

Community of Practitioners – Ensuring relevance and resilience of future Multimodal Traffic Management

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Future transport will benefit from optimizing means for the whole transport chain. Traffic management across silos or transport modalities are rare. One challenge is that operations of the different modalities for road, sea, rail, and air transport today are executed by different technologies, regulations, and degree of automation. Another challenge is the implementation of more automated vessels/vehicles. Thus, multimodal traffic system will change the way of managing the traffic system both at a strategical, tactical, and operational level.

This paper will present the EU project ORCHESTRA, for the period 2021 – 2024, focusing on designing a future Multimodal Traffic Management Ecosystem (MTME) including defining significant scenarios, stakeholder types, and functions. Two central objectives are to (1) Establish a common understanding of multimodal traffic management (MTM) concepts and solutions, and (2) define MTME.

Stakeholder involvement and anchoring process – Communities of Practitioners (CoP) – are essential in the process of developing and modifying concepts and solutions, e.g. within and across modes, for various stakeholders and contexts, where traffic managements are coordinated to contribute to a more balanced and resilient transport system, bridging current barriers and silos.

The purpose of the paper is to present and discuss how CoP may be involved in the design process of future management systems. This includes iterative interaction between project partners and operational practitioners to give input on, discuss and validate results regarding e.g. scenarios and resilience aspects.

Keywords: Community of Practice, Multimodal Traffic Management, Autonomous vehicles and vessels, Resilience, Citizen science.

1. Introduction

Traffic management usually aims for safe and efficient traffic flows within silos, i.e. managed separately for each modality (air, road, rail, and sea). However, transport systems are becoming increasingly interconnected, interdependent, and complex. Further, new challenges emerge with increased automation of the transport means and infrastructure in all transport modes.

The current EU project ORCHESTRA focuses on future traffic flow coordination and management across the modality silos in a (smaller or larger) geographical area. The aim is to provide policy makers, transport stakeholders and citizens with knowledge and (technical and organisational) solutions to enhance collaboration and synchronization of operations within and across transport modes, enhance safety, increase accessibility, and reduce emission.

The relevance of the ORCHESTRA results is validated through involvement of experts – labelled Community of Practitioners (CoP). It engages relevant stakeholder types (but not limited to) as transport service providers, traffic managers, regulators, technology providers and academia from diverse disciplines.

Since 2015 involvement of practitioners has been a requirement for EU-funded calls (EU, 2022). Important aspects of societal impacts are collaboration of partners and significant stakeholders, in addition to involvement of end-users during the project lifetime.

The ORCHESTRA CoP shall provide (a) input on needs, barriers, sensitivity to local conditions, policies, regulations, culture etc., (b) reflect upon and validate intermediate results to ensure relevance, and (c) be communication amplifiers and contribute to uptake of the results.

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2. Community of Practice

2.1. Situated learning

The concept Community of Practice (CoP) is based on situated learning theories. CoP is a basis for learning or functioning (Bootz & Lievre, 2022). The social constructivism approach to *learning* includes a belief that individuals learn and develop when participating in social activities in the world (Stene, 2009). The socio-historical perspective based on Vygotsky (1978) is a central theoretical foundation, arguing that human learning and development occur in social and cultural shaped contexts. Thus, the learning process is closely linked to involvement in community practices.

Other theorists focus more on the *functioning* of CoP, e.g. represented by Wenger (1998). CoPs are regarded as groups of people who share practices, frequently communicate, and develop a set of values and identities related to their interests and the group.

2.2. Definition

Several definitions of CoP exist. Lave & Wenger (1991) defines it as: "... a system of relationships between people, activities and the world; developing with time, and in relation to other tangential and overlapping communities of practice."

McDermott (1999) describes CoP as: "... a group that shares knowledge, learns together, and creates common practices. CoP share information, insight, experience, and tools about an area of common interest."

2.2. Three characteristics

CoP provides a social context for learning and co-creation of shared practices. Three characteristics are crucial to be considered a CoP: the domain, the community, and the practice (Mládková, 2023). The *domain* represents the shared interests and is why the CoP exists. Members are committed to the domain, which distinguish them

from other people. The *community* represents interactions, relationships, and mutual assistance among members, allowing them to share knowledge and build trust. A community to describe work collectives. The *practice* represents knowledge creation by cooperation and sharing of experiences, stories, tools, and ways of addressing problems. According to these, a CoP defines itself along three dimensions (Wenger, 1998):

- *What it is about* – Joint enterprise as understood and continually renegotiated by its members.
- How it *functions* – Mutual engagement that binds members together into a social entity.
- What *capability* it produces – Shared repertoire of communal resources (routines, sensibilities, artifacts, vocabulary, styles etc.) that members develop over time.

The driving force behind such professional networks may vary between members and may depend on what each individual values and the extent to which he or she feels a sense of belonging to the group (Wenger, 1998). Motivation and interest are important for both the creation and dissolution of a group. Some groups meet only a few times, while other professional networks can run for several years.

2.4. CoP types, members and levels

CoP may be characterized by type, members or levels. Terry et. al. (2019) distinguish between three *types*: (a) *Informal* groups seek to provide a forum for discussion among individuals who are interested in a topic. (b) *Supported* groups are sponsored by management and seek to build knowledge and skills for a given competency area. (c) *Structured* groups are developed and managed by an organisation to advance business strategies or goals.

Five types of *members* are identified: leaders or facilitators of dialogue and processes, experts of the topic, core and active members, key resources of knowledge (not meeting regularly) and peripheral participants.

Organisations increasingly seek to pilot CoPs to support knowledge management (Bootz & Lievre, 2022). *Piloted communities* (PCoP) differ from traditional hierarchical structures regarding self-organisation and control and may be classified as (a) *Strategic* or (b) *Operational*. The ORCHESTRA project may be labelled as the

former. (a) is piloted as a continuous exchange of innovative ideas based on sharing of practices and knowledge across different sectors of the organisation. Exploration aims to improve the strategic capabilities. The group manager is not necessarily an expert in the domain but has overview of potential persons and positions. (b) is managed by experts who exchange technical and operational practices to optimise daily activities. The exploitation aim is to improve existing methods. Often these communities are spontaneous and the management control relatively flexible.

3. Citizen science – Involving the public

Involving non-scientists in research and development ensures that science and technology respond to the needs, values, and expectations of society (EC, 2021).

3.1. European policy and Horizon Europe (HE)

Currently, citizen science is one of eight *ambitions* under the *Open Science policy* of the European Union. The idea is that the general public should be able to make significant contributions and recognised as valid European science knowledge producers. The aim under HE is to "*engage and involve citizens, civil society organisations and end-users in co-design and co-creation processes and promote responsible research and innovation.*"

The European Citizen Science Association (ECSA) was launched in 2013 to encourage participation of the general public in research processes. The first ECSA conference was held in Berlin in 2016. One motivation was to increase the democratization of knowledge production, by e.g. building a stronger connection between researcher related to citizen science through European projects.

3.1.1 Missions

The European Commission aim to "*engage with citizens to boost societal uptake of new solutions and approaches*". Public should be involved in actions under the HE work-programmes for all five defined *missions* (cancer, soil, climate change, restoring oceans and waters, and climate neutral and smart cities). Recently a European Mission Network (EMiN) has been created as an emerging CoP connecting key stakeholders from

business, academia, civil society organisations as well as governmental actors (FCP Flanders, 2021). The aim is to bundle expertise, experiences, scientific findings and practical examples of adaptation to the mission environment.

3.1.2. Impact of HE projects and innovations

In the impact section, HE call-topics refer to inclusion of the public. In addition to citizen science, key words are e.g. consumers, end-users, and societal engagement. HE defines three significant impact types (so-called Key Impact Pathways) – scientific, societal, and economic. To have societal impact, strengthening the uptake of R&I in society is emphasised. To accomplish this, public involvement may be one important measure.

3.2. CoP – Ensuring relevance and resilience

Practical knowledge and experience are increasingly regarded as crucial facets of operational *resilience* (Passenier et al, 2019). Involving end-users with knowledge of "work-as-done" will ensure *relevance*, e.g. in developing guidelines, tools, and training programs. People working in highly risk conditions build knowledge and experience by learning in formal training, participating in CoP, and internalizing lessons from on-the-job performance. They have insight into everyday challenges and can contribute to create relevant scenarios, adaptive performance, and how to act adequately in surprising and ambiguous situations.

Some EU founded project use the term "*Community of Practitioners*" to describe the involvement of non-academical partners. One example is the DARWIN project aiming to develop resilient crisis management in healthcare and air traffic management. To ensure *relevance*, DARWIN Community of Practitioners (DCoP) involved both operational experts and end-user organizations throughout the project (Branlat et al 2017). The evaluation process made it possible to gather early feedback and collaborative revisions of guidelines and tools: (1) initially, involving the internal end-users and experience in the two domains; (2) feedback from DCoP including experts of crisis management from a wide variety of domains; (3) 'pilot exercises' with active participation of

practitioners with experience in the two domains and from domains potentially affected by the crisis.

4. The Orchestra project

ORCHESTRA^a is an ongoing Horizon Europe project (period 2021-2025). The problem addressed by ORCHESTRA is that traffic caused by transport has many negative effects like congestions, delays, and emissions. Disruptions may challenge resilience and efficiency. One dilemma is due to current lack of coordination between the different transport modalities (road, sea, rail, and air). In addition, future transport will be more automated, including information exchange, infrastructure, and connected and automated vessels/ vehicles (CAV).

4.1. Objectives – Balanced and resilient transport system

The long-term *vision* is a future where it is easy to coordinate and synchronise the traffic management of all transport modes to cope with varied demands and situations. One central part is to define an ecosystem where traffic managements in different modes and areas (rural and urban) are coordinated to contribute to a more balanced and resilient transport system, bridging current barriers and silos.

The *objectives* are: (1) Establish a common understanding of multimodal traffic management (MTM) concepts and solutions, within and across modes, for various stakeholders and contexts, and addressing safety, resilience, accessibility, emission reduction, and business issues, (2) Define MTME (MTM Ecosystem) where traffic management in different modes and areas are coordinated to contribute to a more balanced and resilient transport system, (3) Support MTME realisation and deployment, through provision of tools, models and guidelines, (4) Validate and calibrate MTME with respect to organisational issues, functionality, capability and usability, and (5) Maximise outreach and uptake of project results.

4.2. CoP – Ensuring relevance and resilience

Validation and evaluation are making use of Communities of Practitioners (CoP) and two Living Labs (freight and person transport). CoP represents the anchoring process and is essential to ensure relevance and achieve the objectives. In addition to academia, CoP engages relevant stakeholders as policy makers, regulators, traffic managers, transport service providers, and technology providers.

Relevance: Stakeholder involvement shall enable solutions that end-users consider useful and valuable for both freight and passenger transport. Results are validated during the whole project by:

- Providing input on needs, barriers, opportunities, sensitivity to local situations, policies, regulations, culture etc.
- Discuss, comment upon, and validate intermediate results, and thereby ensure their relevance.
- Be communication amplifiers and contribute to awareness about the project and results.

Resilience: Future transport will have to handle more automated data exchange, infrastructure and CAVs, including changed way of cooperation and ways of working. To be resilient, the system adaption capabilities will be significant to cope with new normal practices, foreseen and unforeseen events prior to, during, and after disturbances or changes. Further, multimodal traffic management call for polycentric governance architecture.

4.3. CoP Workshops – Freight and person transport

Four of the eight CoP workshops are currently arranged; two in Norway, Herøya Industry Park (freight transport) and two in Italy, Malpensa Airport (person transport). The same curricula are used as basis for implementation of workshops in the two countries. The *main goal* of these CoP workshops was to ensure relevance of initial concepts and models by stakeholder involvement, interaction, and exchange of ideas.

4.3.1 The 2021 workshops

The first two workshops – one in each country – were completed in autumn 2021. The *objectives* were to (1) obtain expanded and refined visions for multimodal transport, (2) collect

^a Coordinating and synchronising multimodal transport improving road, rail, water and air transport through increased automation and user involvement.

stakeholders' opinion on MTME, (3) help designing high-level scenarios, and (4) get new ideas for the detailing of use cases for the different transport stakeholders.

The 6,5-hour workshops were structured in three main *sessions*: (1) Two Corners Debate, (2) Story-mapping, and (3) World Café.

"*Two Corners Debate*" included provocative sentences, related to the future vision for multi-modal transport (mobility in 2030 and 2050). Based on what extent they agreed, the participants were split into two groups according to whether they agree or not. Each group discussed their thesis and noticed arguments for their point of view. The groups presented and discussed the arguments, giving the participants the opportunity to grow their opinions due to the debate and exchange of information.

"*Story-Mapping*" graphically presented 2030 and 2050 scenarios through a story-map made up of different user stories. In Norway these included freight, and in Italy passengers. The participants were split up in smaller groups (4-5 people) in order to allow more in-depth discussions and exchange of ideas. Red and green Post-It were placed on a story-map board indicating negative and positive statements, critical issues, and potential problems. The group shared their thoughts, opinions, and statements along the stories, identifying enablers, barriers, and possible solutions for the 2030 and 2050 scenario.

"*World Café*" constituted focus group gathered around four tables and facilitated by a host. The objective was to get input from the stakeholders on needs and motivations regarding future resilient and multimodal traffic orchestration. Each of the table was dedicated to a specific future traffic role: Traffic Orchestrator, Transport Service Provider, Fleet Operator, and Network User. During the session the groups rotated between the four tables. Post-It was used to mark motivations and related needs related to each role. The host of each table summarized the results and discussions related to the given role.

4.3.2 The 2022 workshops

The next two workshops took place autumn 2022 – one related to freight and one to person transport. The *objectives* were that the participant together could (1) get insight into the

results achieved so far (scenarios, concepts explaining the traffic management ecosystem, tools to be used, etc.), (2) provide feedback on what is useful, necessary improvements, and fill gaps, and (3) discuss and influence further work to ensure usefulness.

The 7-hour workshops were structured in five main *sessions*: (1) Concept model, (2) Vision and scenarios, (3) Value network, (4) Living Labs and tools, and (5) Evaluation.

"*Concept model*" session included two parts – an introduction on Multimodal Traffic Management (MTM) and playing a MTM board game. The purpose of the session was to get feedback on MTM concept and input to functionality models and resilience aspects. The objective for the individual participant was to get: (a) understanding of how MTM will be managed, and what is useful, (b) be in a better position to discuss and provide input regarding the concept, (c) understand why communication and decision support is needed, and (d) understand that information hold by one actor may be useful to others. The participants were split on four groups, and played the game facilitated by a host.

"*Vision and scenarios*" split the participants in three groups, and each was dedicated to a specific scenario. One facilitator and one moderator (taking notes) were dedicated to each group. The purpose of the session was to (a) get feedback on Key Performance Areas, (b) get input to acceptance hypothesis and business models, and (c) get input to a survey and for future scenarios.

"*Value network*" included an introduction illustrating some network maps, in addition to discussion groups facilitated using defined questions. The purpose was to get feedback on (a) environmental context (values) and (b) tool requirements.

"*Living Labs and tools*" included selected stories of relevant future scenarios, in addition to illustration and videos on planned simulations in the Living Labs. The purpose was to show the partners the scenarios and use cases which will be realized in the LLs.

"*Evaluation*" included feedback on the workshop, followed by an on-line digital survey regarding evaluation of objectives, settings, processes, content, participant qualifications and evaluation/feedback during the day. The purpose

was to get a basis for improvements when planning the next workshops.

4.4. Intermediate, practical results

During the workshops intermediate drafts and models were presented for collective reflections, contributions, and corrections to ensure relevance for future MTM. Some lessons learned and practical results are:

- *CoP members are significant.* It is vital to invite relevant stakeholders with practical and operational knowledge and experience from all relevant transport modalities.
- *Preparation of workshops is vital*, e.g. objectives, participants, settings, content, methods/processes, and evaluation.
- The *target vision* for MTM is adjusted; participant gave input to needed requirement, gaps to fill, and barriers to overcome.
- *Three initial future scenarios* are formulated to ensure resilience of MTM: normal variation, expected events, and unexpected disruptions or changes.
- *Four stakeholder roles* are specified: Traffic Orchestrator, Traffic Service Provider, Fleet Operator, Network User.
- *Polycentric Multimodal Architecture:* Input to and feedback on initial concepts, function models and resilient aspects of a future Multimodal Traffic Management Ecosystem.
- *Traffic Orchestration Measures:* The board game exemplifies measures to handle transport and traffic challenges both in ordinary and extraordinary situations, e.g. by zone restrictions, priority, access control, and speed.
- *Enabling toolkit to support MTM:* Some tools are being developed regarding data sharing and governance across stakeholders, transport modes, and networks. Real-time data exchange has become important.
- *Business Value Network of MTME:* Input is given to functioning and collaboration in foreseen and foreseen disturbance scenarios.
- *Survey:* Input to key questions on new business models and acceptance hypotheses.

5. Discussion

5.1. Context and shared practice

Since context is considered crucial for learning, it is important to *create good arenas* for learning and experience transfer. CoP is usually an arena that enables the development of an organisation or companies' own expertise. One purpose is to create meeting internal organisational places for the exchange of experiences that can help improve practice.

Learning cannot be separated from the *context* in which it takes place. Ison et al (2014) argue that focusing on context in a learning context is very relevant to CoP. Theory and research emphasize the importance of social factors both for learning and for the choice of behaviour. Learning does not happen in a vacuum, but in social interaction with others. Other people are considered an important part of the context, but at the same time there is some difference in the view of how influential other people are.

Current theories within a sociocultural perspective (also called "situated" learning and socio-historical theory) argue that a person's knowledge is related to the *situation and culture*. An individual in the present will always be oriented towards the future as well as the past. Thus, the context encompasses both the present, the past and the future – including historical, organizational, and cultural features.

Thinking is rooted in a cultural-historical process that we engage in through *social interaction, primarily through language* Vygotsky (1978). Social interaction is the starting point for learning, not just part of the learning setting. Within symbolic interactionism, human behaviour is considered exclusively social and conditional (Harter, 1996). Social interaction means that perceptions of other people's opinions are incorporated into the perception of oneself (internalized). We are formed through interaction and the exchange of symbols with each other.

Language, dialogue, and reflection become essential tools for sharing experiences. Knowledge and meaning are created together with others in a process where the people act as mutual support for each other. *Language* is seen as an important tool in thinking and reflection. Although language is the primary tool for learning, other aids can also be used in interaction between people. Examples of this are

pictures, videos, books, maps, forms, and diagrams.

Active use of language is a tool for learning by taking part in the surrounding world and in building a larger cultural community. That is, *dialogue* is essential. Dialogue can include reading, listening, speaking, and writing. All four language processes are important for learning. Some theorists emphasize the very language of communication and exchange of opinions, and how the opinions of others are internalized. While others place more emphasis on reflected consideration of the input and opinions of others. This means that learning and competence development can take place by *reflecting* on other people's and one's own practice.

Terms such as the proximal zone of development and scaffolding are used to describe how a person can learn alone and with support and with others. The *proximal zone of development* implies that tasks and work are slightly above the current level of performance, not too difficult and not too easy. *Scaffolding* involves what a person can learn with support, guidance, or help from others.

In addition to learning through dialogue and language, social interaction also involves the possibility of learning through *imitation and observation* of other people who have progressed further in their development and taking part in activities with them. According to social learning theory, learning occurs in social settings and that collective mastery is the result of cooperation (Bandura, 1986).

5.3. What is the benefit of professional networks?

One key element for project success is a context characterized by collaborative processes, social interactions, and teamwork (Hertmann & Dorée, 2015). Shared understanding can improve the utilization of existing knowledge and create new knowledge in organisations (Eriksson, 2013).

Several studies indicate the benefits of meeting in *professional networks*. European proposals emphasise involvement of the public in research and innovation projects. Several projects use the term "*Community of Practitioners*" to refer to collaboration and integration of stakeholders from different domains, organisations, and management levels.

One main purpose is to *ensure societal impact and relevance*. Hence, CoP in the sense of including academical professions, operational experts, and end-user organisations may ensure relevance of project results. CoP plays a significant role in developing expertise in project management (Lee et al, 2015) by offering a kind of internal reward to participants.

CoP can be thought of as a common *arena for the development of relationships*. Such an arena can be physical, virtual, mental or a combination of these (Nonaka & Konno, 1998). Such arenas play an important role in both the formation and development of knowledge both in and between organisations. That people are meeting may offer a platform to promote individual and/or collective knowledge development.

To *meet physically* may be of importance for knowledge creation and learning. Socialization between cooperating parties in a community promotes the sharing of so-called tacit knowledge (Nonaka & Takeuchi, 1995). Tacit knowledge is about the knowledge that cannot be expressed directly with words, expressions, and numbers. It can be practice or automated skills, and where behaviour and action can be helpful illustrating or expressing what one is doing to master this. A typical example of tacit knowledge is riding a bicycle. It is difficult to describe in words how to ride a bicycle, and it is virtually impossible for a beginner to learn to ride a bicycle by reading an instruction manual. Observation and imitation are important processes that help transmit *tacit knowledge*. In an organization, tacit knowledge is about *practices, automated actions, intuition, culture, attitudes, and norms*. Polanyi (1966), who introduced the concept of tacit knowledge, argues that the silent part constitutes a significant part of the total knowledge; Knowledge expressed in words, numbers, etc. is just the tip of an iceberg.

Social networks are mechanisms or arenas for transmitting tacit knowledge between people. In addition to helping to gain insight into each other's tacit knowledge, social networks will also help *clarify contextual elements* (Wenger, 1998). In other words, insight into the context is essential for the transmission of (tacit) knowledge. Meeting physically increases the possibility of insight into other organisation and

domains' practices, culture, etc. as a basis for mutual learning and experience transfer.

Later theories emphasize collective learning, collective reflection, and community of practice (Stene, Hermundsgård & Madsen, 2010). One moves from looking at information and instructions (one-way communication) to *dialogue and collective reflections* (two-way communication). This points to the need for and importance of feedback. In connection with CoP, feedback from others on their own practice can enable participants to quickly translate into improving practice. The practices and experiences of others can provide inspiration and ideas for testing other methods and tools. Furthermore, mutual exchange and feedback may lead to agreement to test new practices and/or new aids. Through a joint project for testing practice, the participants can gain experience from operational practice in varying contexts, and further exchange experiences and tips from each other as a *basis for further improvements*.

Acknowledgement

The author acknowledges the Horizon 2020 projects ORCHESTRA (EU Grant Agreement Number: 953618).

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