

Full Paper

The Value of Rural – The case study and evaluation of “Smart Landsbygd”, and an argument for more rural living labs.

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Abstract

Broad collaborations are needed to tackle society's wicked grand challenges, yet rural perspectives are underrepresented in the data from living labs. Simultaneously, there is an overall lack of openly available data attesting to the effectiveness of living lab methodologies. This paper aims to help fill these gaps by presenting evaluation data from the “Living lab for autonomous rural transport” (called “Smart Landsbygd”) in Tavelsjö-Rödå in the north of Sweden. Smart Landsbygd is an active living lab, bringing together 19 (now over 70) partner organisations from across several sectors, for inclusive dialogues, needs analyses, service design, and demonstration development, with the aim of finding innovative solutions to the issues associated with rural transport and logistics. It has amassed a total project portfolio budget of just under €20 million towards demonstrations of improved rural logistics and personal transport solutions. The evaluation data was achieved using several evaluation frameworks, is presented in case-study format, and places particular emphasis on the identified advantages of rural living labs for both internal functioning and effectiveness from a socio-technical change perspective. The findings suggest that a rural focus could improve a living lab's capacity to tackle various grand societal challenges.

Key words (4 to 6 keywords)

Rural, Evaluation, Inclusion, Sustainability, Autonomous, Mobility.

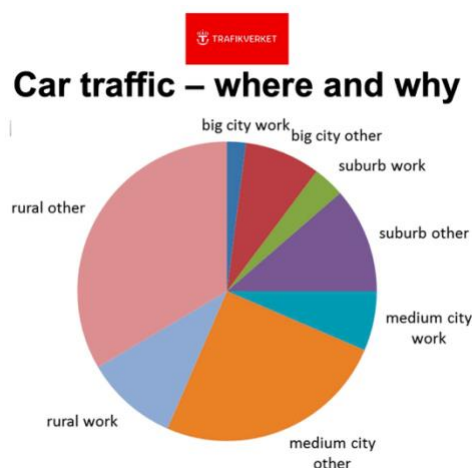
1. Introduction

Living Labs have grown in popularity over the past decades, particularly in urban areas. The ENoLL network alone sports a total of 184 active members around the world, with a majority of these having an urban focus (ENoLL, 2025). The popularity of living labs has, however, not been driven nor substantiated by openly available data attesting to the effectiveness of living lab methodologies, which is deemed as lacking (Paskaleeva & Cooper, 2021). Possible explanations for this are the long timelines for seeing large-scale system effects (though not the aim of all living labs) or the complex nature of change-processes, making causality difficult to track or argue convincingly. Recently there have been developments in evaluation frameworks, beyond concrete results. Several converging evaluation frameworks now exist for judging the effectiveness of living labs and other similar innovation system formats. Evaluation methods can use a mix of methods (Wise et al, 2022) from measuring concrete results of the actions taken, to conduct evaluation of the internal processes (typically focusing on learning), and evaluation of the effects on socio-technical change parameters.

This paper presents the background of the rural transportation challenge in Sweden, as context for the “living lab for autonomous rural transport” (henceforth referred to by its colloquial name “Smart Landsbygd”), and discusses evaluation frameworks before describing the methods and evaluation results.

1.1 Background to the challenges in the transportation sector in Sweden:

In Sweden, roughly one third of all emissions stem from the transportation sector, with 94% of these emissions attributable to road transport and the dominating culprit being private cars with a 56% share of total transportation emissions (Swedish Environmental Protection Agency, 2025).



*Figure 1. Car traffic in Sweden by person-kilometers.
Image by Trafikverket (Eliasson, 2020)*

A significant share of this transportation by car occurs in rural areas, circa 45% (Eliasson, 2020). Additionally, Sweden is an elongated and sparsely populated country, in comparison with its European counterparts, whereby a “medium city” often consists of significant segments that could also be classified as rural or at least peri-rural. For these citizens, there are generally no other practically viable options other than the car. Hiselius and Rosqvist sum it up as “the overwhelming majority of total passenger mileage by car (>90%) is produced by a minority of the population (25%)” (Hiselius & Rosqvist, 2018).

The transportation system, despite relying on the convenient private car, is still not inclusive and egalitarian. Women typically perform more errand-travel and men

typically commute further for work (Tyréns et al, 2019). Furthermore, there is a significant part of the population, particularly in rural areas, consisting primarily of elderly and youth, which are affected by “mobility poverty”, meaning that the lack of transports limits the fulfilment of their needs and desires. This is often invisible in the data, as the trips that should have happened but did not won’t appear in conventional transportation statistics. Overall, there is a disparity between women and men, and between rural and urban areas, where rural areas show a significantly higher car ownership and car dependency. A greater focus on rural mobility is particularly likely to benefit elderly, youth, low-income earners and women (Tyréns et al, 2019).

The transportation and logistics sector is similarly not efficient in these geographies. Last-mile logistics is known for being a most difficult transportation segment when it comes to efficiency and sustainability (Olsson, 2023). People take their own cars to pick up packages and small companies struggle with costs and timeliness of transportation.

The transportation sector’s complex challenges have led several institutions and agencies to conclude that electrification is necessary but not enough, innovation is a clear must (K2, 2022; Ruter, 2019; VTI, 2017).

2. Theoretical frameworks for evaluation of living labs

Despite having had significant popularity for over 20 years, the Living Lab construct, has little substantiated and openly available evidence as to its effectiveness (Paskaleeva & Cooper, 2021).

Evaluation of a living lab can have different focuses, where evaluation of how well the internal processes are being conducted according to a living lab methodology is one focus, and whether the activities which are being done are likely to be effective towards remedying the challenge (effectiveness or change potential) is another. One judges adherence to a process, the other progress/potential towards solving a challenge, according to a theory of change. Ideally the evaluation of a living lab should incorporate both perspectives.

Van Geenhuizen has developed a framework for the evaluation of the living lab process, suggesting a minimum of answering the following questions:

- A. Are we sufficiently on schedule?
- B. Is user feedback and learning being integrated into the future design work?
- C. Is there sufficient internal alignment?
- D. Are partners reasonably satisfied?
- E. Is the living lab sufficiently open towards network broadening for scaling up solutions?

(van Geenhuizen, 2018).

Wise and colleagues’ “Transformative Innovation Policy” evaluation framework further stresses aspects such as learning informing future design work, flexibility and mixed methods in evaluation of effectiveness, an adaptive theory of change, inclusivity and participatory involvement in policy development (Wise et al, 2022).

A general convergence can be seen in the literature towards these and similar key factors. Much emphasis is given in the literature to the formation of social networks and strengthened business ecosystems (Schot & Geels, 2008; Kumaraswamy et al, 2018; Garud & Gehman, 2012), as well as reflexive “niche”-internal learning that continues to guide the future work and design (Hekkert et al, 2007; Loorbach, 2010; Vinnova & Ramboll, 2023).

When working towards the global sustainability agenda and solving grand societal challenges (as opposed to more local issues or ICT development), the evaluation should include the potential effectiveness towards remedying the problem(s), through the lens of a continuously refined theory of change. The literature around how socio-technical change happens provides a blueprint and the basic contours for a more case-specific theory of change. The recurring pattern of how socio-technical change tends to happen is that an enduring need within a niche-market harbours and incubates one or more innovative solutions, which grow stronger in that protected environment, to gradually then interact with and reconfigure the larger sector. This environment is referred to as a “niche”, and the construction being reconfigured (it need not be delimited to a sector) is termed the “regime”. The importance of an enduring need or potential within a niche is often stressed for affecting change, in the historic case-studies (Schot, 1998; Schot & Geels, 2008; Geels, 2002; Loorbach, 2010; Miedzinski et al, 2019). Above the regime lies the greater macro-political, cultural and macro-economic “landscape”, which oftentimes exerts a transformation pressure upon the regime, creating internal tensions and space for new reconfigurations (Schot, 1998; Schot & Geels, 2008). Socio-technical change is thus an interplay between these three levels.

These regimes consist of mutually supporting components that can be categorized as follows:

- policies and regulations,
- knowledge base,
- culture and symbolic meaning,
- industrial structure,
- markets and users,
- technology and infrastructure,
- guiding principles

These components are mutually reinforcing and together give regimes an inertia and resistance against change (Boyer, 2013; Schot, 1998; Geels, 2002). For achieving change, a living lab or other innovation system, would ideally include a well-rounded subset of these regime components within the consortium or the larger network around the living lab.

Though widely adopted, this framework (Multi-Level Perspective theory) has somewhat undeservedly been accused of providing an overly static view of transformative change. This criticism can be resolved with the inclusion of the literature on functions of a “Technology Innovation System”, TIS, (Bergek et al, 2008), best described by Hekkert and colleagues as being:

1. Entrepreneurial activity,
2. Knowledge development,
3. Knowledge diffusion through networks,

4. Guidance of the search (that the focus and prioritization of efforts in the larger system is guided by the knowledge developed).
5. Supporting market formation,
6. Supporting resource mobilization,
7. Creation of legitimacy and counteracting resistance to change

(Hekkert et al, 2007; Bergek, 2008).

A living lab could here represent a deliberate subsystem of a larger TIS. With the possible exception of function number 2, the functions represent the externally oriented activities (from the living labs point of view) by which the living lab can be evaluated as to its effectiveness towards larger change, together with the component-representation and key transformation insights mentioned above.

Collectively, these frameworks can be used to evaluate a living labs effectiveness, supplementing possible early concrete results.

3. Methodology

The Smart Landsbygd living lab has an ambitious vision that concretizes and focuses its activity on solving rural mobility and logistics challenges. Prior to its inception, several years of dialogue and pre-studies were spent on investigating the challenge and the preconditions for a living lab.

The living lab was proposed in an era of strong urban focus. The need to broaden the range of voices in mobility innovation became apparent to avoid future solutions being designed exclusively for urban environments. Thus a living lab, with its intrinsically collaborative and inclusive design, was seen as the natural format. The living lab was established in the rural area of Taveljö-Rödåbygden in the north of

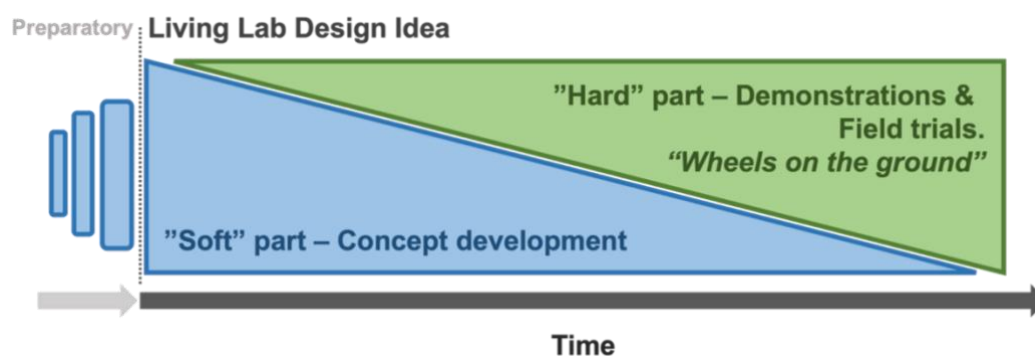


Figure 2. The Living lab portfolio design, with predecessor network projects and dialogues. The living lab is the “soft” part with needs inventory and concept development work, and the “hard” part consists of system demonstration projects.

Sweden, due to its high levels of local engagement.

Smart Landsbygd’s design was a pragmatic construction merging previous experiences with testbeds, living labs, and the latest research within socio-technical change. As such a project-based living lab was



approved, funded by the Swedish Innovation Agency and designed to be the “soft” part of the living lab-portfolio. This “soft” part was intended to engage nineteen organisations to better understand the local needs, design hypotheses for possible service solutions, and apply for permits to conduct field trials to test the identified transportation services. The corresponding “hard” part of the living lab, shown above in Figure 2., was designed to be the concrete field trials of the solutions and system concepts designed in the living lab’s “soft” part. Within the living lab these are colloquially referred to as “wheels on the ground” projects, yet also include drone and telecom projects (for connectivity in rural areas) that were deemed necessary complements to test and learn more about possible solutions. As such the living lab has had an iterative learning focus, central to living labs, which is deemed as key in the research (Wise et al, 2022; Van Geenhuizen, 2018).

As shown in Figure 2., the focus of the living lab work has shifted from needs inventory and concept development to more concrete system demonstrations and field trials, which also entailed the “soft”-project gradually adapting to a strategic-role and emphasising cross project learning. The activities of the living lab secure quality of the work by addressing all interconnected agendas of the CALM-acronym (Connect, Align, Learn, Make) (Ashoka & CoCreative, 2021).

Since its inception, the Smart Landsbygd Living Lab has followed an action research methodology. The continuous collaborative learning which informs the future work, combined with the focus on refining the theory of change (anchored in the literature) and the participatory nature of living labs fulfil and aligns with the action research methodology (Reason & Bradbury, 2001). Larger deliberate evaluations were held yearly. Due to the strategic and investigative focus of the “soft” part of the living lab, almost every meeting has embedded reflective evaluation and learning.

In evaluating Smart Landsbygd, the early success of the living lab prompted us to investigate further into “What factors can explain our early success?”(RQ) through the theoretical lenses mentioned previously. This revealed certain key drivers posited as particular to the rural element of the living lab.

4. Results and analysis

This section presents evaluation results from the Smart Landsbygd living lab in a case-study format. The results cover concrete results, internal process evaluation, and effectiveness evaluation based in socio-technical change theory. In this case-study format, the analysis is woven in with the results to provide descriptive context.

4.1. Concrete living lab results:

The living lab results include insights around the challenge(s) and solution ideas. Solutions to the identified challenges were developed iteratively, some became (“hard”) system demonstrators expanding the portfolio, others were direct initiatives. The cumulative effect is that the living lab has grown from 1 project to 11 projects in the portfolio, with a total of around €20 million in budget.

Findings from the living lab's prototype area of Taveljö-Rödåbygden, a large rural area in northern Sweden, includes that virtually all individuals are dependent of the privately owned car, that half of the population experience challenges with their daily transportation, that 22% regularly find themselves in



Figure 3. A mobile youth-centre.

“mobility poverty”, and that 17,6% experience challenges with their daily shopping and logistics. These, and more detailed, insights provide the basis for designing solutions.

One solution (Figure 3.), led by one local partner, was to buy a mobile construction barracks and refurbish it, together with the youth in the area, into a mobile youth-centre which can be transported and placed in different places in the rural community to allow greater access to all youth.

Another intervention was the trial “on-demand transport” service (Figure 4.), aimed at emulating the service and validating the results from the needs inventory. This test simulated autonomous on-demand transportation services within the rural area with 19 volunteer drivers (instructed to be passive and not engage in conversation), for 2 months. The test successfully reached 80% of the rural community (of circa 2500) with information, and 15% of the community actively used it, with an overrepresentation by youth and elderly, supporting the findings from the previous needs inventory, that these groups are particularly affected by mobility poverty. Furthermore, around 40% of the trips would not have been possible without this service, capturing data on the hidden mobility need that is invisible in conventional measurements, outside such tests.

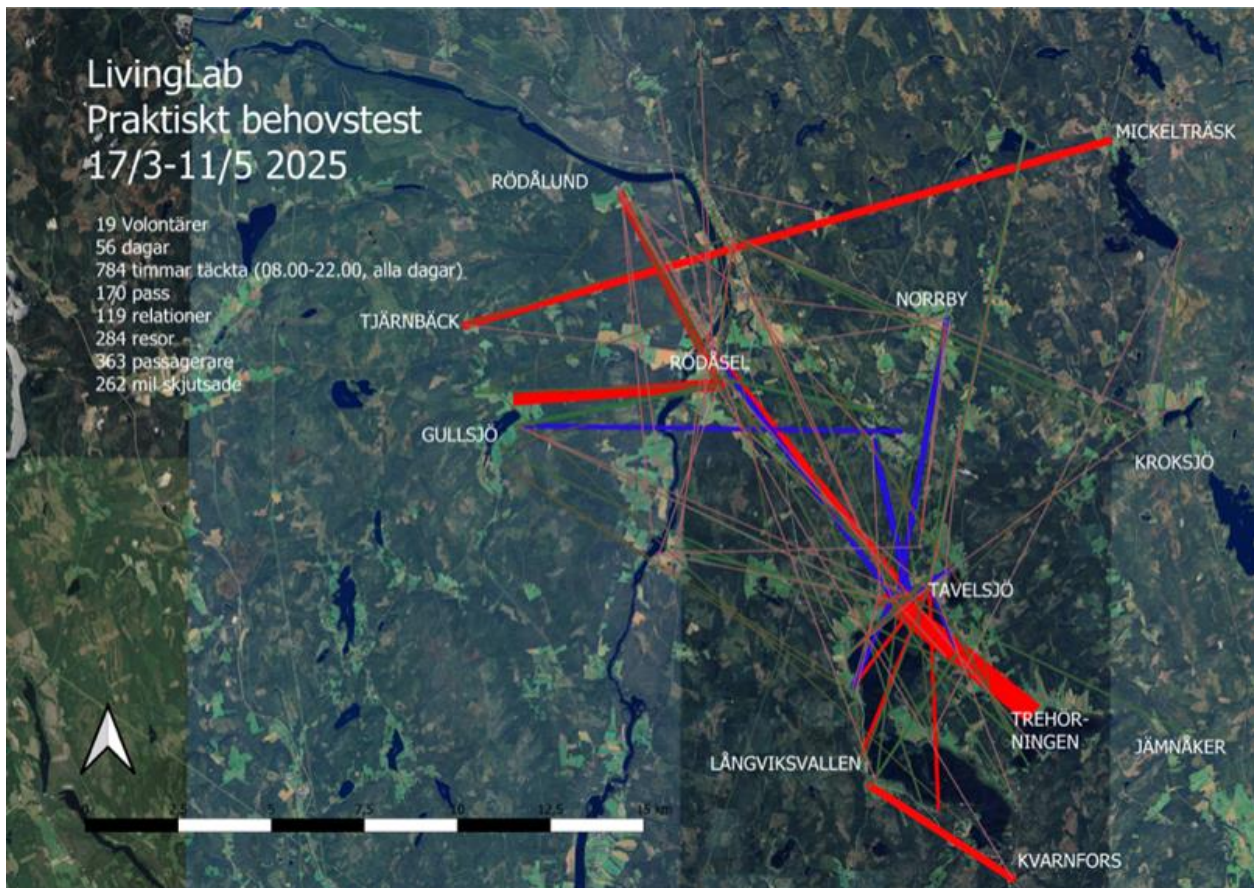


Figure 4. The data from a 2 month on-demand test showing the transport connections that were ordered. The thickness of the lines illustrate frequency of routes taken.

The high participation rate during the simulated on-demand test (15% of locals), the reach (around 80% of the locals) and the degree and depth of insights (further expanded upon in 4.2 and 4.3) appear to be a consequence of rural communities' tight networks, and lack of other "external" initiatives (excluding purely local initiatives), translating into less competition for attention, easier communications and higher commitment amongst locals. This is a share of the population that would be nearly impossible to engage in urban areas such as Stockholm or Malmö. This initiated a virtuous cycle as subsequent consequences for the lab have been an extraordinary level of helpfulness and engagement.

Opportunely, the on-demand tests benefited from a concurrent benchmark in Ruter's first autonomous initiative round in Grorud Valley (suburban area in the Oslo region), in our opinion Europe's foremost autonomous trials, now entering its second phase. They have run operations with 2-3 cars (compared to 1-2 for Smart Landsbygd) for 1 year (as opposed to 2 months) and achieved a grand total of 7046 passenger, or 5% engagement of the local population (Ruter, 2026). The extraordinary 15% engagement rate in the Tavelsjö-Rödå area is due to the severity of the mobility poverty and lack of competing solutions.

Other living lab insights required larger initiatives and were packaged into concrete services and solution concepts with associated ecosystems, becoming the basis for the “hard” projects within the living lab:

- Winter-Hugo: Small winter-adapted transport robots for several local and industrial needs.
- Rural dual-use logistics for small companies: Larger EU-pallet robots for better rural logistics
- Autonomous transports on snow-mobile trails: Using the same larger transport robot on a different road-network
- Fossil-free deliveries: Testing out drone transports to remote rural areas, compared to business as usual.
- Resilience Tests: Advancing the resilience of drones in nordic climates with challenging edge-cases and better uptime.
- Drone bases: Developing autonomous charging solutions and redesign of bus stations into drone and robot mobility hubs, for commercialization.
- Drone-logistics for the frontline: Adapted dual-use drone logistics
- A connected countryside using small base-stations: Improved rural connectivity with local autonomy and greater resilience.
- Autonomous transports during crises: Combined UAV and UGV-swarmling for preparedness.

Furthermore, the living lab results and focus proved valuable for frontline logistics, which culminated in a NATO Research Task Group and NATO-funding for a demonstration.

- Research Task Group SAS-218-“Autonomous Transport Swarms”.

Cross-pollination across projects has led to further refinement and learning within the living lab.

4.2. Evaluation results of internal living lab processes and advantages of the rural dimension:

The questions from van Geenhuizen’s framework are all answered favourably, with the exception of delays in one auxiliary permit process (A). Learning and alignment is continuously strengthened and incorporated into future design steps (B-D) and the design includes onboarding of new project members (E). Two apparent advantages with rural living labs were:

- the lower levels of other competing activity.
- the large gap in services.

These leave a persistent and engaging need for a broad and diverse set of partners to rally around. The depth of learning and collaboration here are a consequence of efforts to connect, align and build trust.

The Smart Landsbygd living lab has spent significant effort towards balancing the 4 agendas in the CALM acronym(Connect, Align, Learn and Make) ensuring that the nationally distributed partners meet regularly during physical project meetings (to connect), share and reiterate the shared mission (to align) and simply socialize(connect). This generates the mutual understanding (learning) and trust (connect) needed to be able to openly share ideas and solutions freely (learning & making). The result has been

detailed learning around the local needs, technical requirements, system actors' internal processes, different time-perceptions and desired focuses of the demonstration projects and field trials.

The breadth of collaboration has resulted in a deeper understanding of the necessary ecosystem constellations for building solution activities and shifting a system. The level of engagement and quality of collaboration has in turn been a consequence of the rural setting (decreased competition for attention) and the fact that the Tavelsjö-Rödå rural area has true needs and challenges. This allows the formulation of a truly meaningful “mission” to be tackled (Miedzinski et al, 2019), with solutions able to be generalized to additional rural areas in Sweden and the world, which generates a larger appeal and sense of greater purpose to the collaboration(alignment). These factors are internally seen as a key to the living labs success, and creative output.

The degree of learning and the weight it is given in the living lab can be witnessed by several inflection points in which the direction of the work has taken new turns based on what is learnt in the living lab.

Learning pertaining to internal learning and Hekkerts' function “guidance of the search” (Hekkert et al, 2007):

- One demonstration project used smaller transportation robots and the project realized that it was going to be too small for the rural purposes. It pivoted the whole thinking and needs perspective of the living lab consortium from then on, influencing future demonstrations and inclusion of new partners.
- A seemingly inconsequential joke on the part of one local partner, suggesting we should use snow-mobile trails because they are virtually unregulated (meaning that we could cut down trial times because we wouldn't need a permit), was taken seriously enough to the point that a new project of around €1 million was designed and initiated around training autonomous vehicles to manage terrain, which hasn't been done before.
- Local autonomy was found to be a central design criterion, for ensuring solution longevity, trust and engagement of the local community. It has since influenced the focus of all implementation thinking in the projects.
- The operational design domain (ODD) of nordic rural autonomous transports has striking similarities to the reality of defence logistics. Logistics, in turn, is an excellent form of conflict deterrence. This led to contact with several defence and preparedness players and has informed the design of 3 demonstration projects as well as led to a NATO Research Task Group around “Autonomous Transport Swarms”.

The qualities shared by these anecdotes is that they exemplify instances where true listening and desire to address a persistent and relevant issue achieved deeper learning. These insights have gradually been disseminated more broadly in interactions with e.g. NATO and the Swedish Innovation Agency (Vinnova), and early signs of being integrated in their future work can be seen.

4.3. Evaluation of potential to affect socio-technical change and the advantages of the rural dimension:

In evaluating the potential towards socio-technical change, we ought to look both at the constellation and at the TIS functions being fulfilled. In assessing constellations, regime-external “outsiders” are particularly emphasized for breadth in perspectives (Schot & Geels, 2008) and for finding “intermediate niche positions” (Boyer, 2013). From this evaluation standpoint the posited advantages of rural living labs are:

- the access to a broader and more diverse set of actors,
- the persistent and significant need of rural communities,
- the under-representation of rural environments in datasets,
- the positioning with regards to socio-technical “landscape” pressures.

In the post-Covid19 world of hybrid work, an urban living labs’ advantage of relative density and proximity between partners largely vanishes. Instead, rural living labs can now engage the same set of actors, with the addition of local SMEs and civil society, who typically would/could not engage in initiatives that are not locally relevant to them. Smart Landsbygd has actively engaged (with budgets) +70 organisations in the living lab portfolio and has contact with international bodies such as CCAM, and the EU. The concrete need and challenges have served as an engaging rallying point for this broad engagement. The breadth spans a great diversity across all quadruple helix areas from local civil-society and SMEs, to national policy-makers and multinational corporations covering virtually all components of the transportation regime. This breadth has given rise to insights in specific socio-technical domains exemplified below (F2-Knowledge development, F3-Knowledge Diffusion, F4-Guidance of the Search).

4.3.1. Technological development: With AI and autonomous solutions incorporated in many innovations and regime-shifts (e.g. autonomous driving, industry 4.0, autonomous defence tech), the technology development process becomes heavily reliant on studying large amounts of realistic/representative use-case data.

With autonomous driving this means that simply training in urban areas (which is virtually all autonomous transport testing) means training the technology to handle only a small share of the total driving workload. Instead, it is rural driving, with the greater seasonal variations in snow, road conditions, lighting, terrain and more that should comprise the bulk of the training, as only a minority of driving workload is performed in bigger cities. Limiting the training dataset, limits the learning of the technology. The living lab has performed training of autonomous drivers in rural environments (small transport robots) and on snow-mobile trails (integration with a tracked vehicle), which is data that is neither automatically obvious to train on nor immediately accessible to urban testers. In concrete terms, this unique environment has provided established commercial actors with insights into the challenges of rural environments, e.g. how to compensate for sensor vibration from driving in terrain or snowy conditions. Similar technological learning has been achieved with regards to hardware, where only rural testing can validate necessary adjustments to tire-patterns, clearance levels, suspension etc...(F1-Entrepreneurial activity)

4.3.2. Design-related learning: Boyer, Schot and Geels discuss the reconfiguration of design criteria in socio-technical transitions, and the historic precedents where shifts in desires, quality

measures, design preferences, and purchasing criteria associated with technology shifts lead to a type of blindness among incumbent actors and an underestimation of the socio-technical shift (Boyer, 2013; Schot, 1998; Schot & Geels, 2008).

In the case of the living lab and the autonomous transportation sector, the assumption that the car, in its current form, is the ideal shape for local needs is limiting and likely incorrect. We see that youth and elderly are particularly overrepresented amongst the individuals classified as suffering from “mobility poverty”. Apart from not being able to drive themselves as others would, these demographics typically have specific needs in terms of enough space for hockey equipment (particularly popular amongst youth in the north), enough space for a walker (for elderly or handicapped) or enough space for other tools and goods (for larger rural home projects). There is also an identified need to supplement or combine personal transports with



Figure 5. Concept vehicle design by Alexander Borisch, Umeå Institute of Design

being able to transport autonomous transport robots in rural areas (for economic and capacity reasons), and as such the living lab developed a new concept-vehicle design that accommodates more of the need for versatility. This design benefits elderly, youth, and people purchasing goods at IKEA even in cities, but the design needs are extra poignant in the rural areas which feel a greater mismatch between their current needs and the available alternatives.

4.3.3. Business model and ownership structure related learning: Urban areas are more densely populated compared to rural areas. Therefore, the density of possible clients is larger and the business models get designed around this setpoint. In rural areas, however, there is a need to think differently in designing the business and ownership models. Projects have failed or are rolled back due to perceived lack of economic profitability, e.g. societal telecom masts where the service providers could not see any profitability to enter (Bredbandsforum, 2022), and thus local initiatives start to own collective goods in a cooperative format. Rural areas tend to value solutions with local autonomy for these reasons. The living lab has taken such lessons to heart and, adding insights from the many local cooperative-style ownership models, investigates alternative models that typically only arise in rural communities out of necessity. One such popular model are the multiple use and income stream solutions (European Network for Rural Development, 2018), where one transportation vehicle can service several needs such as school transport, package delivery (off-peak hours), road data collection, and on-demand transport in the evenings. These multiple income streams can increase utilization of the vehicle and compensate for lack of customer density.

Lastly, two interrelated advantages of rural areas are the “landscape” pressures and the lack of services in the area leading to lower degrees of active resistance to change.

Rural areas of northern Sweden are among the populations least serviced by any transportation system. The distances are vast, the environment complicated, and the economics suboptimal for traditional solutions. The need for alternative solutions remains high, particularly amongst elderly, youth and the disabled. Bringing in new solutions for their mobility is therefore mostly welcome. The lack of solutions translates into a lack of resistance, as fewer incumbent actors exist whose interests are challenged, unlike in urban centres, as with the case of Waymo being blocked in New York (Popa, 2026). Youth and elderly have however been far from the only ones who seem to benefit from new solutions for personal transport and delivery logistics. Whilst youth and elderly have widespread popular sympathies, the full and expanded list of beneficiaries and potential users provide a driver for mobilizing more resources and engagement as well as building a niche-market that does not displace any existing interests. This is actively being argued towards institutions (F7-Counteracting resistance to change). Urban living labs, if wishing to mobilize actors, will tend to catch the attention of both creative and incumbent forces in the surrounding systems, potentially limiting the work. Rural living labs through acting in areas ignored or neglected by other activity, have both the persistent need that gathers supporters, and fewer actors or vested interests that would be sources of resistance to change. Any such interests would in such a case argue against the challenges and value created for underserved populations of youth and elderly, which we have seen to be tough from a communications standpoint. From this perspective the landscape pressures - the cultural, macro-economic, macropolitical and geopolitical exogenous environment – are poised to favourably promote a focus on rural challenges. Smart Landsbygd has actively worked together with the regionally owned(public) logistics company to form markets for autonomous logistics (F5-Supporting market formation) and to mobilize resources (F6-Supporting resource mobilization) e.g. through dual-use logics for defence along NATO's eastern border and for preparedness in general.

5. Discussion

Broadening the perspective, reveals an additional advantage to a rural focus. Tensions between urban and rural areas have been growing all over the world, Sweden included, becoming a threat to the social contract and the social sustainability of our societies. With their inherent inclusiveness, living labs could be effective tools for tackling this complex urban-rural tension, which should not be seen as separate from other issues, but an inherent dimension of an increasing number of grand societal challenges.

Trust in society and opinions on “appeal of democracy” is lower in rural communities (Erlingsson et al, 2023), as these rural populations find that more of their surrounding public institutions and services are being rolled back. This is reflected in election results around the world, not in the least in Sweden (Erlingsson et al, 2023; Holmberg & Rothstein, 2015). This erosion is due to that society and the public institutions that represent the state are not perceived as impartial. According to Missimer, Robèrt and Broman, social sustainability is to be defined through a set of first principles by which a social system's functioning can be maintained, and if eroded cause the collapse of trust and the social system. A key such

principle is specifically the impartiality of institutions (Missimer et al, 2017). This factor of impartial or inclusive institutions (and that society at large is perceived as impartial) is backed up by a large body of research on Quality of Government, with Bo Rothstein being an early proponent (Rothstein, 2005), and is the reason for the 2024 Nobel prize in economics to Daron Acemoglu and his colleagues (The Nobel Prize, 2024). If society is systematically kept from being impartial, trust, or “social capital”, in society is eroded. Degrees of trust have been shown to mediate collaboration, compliance (Rothstein, 2005) and economic performance of societies (Knack & Keefer, 1997). Blindness towards this dimension could thus hamper a living lab’s efforts.

Trust has long been hailed as the success factor of the Nordics and has been shown to fuel the economy and innovation (Nordic Council of Ministers, 2017). This erosion of trust should be considered concerning. Supporting rural communities is therefore an important activity for reversing this trend. Living labs are often publicly funded (Akasaka et al, 2025; Katzy, 2016) in collaboration with private co-financing, and as such signal a public/governmental investment and interest. Rural living labs therefore send the direct opposite message compared to the shutdowns of rural schools and clinics; since resources, time, and effort become dedicated specifically to solving the problems of these rural communities.

In the Smart Landsbygd living lab, the analyses and demonstrators have all stemmed from clear needs articulated by the rural community itself and has consequently benefitted from increased trust levels. The aim is to produce the experience of hope for the future and a feeling of trust in that the society will meet their needs on equal terms, in new and adapted ways.

From a socio-technical change perspective, there is a growing likelihood that societal landscape pressures (perhaps exempting political) will shift to increasingly promote this focus. Early signs of this are already being seen in Sweden (particularly in defence, food security, and transport). Rural-focused living labs, are likely to have an advantage in addressing large and complex grand challenges as a significant portion of our time’s challenges are inherently spatial in character or have a spatial dimension. This is directly evident of the transportation sector, yet no less the case for:

- Agriculture and food security
- Renewable energy and energy security
- Mining and forestry resources
- Water access and marine environments/ecosystems
- Defence, resilience and preparedness

Borén and colleagues argue that a key shift with the sustainable transition is that resources become more deeply tied to spatial assets whereby the technical solutions and social aspects, rural and governance questions, become more intertwined and inseparable (Borén et al, 2017; Robèrt et al, 2016). The inclusive and participatory living lab methodology could thereby be becoming increasingly more important for addressing grand societal challenges, increasingly promoted by the socio-technical landscape pressures.

6. Conclusion

Urban living labs are overrepresented in the data and there is also a lack of data as to performance of living labs as a whole. This paper has endeavoured to provide evaluation data from the “living lab for autonomous rural transports” portfolio (“Smart Landsbygd”) and highlight areas where it can be argued that rural living labs seeking to tackle a grand societal challenge can have advantages over urban counterparts. Naturally there have been challenges as well, with differences in perception of time leading to impatience, challenges with permits for field trials encouraging testing of smaller vehicles first, and with finding a structure that allows for everyone to gather and engage deeply in the work. The challenges are not deemed as specific to rural living labs, instead with the advent of hybrid work the most significant disadvantage of rural living labs is now gone. Instead, several advantages have internally appeared to be significant, these being:

- 1) Many rural areas struggle with basic societal functions and will therefore tend to converge with greater and more lasting engagement upon the fewer initiatives that do occur around them.
- 2) This rural placement and persistent need allow access to a greater breadth of actors, and the creation of a truly inspiring vision. This in turn attracts additional actors and fosters greater commitment, leading to richer perspectives and deeper learning.
- 3) There is less competition, than in urban environments, which reduces resistance among incumbents.
- 4) The trend of urbanization has left gaps that are becoming apparent, leading to a shift in landscape pressures, promoting a rural focus.

The initial design with “soft” and “hard” parts of the living lab has stood the test of time, allowing natural onboarding of an increasing number of new partners. In practice, the realized structure of the lab has seen the line between “soft” and “hard” become somewhat blurred, regarding where learning and insights arise. Additionally, for the autonomous transportation sector, Nordic rural environments represent valuable learning and training data, particularly relevant for preparedness and defence purposes.

These are advantages that the Smart Landsbygd living lab has experienced repeatedly, whether looking at concrete results generated, internal living lab processes, or external socio-technical change potential. Particularly for socio-technical change potential these advantages appear significant, suggesting that an increased rural focus would be beneficial to tackling grand societal challenges. Limitations of this study include the limited time that the lab has been running, and the inherent embedded nature of action research methods making direct replicability challenging. The advantages surfacing from the evaluation data, though arguably generalizable, have only stemmed from one sector (transportation) and one country (Sweden). Further work is needed to ascertain to what degree these advantages are recurring.

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