Non-road mobile machines to accelerate the journey to green and digital transition

SIX Mobile Work Machines Position paper

Proposals for the European agenda on non-road mobile machines green and digital transition

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The non-road mobile machine sector

Non-road mobile machines (NRMM) serve a wide area of industrial sectors such as mining, material handling, forestry, agriculture and construction. They are essential assets in many value chains and serve in various tasks and environments. The mobility and a work to be done unify all NRMMs. The common features allow to harvest synergies in R&D for NRMM and to increase return of investments of the R&D.

The global market size of mobile machines covering the different industrial sectors in 2021 [1]:

- Construction and mining 167 B$
- Agriculture 124 B$
- Port cargo handling equipment 30 B$
- Forest harvesting 9 B$.

The manufacturers of NRMM are significant employers in Europe and are globally competitive. The European OEMs and system suppliers are globally leading innovators in their markets. Developing competitive solutions will enhance the efficiency, productivity, sustainability and carbon neutrality of the whole value chains in each domain the non-road mobile machines serve.

There is constant pressure for new solutions. 100 European cities have set ambitious targets to become carbon neutral by the year 2030 and the targets will directly reflect on the OEMs of non-road mobile machines at constructions sites. The Green Deal initiative will directly and indirectly impact off-highway application areas. OEMs, suppliers and service providers are to develop sustainable approaches in processes, manufacturing and product lineups.

It is predicted that the revenue of new solutions such as electrified machines will increase annually around 15% in the following five years.

New initiatives are needed. Intelligent mobile work machines, such as mining and forestry machines, agricultural machines, and logistic equipment, are a cornerstone of Finnish industry with machines and vehicles comprising more than 25% (15 billion €/yr.) of Finnish export. A group of Finnish OEMs and technology providers have formed an industrial cluster outlining an innovation road map with a vision for 2030 directly reflecting the perspective of the industry on the future research and development needs.

Vision 2030

The vision for the sector in Europe is to lead the way to *zero-emission mobile work machines enabling digital, data based and climate neutral industrial value chains,* first on the markets to foster European growth and employment. Towards 2030 Europe will be the first to fully deploy zero-emission technology on all NRMM domains. Europe will be the first to fully apply digital technologies to make the industry attractive to employees and profitable for the users and OEMs.

Green and digital transition driving the technology

The machine and mobility sector are undergoing a major Green and Digital transition with significant drivers leading to considerable needs for technology development:

- Phasing out of fossil fuels offers Europe's NRMM manufacturers an opportunity to advance in the competition by developing NRMMs with novel solutions.
- Digital technologies and data provide effective means to increase productivity, sustainability, safety and security both at NRMM and system level.

New business opportunities

The twin transition offers new business opportunities for the sector. To enable and significantly advance the transformation, several areas of technologies are being developed and applied:

- Automated and electrified efficient operation of the machine and fleet.
- New energy conversion and storage solutions connecting the machines to the energy system providing new opportunities for novel actors.
- Connectivity and co-operative operations for mission driven operations of machine teams
- System data including cyber security services supporting lifetime service business.
- CO2 free sustainable value-chains through materials, manufacturing, operation, and data

Digital technologies and data have a considerable impact on enabling new services creating additional growth for the entire business.

Boosting resources for research and development

The industry needs clear and dedicated opportunities available in European R&I programs to sustain the leading position of European OEMs and to strengthen the role of mobile machines in data-based value creation.

European innovation strategy is based on the green and digital transformations that are underway in the society. They will help to move faster towards a sustainable and prosperous future for people and planet, based on solidarity and respect for shared European values. [2]

Horizon Europe is starting to recognise the importance of more sustainable and cleaner NRMMs. As manufacturing series are smaller, cost reductions through scale benefits are harder to achieve than in the automotive sector and it requires modular and scalable design approaches. Issues related to pre-normative research, standardisation and regulations must be dealt with to support design, manufacturing, and industrial deployment.

While NRMMs are mobile, they are in fact, only part of the production and the transportation system. Thus, NRMMs are rarely addressed in transportation themes of R&I programmes, 2ZERO for road transport, WATERBORNE for maritime and shipping, CLEAN AVIATION for airborne, and relevant cross-cutting partnerships of Batteries European Partnership, Green hydrogen, CCAM and CET. Other highly relevant partnerships are Made in Europe and AI, Data and Robotics.

The RDI in these areas needs to cover both mid-TRL (RIA) for research and innovation, and higher TRL (IA) for innovation and piloting in relevant end use domains, covering the value chain from key components, powertrains, machine design, and systems engineering, alternative energy infrastructures, operations, and deployment for end-users. Several destinations have been identified supporting the thematic areas which are included in cluster 4 and 5.

Applications or use-cases of non-road mobile machines have not been addressed properly so far and considering all various forms of mobile machines it is a significant industrial sector and a growth area in Europe.

KEY RECOMMENDATIONS

- The aim is to address the industry's R&I investments in the next Horizon Europe Strategic Plan for 2025-2027 as part of Cluster 4 and 5 as well as Made in Europe, Battery Europe and Clean Hydrogen.
- Increase transparency of planning future work programs and calls
- Increase the awareness of the industry in Europe and better connect it to the existing working programs.
- Form a Public – Private – Partnership dedicated to the area.

SIX Mobile Work Machines Cluster

The Sustainable Industry X – SIX has been running since 2020 and has been formed by a number of innovative industrial companies in Finland. The SIX mobile work machine cluster provides an efficient platform to speed up the twin transition of the machine business to fulfill new requirements and create new value. To create new knowledge, expertise and capabilities it bases its operation on close co-operation between various businesses, research and academia. Currently it is in its early stages and operates nationally in Finland but will be expanding its operations rapidly across Europe.

SIX mobile Work Machines innovation roadmap

The SIX Mobile Work Machines cluster has outlined an innovation roadmap for future mobile work machine vision 2030, which consists of seven thematic areas. The thematic areas are continuously evolving, and they show the way to lead and inspire research and innovation activities in the field.

1. Autonomous and smart mobile machines with advanced operator assistance systems - efficient machine fleets.
2. Carbon neutrality, environmentally sound power solutions, fully electric mobile machines - new additional value from electrification – compact, reliable, super-efficient and safe machines
3. Connected and communicating – real time information exchange and total situational awareness.
4. Control systems for intelligence - new bus technologies, extensive computing capacity enable fluent information management and transfer.
5. Data intensive lifecycle services – need based maintenance, open data systems, advanced analytics, digital machine identity, re- and de-manufacturing, fluent software updates
6. Enabling new value from data – growth of productivity, process KPIs based on data collected by the machines.
7. Human in the loop - meaningful work ensures qualified labour for the customers, adaptive user-experience, optimized productivity and increased safety.

[1] Global Off-highway Equipment Growth Outlook, 2022, Frost & Sullivan
[2] European Commission: Research and innovation strategy 2020-2024 https://research-and-innovation.ec.europa.eu/document/download/03c65795-5c04-4feb-a701-30bc7ea9dc4b_en