Description of best practice

Best practice	
Title	Assessing the EU- Project “Forwarder2020” Prototypes
Picture	
Domain	Sustainable management and planning
Source of wood	Stemwood
Location	Switzerland, Saxony (Germany), Scotland, Lithuania, Romania
Implementers	Forwarder2020 Consortium
Actual status	Finished project with ongoing evaluation on demand
Approach	With two newly developed forwarder prototypes, five new and different modules were implemented and tested in the fields under varying production conditions within Europe. These modules are developed towards raising the productivity of the machine, improving the working conditions and lowering the ecological impact of the forwarding process. The modules contain a hydrostatic-mechanical transmission system (HVT, M1), a suspended cabin (M2), an energy regenerating and recuperating hydraulic crane (M3), a triple bogie axle for wet terrain, that can be used with or without tracks (M4) and a monitoring system to surveil and document the machine status to derive further information of production and environment (M5).
Main results	Within the field tests, all modules of the “Triple Bogie Prototype” (M3, M4, M5) were assessed with a positive effect. For wetland (Saxony) or even peatland working conditions (Scotland, Lithuania), the triple bogie showed advantages in technical accessibility but also the lower

	environmental impact on sensitive areas. Without the use of tracks, especially under varying, partly sensitive soil conditions the system has advantages towards other systems as the machine was able to relocate itself on own axle for long distances and provide the protection effect. The protection of ditches while entering forest stands was a positive additional effect of the system that could be observed as it acts like a built- in bridge. Due to potential high load capacity of both base machines, also a high productivity was recorded that fit or exceeded literature findings. The crane system (M3) which has also a high positive influence on the fuel consumption could withstand a fuel consumption reduction effect on its own, at is was proven under laboratory conditions. With higher productivity, now due to higher driving speeds and in course of a lowered fuel consumption, the second, "HVT- Prototype" (M1, M2, M5) setup presented its advantages especially under longer hauling distances with high possible driving speeds. This machine can be especially be efficiently used in regions with low road densities. With the monitoring system (M5), the environmental impact and the machine behavior was actively observed and evaluated. As the here implemented iFOS system is freely configurable, it was successfully implemented in the project and could for instance be further introduced as modular environmental documentation system by forest enterprises or in public services. The separately developed data-based crane scale as stand-alone or industry 4.0 service, makes it possible to use the forwarding information in logistic applications like the energy wood supply in the wood chip logistic (Geiger et al. 2019).
Lessons learned	With the tests of prototype machines, the aims of development could be proven by the field tests, that were executed within the study. Especially the effect on the soils on sensitive areas, also without the use of bogie tracks, as it was tested on distributed bark beetle infested stands in Saxony, was one field of application where the advantages of tire-based working, longer bogie axle and high contact surface were positively assessed. With more experiences, the revelation of further advantages or limitations are expected.
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Link to website	https://www.forwarder2020-project.eu/
Code	BP_CH_11

Best practice assessment

Region	Saxony, Scotland, Lithuania, Romania
Time scale	2017 – 2019
Mobilization Potential	1 – 2 m^3/ha
Kind of wood concerned	Stemwood
Sustainability Potential	Very positive – currently under complete assessment (LCA)
Impact on environment & biodiversity	Positive effect on environmental impact and forest working resilience enhancement. Also providing an environmental impact documentation system.
Ease of implementation	Difficult - Module dependent - now partially in basic portfolio of the manufacturer (HSM)
Economic impact	Due to higher potential driving speeds and thus a higher productivity as well as a lower fuel consumption under certain circumstances, a double positive effect can be noted. Also, a higher grade of profession can be reached in the supply chain by implementing the volume information in the planning process.
Job effect	Higher subjective comfort and stress relief due to highly suspended working area (M2)
Income effect	Positive / more efficient working processes / cost reduction possibility / better and enhanced working conditions in soil sensitive areas / higher productivity on low road density areas
Specific knowledge needed	Developing support of monitoring services to implement in the own software- and working environment; no additional knowledge needed on the use of the hardware equipped machine towards conventional machines.
Costs of implementation	Individually to estimate on request: - Monitoring service introduction or development - Cloud service providing Additional module cost (with new machine): - HVT transmission: app. 25 000 € - Triple Bogie: app. 29 000 € - Fully-suspended drivers cab 7 500 € Other modules on request.
Technical readiness level	Partly direct applicable – request necessary
Key information for adoption	https://www.hsm-forest.net/ Geiger, Chris; Greff, Daniel; Starke, Michael; Geimer,

	Marcus (2019): Entwicklung und Evaluation eines Wiegesystems für Forstkräne auf Basis von künstlichen neuronalen Netzen. LANDTECHNIK, Bd. 74 Nr. 5 (2019). DOI: 10.15150/lt.2019.3213.