varying national approaches, similarities in challenges exist in Finland, France, Germany and the United Kingdom. Therefore, the developed outputs and models can be applied in other regions as well. Moreover, even if the primary purpose was to meet the needs of the participating countries, the results can be applied in other regions too, serving wider community.

Compared to existing processes, critical improvements can be made by adding more flexibility to the wood value chains.

- **WACs** are the **"new" business partners** in the wood supply chain and incur costs
- **Business models** have to be created so that the **total labour and costs** to supply wood **remain approximately the same or drop** (for each partner in the process as well).
    - In collaboration with the industry partners, the **performance indicators** (list of indicators) were used to demonstrate the existence of **potential savings** and WACs' capability to **boost efficiency** in wood supply operations (partner countries' case studies and scenarios).
    - The **organization of WACs in the project regions can vary** greatly depending on the particular local conditions and structures. The results obtained in the VARMA project provide decision aids. Regional development of WACs, in turn, only succeeds when all of the stakeholders along the value chain are closely involved and cooperate.

Open questions remain after the project: how to transfer the developed concepts and ideas into practice and most importantly, how to gain acceptance by the practitioners. Hence, the VARMA project built grounds for following projects to get the results of the testing and prototype level to large-scale use in the industry.

1.4a Capabilities generated by the project

Knowledge generated in the project / outcomes of the project, such as unpublished doctoral theses, patents and patent applications, computer programs, prototypes, new processes and practices; established new businesses; potential to create new business opportunities in the sector.

The project has generated understanding and capabilities on:

- pre-information on test stands for bucking simulation and optimization purposes
- accuracy of three pre-harvest inventory methods (EMO software, ALS and Trestima)
- profitability of stem bucking optimization using different measurement technologies compared to cut-to-length method in the forest
- Industrial customers' needs in wood value chains (in wood construction customer segment)
- potential for implementing WACs as new structures and organizational forms in private forests
- The results and findings of the VARMA project facilitate the creation of suitable business models (analysis, evaluation, implementation).
    - The VARMA Toolset is a resource for the creation of forward-looking WACs.
- WAC improve information and material flows along the wood value chain and also contribute to sustainable pathways for use of timber as material (carbon capture)

- Creation of a scalable and configurable logigram of the choice of a lot of road round logs according to a timber production schedule.
- Optimization program developed on PYTHON code by INSA Rennes University
- Improvement of sector's potential business and add function to the wood software sector
- How better understanding of the resources improves the way we can manage, change and adopt to increase yields, reduce costs and sharing knowledge.

1.4b Utilisation of results

Give a brief description of how the results of the research and development have been used and/or what is the exploitation plan or plans for transferring the results into practice.

The key results are reported in project reports and scientific publications. In France, the optimization software is already used by one sawmill and its use in others sawmills from SELECTION VOSGES and others will be discussed. There are plans to industrialize the software and add function such as logistic database. In Finland, the optimization tool will be demonstrated to the industry and further development collaboration will be discussed with software developers. In Germany, collaboration with regional partners will be continued. Also, initiatives has been launched regarding to mobilizing forestry cooperatives and task forces of forestry companies and haulers to identify service pooling options and structures. The results have been and are being integrated in research and academia, e.g. at Eberswalde University for Sustainable Development, Erfurt University of Applied Sciences, Wildau Technical University of Applied Sciences, and Otto von Guericke University Magdeburg. The UK needs to be more adaptive to change management in the way we deal with our data, how this is used to better understand the resource. Wider collaboration with industry partners at the outset to engage at early stages of new development. More integrated approach to combine and share datasets giving potentially more opportunities for an easier transition to use new developed ideas and techniques.

1.5 Publications and communication

a) Scientific publications

For publications indicate a complete literature reference with all authors and for articles a complete name. Indicate the current stage of the publishing process when mentioning texts accepted for publication or in print. Abstracts are not reported. Indicate the five most important publications with an asterisk.

1. Articles in international scientific journals with peer review

Siipilehto, J., Lindeman, H., Vastaranta, M., Yu, X., Uusitalo, J. 2016. Reliability of the predicted stand structure for clear-cut stands using optional methods: airborne laser scanning-based methods, smartphone-based forest inventory application Trestima and pre-harvest measurement tool EMO. Silva Fennica vol. 50 no. 3 article id 1568. 24 p.
http://dx.doi.org/10.14214/sf.1568

A manuscript titled Measuring and benefitting information on knottiness of Pinus sylvestris for improved recovery of A-quality lumber (SFOR-2017-0016) has been submitted by Dr Jori Uusitalo to Scandinavian Journal of Forest Research.

A manuscript titled "Customer value creation in B2B relationships: Sawn timber value chain perspective" by Marika Makkonen & Henna Sundqvist-Andberg has been submitted to Journal of Forest Economics.

A manuscript titled "Stakeholder perspectives of digitalization business potential in wood products industry" by Marika Makkonen has been submitted to Silva Fennica.

2. Articles in international scientific compilation works and international scientific conference proceedings with peer review

-

3. Articles in national scientific journals with peer review

-

4. Articles in national scientific compilation works and national scientific conference proceedings with peer review

Uusitalo, J., Ylhäisi, O., Rummukainen, H., Makkonen, M. (2016) Modelling knottiness of scots pines prior to or concurrently with logging operation. Proceedings of the 49th FORMEC Symposium 2016 September 4 – 7, 2016, Warsaw, Poland

5. Scientific monographs

-

6. Other scientific publications, such as articles in scientific non-refereed journals and publications in university and institute series

- "Höhere Wertschöpfung durch optimale Rohstoffzuteilung und –verarbeitung". Article in the 2014 Annual Report of the Fraunhofer Institute for Factory Operation and Automation IFF, Magdeburg, p. 62-63

a) Other dissemination

Such as text books, manuals, user guidelines, newspaper articles, TV and radio programmes, meetings and contacts for users and results.
Dissemination of results to industrial partners and industrial partners dissemination within the company.

- WoodWisdom-Net Seminars: Stockholm (9.-10. April 2014) and Duebendorf-Zurich (14-15 Sept 2015)
- "Industrie zwischen Wolke 4.0 und dem Boden der Tatsachen!. Article by Maschmann-Fehrensen, A., Holzindustrie Templin, in: Rundschreiben des Waldbesitzerverbandes Brandenburg e.V., August 2016
- Value Added by Optimal Wood Raw Material Allocation & Processing – VARMA, Website Fraunhofer IFF, retrievable from: http://www.holzlogistik.iff.fraunhofer.de/varma.html
- March 25, 2015, Fraunhofer IFF Conference "Ressource Holz2, Schloss Hundisburg, (Poster presentation by Fraunhofer IFF, HIT, Fehrensen, TUAS)
- July 8, 2015, TUAS Workshop: Timber Meets Logistics, Sustainable Forest Supply Chain Management in the Baltic Sea Region, Wildau, (Presentations by Fraunhofer IFF, TUAS, James Jones & Sons), retrievable from: www.innoholz.org
- July 8, 2015, TUAS Workshop "Anforderungen an Verteilerzentren und Bedeutung für die Branche". Wildau, TUAS, Fraunhofer IFF
- October 29, 2015, "Hol´s Holz" Industry Day of the State of Saxony-Anhalt, Magdeburg, Exhibitor Fraunhofer IFF (Poster presentation)
- November 2, 2015, Fraunhofer IFF Workshop: "Chancen und Risiken regionaler Holzverteilzentren, mögliche Dienstleistungsangebote". Magdeburg, Fraunhofer IFF

- November 13, 2015, Fraunhofer IFF Workshop: “Chancen und Risiken regionaler Holzverteilzentren, mögliche Dienstleistungsangebote”. Magdeburg, Fraunhofer IFF
- 2015, 2014 RESEARCH REPORT der Wildau Technical University of Applied Sciences, “VARMA: Value Added by Optimal Wood Raw Material Allocation and Processing”
- October 16 – 17, 2015, KWF Themed Days, Verden, Lower Saxony. Project presentation and booth with poster and display stand, TUAS
- January 21, 2016, Fraunhofer IFF Workshop: “Möglichkeiten und Potenziale des Einsatzes von Kennzeichnungstechnologien und Verfahren innerhalb der Holzbereitstellungskette”. Magdeburg, Fraunhofer IFF
- January 31, 2016, Principal Design of Novel Business Models and Networks in the Woodworking Industry. Fraunhofer IFF, Wildau Technical University of Applied Sciences 2016, retrievable from: http://www.varma-eu.com/resources/Deliverable_D3-2_Servicecatalog_engl_final.pdf
- January 31, 2016, Service-Katalog. Fraunhofer IFF, Wildau Technical University of Applied Sciences 2016, retrievable from: http://www.holzlogistik.iff.fraunhofer.de/media/pdf/varma/Servicekatalog_web.pdf
- February 5, 2016 Fraunhofer IFF Workshop: “Holzverteilzentren - eine Chance für forst-wirtschaftliche Zusammenschlüsse?”. Magdeburg, Fraunhofer IFF
- February 29, 2016, TUAS, Poster presentation at Wildau Science Week, Wildau February 29 – March 4, 2016
- April 6, 2016, Fraunhofer IFF “Ressource Holz: Leistungen Inwertsetzen” Conference, , Schloss Hundisburg, (Poster presentation, presentation Fraunhofer IFF, HIT, Fehrensen, TUAS)
- April 13, 2016, AGR general meeting, Berlin, Fraunhofer IFF, HIT, Fehrensen
- April 15, 2016, Fraunhofer IFF Workshop: “Holzverteilzentren - eine Chance für forstwirtschaftliche Zusammenschlüsse?”. Magdeburg, Fraunhofer IFF
- May 19, 2016, Fraunhofer IFF Workshop: “Bedeutung von Holzverteilzentren für die Sägeindustrie, für die Waldeigentümer, Schnittstellen von Holzverteilzentren (Organisationsform im Privatwald) zur Sägeindustrie, Anforderungen an und von Verteilzentren aus Sicht verschiedener Prozessbeteiligter”. Magdeburg, Fraunhofer IFF, HIT, Fehrensen
- May 31, 2016, “Marking Technologies in Timber Logistics: Marking System Technology Atlas2. Fraunhofer IFF, Wildau Technical University of Applied Sciences 2016, retrievable from: http://www.varma-eu.com/resources/D_4_1_Marking_System_ Techn_Atlas_final_ENG.pdf
- May 31, 2016, “Kennzeichnungstechnologien in der Holzlogistik - Technologieatlas Kennzeichnungssysteme”. Fraunhofer IFF, Wildau Technical University of Applied Sciences 2016, retrievable from: http://www.holzlogistik.iff.fraunhofer.de/media/pdf/varma/D_4_1_Kennzeichnungskatalog_final_DE.pdf
- June 8 – 11, 2016, KWF Conference, Roding, Project presentation at booth with poster and display stand, TUAS
- June 29, 2016, Highlands and Islands presentation; Understanding the supply chain and how to improve data resources.
- July 12, 2016 TUAS and HIT Workshop: “Kennzeichnungssysteme für Holz und deren Einsatz in Verteilzentren - allgemeine und regionale Anforderungen”. Wildau, Fraunhofer IFF, HIT, Fehrensen, TUAS
- September 28, 2016 North East Confederation of forest industry; Presentation on supply chain using new methodologies to determine the underlying value.
- February 3, 2017 Fraunhofer IFF Workshop: “Holzverteilzentren - eine Chance für Unternehmen des Holztransportgewerbes?”. Magdeburg, Fraunhofer IFF
- http://www.fcba.fr/sites/default/files/files/breve-nord-est-2.pdf
- http://www.fcba.fr/sites/default/files/files/Approvisionnement10.pdf
- Article in the professional journal International Timber No. 3 of January 2017
- Industrial interviews in wood products industry in 2016, Finland
- Federation of the Finnish Woodworking Industries’ newsletter, fall 2016, Finland

1.6 National and international cooperation

Give a brief description of the cooperation/ networking (partnership between the project participants and how this has developed; industrial involvement; synergies of industrial and research expertise; Has the project collaborated

with similar projects in the WW-Net countries or other regions, or established new links with/ between local or international organisations involved in the respective research field? Describe how these partnerships have supported the project.
National vs. transnational aspects in the project; added value for the project and its impacts which result from transnational cooperation.

In general the project partners' cooperation has been very constructive and the partners' cooperation has evolved positively over the project period. Co-operation with non-partners (industry, associations, industry experts and other stakeholders) has been a common practice during the project in all partner countries. Interdisciplinary exchange among partner regions' practitioners, involvement of associated partners (attendance of international project meetings, workshops, …) has been important in terms of building new knowledge and wider understanding.

In Germany, there have been regular discussions with various experts and professionals throughout the project regarding to progress of the work and informing professionals about findings:

- Cooperation with associations and regional practitioner partners (e.g.. national wood haulers' association, raw timber consumers' council, Saxony-Anhalt forest owners' association, Saxony-Anhalt business association, etc.)
- Involvement of regional practitioners in project work: workshops, surveys, presentations, discussions, data acquisition
- Establishment of a national basis for applied research in Germany by the consortium of IFF, TUAS, HIT, Fehrensen (research and industry)

The partners in Germany discuss regularly about the progress of their work with the industry and inform professionals of our (interim) findings by presenting them at workshops, by involving partners in industry task forces, and by public relations.

In Finland, involvement of the industrial partners has been very important in terms of describing the problem, providing input data and giving feedback throughout the project. The close collaboration with other research organizations in Finland has been very significant, providing knowledge and different views on the topic and creating links to other research teams. Also, an interview round executed in Finland regarding to industrial customers' needs in wood value chain has been one important channel to discuss and get feedback about the VARMA project in general, as well as disseminate the project results.

In France results from previous European projects (Indisputable key & Flexwood), and national initiative emobois were used as a basis for VARMA developments.

In France, cooperation between SELECTION VOSGES and the adherent sawyers is important in research projects focusing on wood recovery. The commercial and qualitative development is an important vector of this association. For the FCBA, the industrialists and the ministries manage the strategic orientations of research through a performance contract and professional commissions. Within the framework of the VARMA project, other European projects could be used (INDISPUTABLE KEY, FLEXWOOD, ...) as a bibliography. The research results are deployed in the actions of FCBA in the field of technical support to enterprises, standardization and certification

In the UK cooperation between private and public sector actors gave a different perspective in how to move forward using different methodologies to maximize the forest resource. Feedback through seminars and networking allowed organizations and individuals to be more open to change and how this could add value to each operational stage.

There has not been collaboration with other ongoing WW-Net projects, but developments in some of the other projects have been followed carefully, also, new contacts have been made during the WW-Net events. In addition, industry presentative beyond the project partners have been present in each partners' meetings in Finland, France, Germany and the United Kingdom.