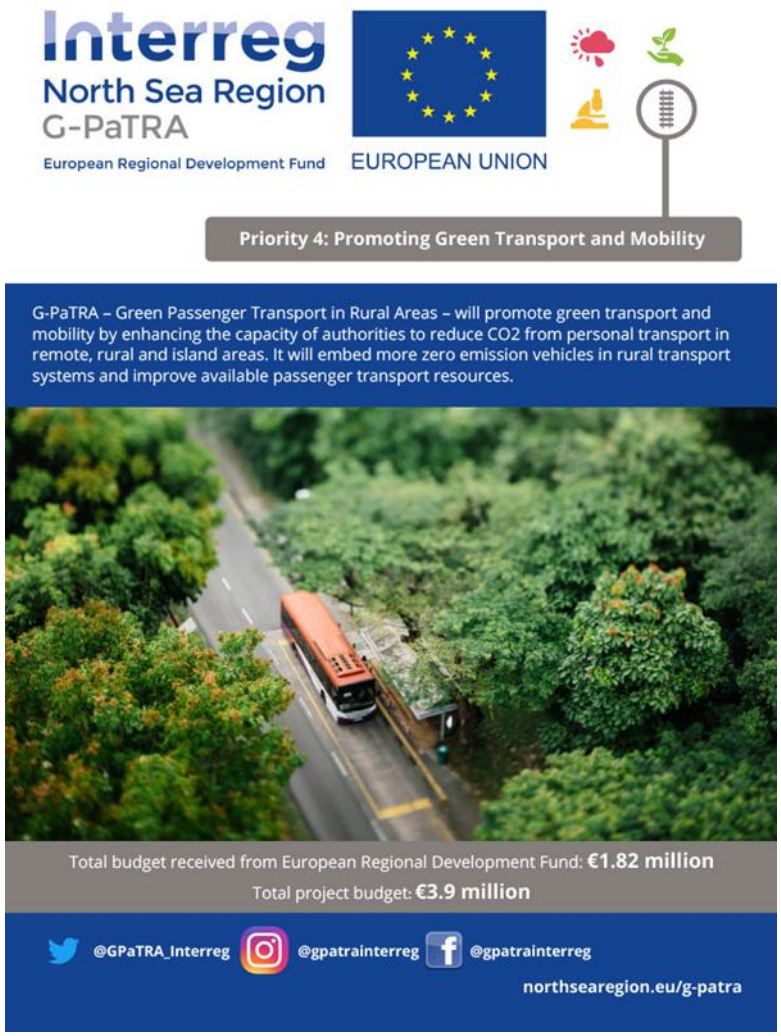

Report on Scoring Innovations in Green Passenger Transport

G-PaTRA Project Output. Work Package Five: Innovation Capture and Transfer

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EXECUTIVE SUMMARY

This report details work undertaken as part of G-PaTRA, a project funded by Interreg NSR. The report falls under *Work Package 5*, which sought to capture and assess the technological, institutional, operational and social transport innovations from the project. To allow the project to compare these innovations an innovation scoring rubric was formulated and evaluated by the project partners.

The development of the scoring rubric and the results of the scoring of G-PaTRA partners forms the basis for this report. The rubric gave the project a framework to describe and compare diverse types of innovation and identify areas where there are opportunities or impediments to transferability of innovation between jurisdictions. Project partners were supplied with the scoring rubric to consider the scores of their transport innovations ahead of an online peer group meeting with other project partners.

The scores revealed that the innovations within G-PaTRA caused, or had the potential to cause, the most disruption of an institutional (68.5) or operational (65) type. The score for technological disruption was 61.5 across the G-PaTRA innovations, and finally social disruption received the lowest score at 52 overall, meaning it had the least potential to cause change or disruption.

This means that, on balance, innovations within the project were particularly disruptive to institutions and operations, with technology also causing some disruption. High levels of technological disruption would be evident where: the technology is relatively unproven or experimental; demonstrator projects exist, but not part of core transport networks; tech is difficult to fix and maintain and spare parts very difficult to obtain; substantial and lengthy disruption if technology fails; very high costs, potentially prohibitive investment required.

High levels of disruption at an institutional level would be indicated by: disruption to the institutional practices and processes of more than one organisation; significant implications for other public sector functions; significant requirement for new skills, knowledge, funding mechanisms and/or procurement regimes; substantial institutional alignment within transport authority and stakeholder organisations; substantial opposition from senior management, sceptical elected politicians and/or colleagues; legislative or regulatory change from Government.

For operational disruption, high levels would be indicated by the presence of a number of the following: radical/revolutionary changes to operational and/or working practices of transport providers; substantial impact on two or more areas of operation; substantial need for (re)training and the adoption of new skills and knowledge; substantial opposition from stakeholders impacted by the operational change.

However, the social aspects of innovation rated lower than the other categories. This type of disruption covered impact on travel behaviour of journey makers, and the scale of social impact such as whether the innovation impacted on all of society vs social or demographic groups with particular challenges.

These results illuminated where was most likely to occur for each innovation and informs strategies to overcome the barriers associated with these disruptions. Scoring this way could guide where time and resource could best aid implementation.

In conclusion, the innovation scoring rubric was developed to better compare the effects of the G-PaTRA project innovations and it allowed project partners to measure this disruption across the four categories of technological, institutional, operational and social. The rubric could be enhanced by scoring transport solutions beyond the project lighthouses and business use cases to improve and refine the scoring and to ensure relevance beyond the bounds of the project.

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1.0

INTRODUCTION

1.1 Scope and Aims

This report details work undertaken as part of G-PaTRA, a project funded by Interreg NSR. The report falls under *Work Package 5*, which sought to capture and assess the technological, institutional, operational and social transport innovations from the project. These innovations differed in approach, scale, and operation and so an innovation scoring rubric was formulated and tested with the project partners**. The development of the scoring rubric and the results of the scoring of G-PaTRA partners forms the basis for this report.**

Project partners were given the scoring rubric and pre-formulated questions to consider the scores of their transport innovations ahead of an online peer group meeting with other project partners discussing the resulting scores. These interviews took place on the 16th, 17th and 19th of November 2020, at a time when COVID-19 restrictions were still in place.

The aim of the work was to devise a framework by which partners could compare their innovative transport solutions, while acknowledging that these solutions were often quite different in approach. This report contains the original scoring rubric, some guidance on how scoring was achieved, and an analysis and discussion of the scored given to the G-PaTRA lighthouse demonstrations and business use cases.

1.2 The G-PaTRA Project

The project sought to promote green transport mobility by **enhancing the capacity of authorities to reduce CO2 from personal transport in remote, rural, and island areas**. A variety of carbon reduction innovation demonstrator projects and case studies were undertaken, ranging from business cases for hydrogen ferries and rail, using electric vehicles on rural routes, demand responsive transport and car sharing, and the use of smart data to optimise transport resources and drivers. It launched in October 2017 and will conclude in June 2023. A final project event on 8-10 May 2023 in Orkney will wrap-up almost six years of investigation into low carbon public transport solutions across the partner countries.

There were a total of six work packages (WPs). WP1 and WP2 ensured smooth running of the project and communication with relevant stakeholders. Both WP3 and WP4 involved capturing the state of the art at transnational expert workshops and then embedding this learning in the design and planning of lighthouse demonstration projects and business use cases. WP3 focussed on accelerating the use of zero emission vehicles and vessels, and WP4 on institutional, operational and social innovation. The objective of WP5 was to capture and assess the technological, institutional, operational and social innovation from the project.

A project extension with additional budget was approved in June 2021, creating the additional WP6, which aimed to build on earlier G-PATRA work and address some of the new challenges which arose due to the Covid-19 pandemic.

1.3 Lighthouse Demonstrations

A short summary of the lighthouse demonstration projects and business use cases which ran as part of the G-PaTRA project are given below. These will feature in the later scoring and discussion sections of this report, therefore some detail as to the scope and experiences of each project are given to provide context for the scores.

Within the context of this project, lighthouse demonstrations are short term, well-defined projects with measurable attributes which serve as a model for wider implementation or scaling-up. They are usually practical demonstrations of a concept on a small scale, for example, a new type of vehicle used on one bus route. Business use cases generally consist of the presentation of desk-based research with analysis of the cost-benefit of a particular innovation and discussion of potential opportunities and challenges, for example, an investigation into hydrogen economy of a region with a view to implementation of hydrogen vehicles.

Note that the G-PaTRA project was granted an extension in 2021, which allowed partners to further develop lighthouse demonstrations, business cases, and trial new green passenger solutions. This work is reported on in other project outputs and more information can be found on the **project website** and **newsletter**.

Aberdeenshire Council, Scotland

Aberdeenshire Council conducted a total transport review which included an area-by-area analysis to maximise the effectiveness of available public sector vehicle resource. This led to a trial dial-a-bus service which served a small town and surrounding rural area. It integrated use of council minibuses, two school transport services, and Monday to Saturday 'public' services. It was an evolving mix of prebooked DRT (Demand responsive Transport) and timetabled transport, which was free to the user, used a telephone dispatch centre, conventional e-scheduling software, and an e-paper timetable. The lighthouse project results showed that there was no significantly underutilised vehicle resource and community buy-in was key. Additionally, there was a need to continuously amend service provision and change was exacerbated by the Covid pandemic. However, the project led to improved working relationships with the health sector, contact with vulnerable customers during the Covid pandemic, informed the next stage of the project (a 'clean sheet review and a digital DRT service) and the service continues post G-PaTRA.

Møre and Rohmsdal Region, Norway

This partner focussed on hydrogen production and value chain as business use cases, exploring the potential for hydrogen ferries and investigating the current and potential future hydrogen economies, particularly in the Smøla region, which is a small island in Norway. The business cases argued that there was a strong case for development of hydrogen production facilities on the island.

HiTRANS, Scotland

The HITRANS region, in the Highlands and Islands of Scotland, faces unique challenges due to the disperse population and large land mass. This means the viability of public transport is reduced and many areas in the region have limited public transport options. Private car ownership is therefore high. A number of pilot projects were ran for G-PaTRA aiming to improve public transport in the region by providing sustainable alternative transport modes for people to use rather than their cars.

E-bus - The first project pilot was an electric bus introduced in 2019, operating between Aberlour and Forres, Mon- Fri. Unfortunately, the bus was hit by another vehicle months after launch and a diesel vehicle was the only alternative and there have been challenges with charging but the vehicle has been reliable.

E-bike - Launched in January 2020 in Aviemore, Grantown on Spey and Fort William. Six bikes were supplied at each location in partnership with local bike shops to offer discounted loans to visitors and residents and was particularly helpful to key workers during the pandemic.

Battery Train - A feasibility study for a Wick to Thurso battery train was commissioned and published here. The conclusions of the study are that the use of a battery train as a viable substitute for diesel trains, in areas where overhead electrification is not viable, has significant environmental benefits.

Mpact (formerly Taxistop), Belgium

Mobihubs - Mobupunten (or 'mobihubs') are being rolled out throughout the entire Flemish region. For their G-PaTRA lighthouse demonstration, Mpact sought to investigate how this concept would work in more rural areas, where people tend to be less multimodal and rely more on car and bike. The concept involves placing a hub in a convenient location for communities which operates as a transfer point for travellers. Ensuring collaboration with communities to design a hub that has the right services, mobility options, design, and targeted marketing is key to the success for rural areas.

Quality Neighbourhoods - Building on previous experience from 2017 in the urban (Sint-Amandsberg) and semi-urban (Molenbergwijk Beveren-Waas) neighourhoods, Mpact experimented in 2018 with extending the concept of Quality Neighbourhoods into a more rural setting (Beveren-Aan-De-Ijzer). The result was **a toolkit** for municipalities in rural areas working on shared mobility to take a 'do-it-yourself' approach.

Provinces of Drenthe and Groningen, Netherlands

These two project partners worked on realising sustainable transport in the rural areas of their provinces. Transport services in the regions include trains, some luxury and high-frequency bus lines, in addition to timetabled busses or 'basic lines'. The blank spots not covered by these services are served by 'Hubtaxi', a demand-driven form of transport. The goal of the G-PaTRA lighthouse demonstration was to reduce empty vehicles in use and increase vehicle occupancy rate. They sought to achieve this through combining passengers who were making similar trips but for varied reasons. This approach needed good data to organise the trips efficiently and make billing straightforward therefore a dashboard was developed and trialled.

Leine-Weser Region, Germany

Morema - This project matched unused vehicles with possible drivers to meet mobility demands in a project named Morema (Mobility Resource Management). The unused vehicles were from Local Authorities, transport companies, the fire service and charitable organisations. Possible drivers were identified in underused bus drivers and volunteers. The mobility demands included shuttle services to connect with regular public transport, transport to events and other services in addition to regular public transport. It ran from 2018 to 2020 and was stopped due to the Covid pandemic, with a total of 545 users in 20 months. It was well received but encountered difficulties due to the insurance required for drivers and was not further developed.

On-Demand Hameln-Pyrmont - An on-demand ride-sharing project which resulted in a business case in Aerzen. This project was a political decision by the district implemented as part of the mobility concept with the aim of future realisation.

Traffic Data - This project was based on mobility data from the mobile phone network Telefonica/O2. The data encompassed the whole Leine-Weser region which comprises seven districts. It focussed on the time period from January 2019 to June 2022. The idea was to identify gaps in the public transport, map the Covid impacts and offer public transport improvements to smaller municipalities. The project required contact with the local authorities to support and evaluate their needs and uses of the data. 15 municipalities used this data and the results will be published as part of a university thesis.

1.4 Background to Innovation Scoring

Scoring and comparing innovations and the potential disruption they cause is not a new endeavour and is underpinned by a range of methodologies and theories. **This section will briefly discuss some examples from both the transport industry and related sectors such as agriculture and public policy**.

Nalmpantis et al. (2019) sought to develop a ranking method for public transport innovations which enhanced public transport employing a multi-criteria decision analysis (MCDA) methodology focussing on three criteria: feasibility, utility and innovativeness. Four lists of innovations were derived, ranked with respect to all three examined criteria. The reasoning for developing a ranking method was that the researchers felt a simple list of innovations would not be useful for Public Transport Operators as they cannot implement them all. Therefore, innovations ranked highly across the criteria could instead be prioritised.

Similarly, De Brucker et al. (2015) also employed a multi-criteria analysis to facilitate assessing and selecting investments in intelligent transport systems. Stakeholders interested in improving road safety can use the MCA tool developed in this study to assess alternative options for improving road safety, based on how each option contributes to each stakeholder group's objectives. The preferences of each stakeholder are fully taken into account in a first stage through partial MCAs, which determine how each SIP contributes to each separate stakeholder's specific objectives. In the second stage, the preferences of all stakeholders are bundled, with more emphasis on societal preferences. This second stage analysis allowed identifying policy areas where government incentives could address strong concerns voiced by particular stakeholder groups. In other words, an implicit feedback loop is generated to the SIPs' design, with 'redesign' intended to reduce the gap between societal preferences and specific-stakeholder ones, thereby increasing the probability that the support of all stakeholder groups involved could still be ascertained.

Acciaro et al. (2014) investigated successful innovations in improving environmental sustainability of seaports. The proposed framework of the research builds in part on research concepts developed in the InnoSuTra EU FP7 project. From a methodological perspective, the study developed a method for quantifying the degree of success of innovation to a set of specific objectives. Several case studies were used to test the framework against real innovation examples, such as onshore power supply, or alternative fuels. The researchers concluded that only those innovations that fit port actors' demands and the port institutional environment stand a chance to succeed.

Lamprinopoulou et al. (2014) sought to apply a comprehensive innovation systems analytical framework, looking at analyses of systemic structures, functions, failures and merits of innovation systems to assess and compare the performance of the agricultural innovation systems of Scotland and the Netherlands. An analytical framework was drawn up based on the available literature, and through a process that included document analysis and a series of semi-structured interviews and workshops with experts in the two countries the agrifood sectors were empirically assessed. Researchers found that in both countries, systemic failures in terms of actors' interactions and competencies as well as market and incentive structures were revealed. However, differences emerged between the two countries that appear to relate more to social and cultural (soft institutions) differences rather than the formal legal and regulatory frameworks (hard institutions).

Finally, Bodas Freitas & von Tunzelmann (2008) proposed and tested a three-dimensional model of public support design as a framework to compare public incentives for innovation in firms through time and across countries and to compare forms of policy alignment of innovation objectives. Using data on 149 French and British policy programmes from the early 1980s to 2002, the study showed that policy-makers implement programmes within a different three-dimensional design space in order to align objectives and to strengthen the impact of governmental measures.

The literature in this section has in common the underlying need to find a system by which innovations can be measured and ranked, whether through focus on feasibility and utility, stakeholder preferences, degree of success, or failures and merits. Similarly, G-PaTRA sought to measure and rank the innovations that formed the core of the project, with a particular focus on the potential for disruption, change, or inertia caused by various low carbon solutions for passenger transport.

2.0

THE PROCESS

2.1 Development of the Scoring

As part of Work Package 5 of the G-PaTRA project, project partner Robert Gordon University (RGU) proposed to develop a set of 'innovation change bars' to allow the project to compare lighthouse projects in terms of the amount of technological, institutional, operational and social change/ disruption associated with implementation. It would allow the project one way of comparing G-PaTRA lighthouse innovations, which could be very different from each other and in a sense would be like comparing 'apples with oranges'.

At the first project event in Aviemore in January 2018, G-PaTRA partners **grappled with the challenge of understanding and categorising a range of disparate lighthouse projects and use cases**. For example, how could the project compare the carbon reduction potential and innovation scalability of electric buses; social car share schemes; the use of software and data dashboards to optimise existing transport resources (vehicles and drivers); demand responsive transport; and businesses cases for hydrogen powered ferries and trains? **How could the project compare apples, pears, oranges and peaches?**

To help overcome this challenge, it was suggested that all the lighthouses and businesses cases had some combination of technological, social, operational and institutional innovation and change. Operating electric buses instead of diesel vehicles, for example, involved a substantial amount of technological and operational challenge. In terms of the latter, the limited range of battery powered buses latter might involve more frequent refuelling and the use of additional vehicles, impacting on timetabling, driver numbers, and shift patterns, while the introduction electric vehicles would require new maintenance regimes and training for drivers and mechanics. It may be thought that the institutional and social change involved in replacing one type of vehicle for another would be relatively modest. A social car share

scheme, by comparison, would have little technological, operational or institutional impact, but the social innovation – getting journey makers to change their travel behaviour – would be substantial.

Using data optimisation to optimise the use of vehicles and drivers operated by a range of public sector bodies would involve significant operational and technological innovation and more modest social change. However, it might be argued that encouraging public sector partners to embrace a new modus operandi, changing the way they do things when transport is not necessarily their core business, would involve substantial institutional innovation.

Thus, the G-PaTRA project started to conceptualise much of its thinking and analysis in terms of these four dimensions of innovation, change and disruption (and inertia): **Technological; Operational; Institutional; and Social**.

This informed the development of an innovation scoring rubric, which considered the extent to which each dimension could be scored according to the level of change or disruption (or inertia) potentially caused by innovations. The scoring system indicates the degree of disruption cause by the transport innovation and could range from 0 to 10 (with the social category split into two with each allowing for a score of 5).

As an example, for the technological dimension of an innovation, a '0' score would be attributed where there was 'no technology involved' and a '9 or 10' would be given if 'adoption of technology that is relatively unproven or experimental in both urban and rural settings. There may be demonstrator projects, but not part of core transport networks'. The examples described in the scoring rubric were drawn from numerous project workshops as partners reflected on their experiences launching lighthouse demonstrations or building business cases for their innovations.

The decision to split the social category arose because of the need to differentiate between the impact of the innovation on people's journeys and decision making, but also the extent to which it reaches all of society or certain social groups. For example, innovation could have a significant benefit for or require significant change for one social group such as the elderly, but not have much impact on the rest of society. Or there could be significant impact on everyone's journey-making decisions in terms of their destination, trip purpose, times of the day, and day of the week.

2.2 The Scoring Dimensions

As mentioned, each transport innovation was scored across four dimensions: Technological; Institutional; Operational and Social. The below sections detail what was considered as part of each dimension.

Technological The technological dimension focused on adoption of technology, particularly: the degree to which the technology was experimental or unproven; whether there were demonstrator projects; how difficult it was to fix and maintain and how difficult spare parts were to obtain; disruption to journey if technology fails; and level of investment.

Institutional This dimension encompassed: disruption to the institutional practices and processes of more than one organisation; implications for a number of other public sector functions –land use planning, health and social care, education, etc.; new skills, knowledge, funding mechanisms and/or procurement regimes; institutional alignment within transport authority and across stakeholder organisations to progress; opposition from senior management, sceptical elected politicians and/or colleagues, for whom the innovation is not core business; legislative or regulatory change from regional or national Government.

Operational The operational dimension covers: operational and/or working practices of transport providers; areas of operation such as refuelling, shift patterns, deployment of employees, collection of fare box revenue, use of vehicle routing technology, new types of vehicles or vessels; (re)training and the adoption of new skills and knowledge; stakeholders impacted by the operational change (e.g. management and shareholders of transport providers, trade unions, employees, etc.); timetabling/ trip scheduling.

Social Finally, the social dimension was divided into two parts, the first considered impacts on travel behaviour of journey makers, the second focussed on whether the innovation impacted on all of society vs social or demographic groups with particular challenges.

2.3 The Scoring Process

Project partners were given the scoring rubric (see section 2.4) in advance to consider the scores of their lighthouse demonstration projects of business use cases. They scored their projects independently prior to discussion at group workshops. Partners then met online to discuss and share the reasoning behind their chosen scores. Thus, the scoring was refined through a process of peer review and resulted in an agreed score for each partner project. This method ensured consistency in approach to scoring amongst the project partnership and validated individual scores.

Some partners reflected more generally upon the different elements in a dimension and arrived at a final overall score. Others scored with more granularity, scoring the examples given in each column of the rubric and arriving at an average or overall score.

The peer review sessions took place online on the 16th, 17th and 19th of November 2020, at a time when COVID-19 restrictions were still in place. Three groups were arranged: Group 3 met on the 16th of November and comprised Aberdeenshire Council and Provincie Drenthe; Group 2 met on the 17th of November and in attendance were HiTRANS, Møre & Romsdal Council, and Smøla Business & Culture Centre; Group 1 met on the 19th of November and comprised Leine-Weser, Aalborg University, and Mpact. Urban Foresight and RGU staff members were also present at each peer review workshop to facilitate the discussions and record the scores.

These sessions also featured an evaluation interview for G-PaTRA project members. Partners were asked to consider the following in relation to their innovation: successes; barriers; solutions to barriers; lessons learned; impacts; identification of stakeholders; key information for stakeholders; stakeholder collaboration and buy-in; replication and scaling-up; and the post-project legacy. The results and analysis of these interviews are covered in other complementary G-PaTRA reports.

2.4 The Rubric

This section contains an outline of the Innovation Scoring Rubric developed for the project. The template contained guidance to allow each project partner to score their own innovative transport solution, but the resulting scores were decided as part of a peer group workshop to ensure consistency in approach.

The scoring document itself can be viewed as a series of sections. Firstly, an introductory section asks for some basic partner and project information and outlines the aims and scope of the scoring, giving some pointers as to how to use the rubric. This section is shown below.

Next, partners were given an overview of the scoring and what each score threshold would indicate when applied to their transport solution for each of the four areas of innovation: technological, institutional, operational, and social. As such, these scoring tables follow in the next section.

Innovation Disruption Scoring Rubric	
Partner name	
Lighthouse project	
Peer review partner	
Introduction	• Aim to capture amount of change (or disruption) involved with your rural transport innovation. • A framework to describe and compare several types of innovation and identify areas where there are opportunities or impediments to transferability of innovation between jurisdictions. • 4 main dimensions of innovation identified (technological, institutional, operational and social). • Each lighthouse demonstration project should be to be scored out of 10 on each dimension using the rubric below, based on the amount of change/ disruption involved. • The score for **social change** comprises **2** scores out of **5**. (so you have to score 5 sections: three out of 10 and two out of 5). • Please provide a paragraph or a few bullet points to support/ justify your score for each of the dimensions. • The scoring must be peer reviewed in a WP5 meeting. • Any comments, observations, anomalies and qualifications highlighted during the scoring process should be captured below.
Process: comments, observations, anomalies & qualifications	

Technological innovation						Score for project
Level of change or disruption						
0	**1 or 2**	**3 or 4**	**5 or 6**	**7 or 8**	**9 or 10**	**0-10**
No technology involved. No cost involved.	Adoption of technology that is proven, resilient, well understood and which has been adopted widely in different geographic locations. Easy to fix and maintain/ spare parts easily available. Journeys can still be made without significant disruption if technology fails. Low cost. For example: software solutions such as fleet optimisation algorithms.	Adoption of technology that is relatively commonplace, has been demonstrated to work in rural setting and is set for mainstreaming in rural and island areas. Straightforward to fix and maintain/ spare parts easily available. Some disruption to journey making if technology fails. Appreciable additional investment required (potentially revenue rather than capital). For example: journey planning/ car sharing Apps.	Adoption of technology that is becoming more common place, has proved to be reliable in urban settings and where there are a small number of passenger transport demonstration projects in rural areas. Resilience and reliability in rural setting may be an issue, as is maintenance support and speed of repair. Appreciable disruption to journey making if technology fails. Significant revenue and/or capital investment required. For example: electric buses/ system wide trip management software.	Adoption of technology that has been demonstrated in certain (urban) settings but is untested in rural areas. Technology may be embedded in a handful of urban transport networks but not in rural or island areas. Potentially difficult to fix and maintain and spare parts difficult to obtain. Significant disruption to journey making if technology fails. Substantial investment required. For example: hydrogen fuel cell technology in buses.	Adoption of technology that is relatively unproven or experimental in both urban and rural settings. There may be demonstrator projects, but not part of core transport networks. Potentially very difficult to fix and maintain and spare parts very difficult to obtain. Substantial - and potentially lengthy - disruption to journey making if technology fails. Very high, potentially prohibitive investment required. For example: autonomous vehicles.	

Institutional innovation *(impacting municipalities, transport authorities and their stakeholders)*						**Score for project**
Level of change or disruption						
0	**1 or 2**	**3 or 4**	**5 or 6**	**7 or 8**	**9 or 10**	**0-10**
No impact on institutional practices or processes.	Innovation has an appreciable but not significant impact on day-to-day institutional practices and processes of one organisation but does not significantly impact on other stakeholder organisations. Transport innovation has limited implications for one or two other public sector functions –land use planning, health and social care, education, etc. Little or no requirement for new skills, knowledge, funding mechanisms and/or procurement regimes. Presence of alignment within transport authority helpful but not critical. Project champions unlikely to encounter opposition to project.	Innovation has a significant impact on the day-to-day institutional practices and processes of one organisation and may require cooperation from other stakeholder organisations. Transport innovation has appreciable implications for one or two other public sector functions Limited requirement for new skills, knowledge, funding mechanisms and/or procurement regimes. Presence of alignment within transport authority and with stakeholder organisations helpful but not critical. Project champions may encounter a degree of opposition from colleagues and/or sceptical elected politicians.	Innovation has a significant impact on the day-to-day institutional practices and processes of more than one organisation. Transport innovation has significant implications for one or two other public sector functions. Appreciable requirement for new skills, knowledge, funding mechanisms and/or procurement regimes. Requires presence of alignment within transport authority and with stakeholder organisations to progress. Project champions will meet with appreciable opposition sceptical elected politicians and/or colleagues, for whom the innovation is not core business. May require approval from regional or national Government.	Innovation involves substantial disruption to the institutional practices and processes of one organisation while having a significant impact on others. Transport innovation has substantial implications for one or two other public sector functions. Significant requirement for new skills, knowledge, funding mechanisms and/or procurement regimes. Requires strong institutional alignment within transport authority and with stakeholder organisations to progress. Project champions will meet with significant opposition from sceptical elected politicians and/or influential colleagues, for whom the innovation is not core business. May requires legislative or regulatory change from regional or national Government.	Innovation involves substantial disruption to the institutional practices and processes of more than one organisation. Transport innovation has substantial implications for several other public sector functions. Significant requirement for new skills, knowledge, funding mechanisms and/or procurement regimes. Requires substantial institutional alignment within transport authority and across stakeholder organisations to progress. Project champions will meet with substantial opposition from senior management, sceptical elected politicians and/or colleagues, for whom the innovation is not core business. Requires legislative or regulatory change from regional or national Government.	

Operational innovation *(impacting transport providers and operators)*						**Score for project**
Level of change or disruption						
0	**1 or 2**	**3 or 4**	**5 or 6**	**7 or 8**	**9 or 10**	**0-10**
No impact on operational working practices of transport providers.	Will require minimal changes to operational and/or working practices of transport providers. Appreciable impact on one area of operation (refuelling, shift patterns, deployment of employees, collection of fare box revenue, use of vehicle routing technology, new types of vehicles or vessels). Little or no need for (re)training and the adoption of new skills and knowledge. Little or no opposition from stakeholders impacted by the operational change (e.g. management and shareholders of transport providers, trade unions, employees, etc.)	Will require appreciable changes to operational and/or working practices of transport providers. Significant impact on one areas of operation (refuelling, shift patterns, deployment of employees, collection of fare box revenue, use of vehicle routing technology, new types of vehicles or vessels). Limited need for (re)training and the adoption of new skills and knowledge. Limited opposition from stakeholders impacted by the operational change (e.g. management and shareholders of transport providers, trade unions, employees, etc.)	Will require significant changes to operational and/or working practices of transport providers. Significant impact on one areas of operation and appreciable impact on others (refuelling, shift patterns, deployment of employees, collection of fare box revenue, use of vehicle routing technology, new types of vehicles or vessels). Appreciable need for (re)training and the adoption of new skills and knowledge. Appreciable opposition from stakeholders impacted by the operational change (e.g. management and shareholders of transport providers, trade unions, employees, etc.)	Will require substantial changes to operational and/or working practices of transport providers. Significant impact on two or more areas of operation (refuelling, shift patterns, deployment of employees, collection of fare box revenue, use of vehicle routing technology, new types of vehicles or vessels). Significant need for (re)training and the adoption of new skills and knowledge. Significant opposition from stakeholders impacted by the operational change (e.g. management and shareholders of transport providers, trade unions, employees, etc.)	Will require radical / revolutionary changes to operational and/or working practices of transport providers. Substantial impact on two or more areas of operation (refuelling, shift patterns, deployment of employees, collection of fare box revenue, use of vehicle routing technology, new types of vehicles or vessels). Substantial need for (re)training and the adoption of new skills and knowledge. Substantial opposition from stakeholders impacted by the operational change (e.g. management and shareholders of transport providers, trade unions, employees, etc.)	

Social innovation 1. *(impacting on travel behaviour of journey makers)*						**Score for project**
Level of change or disruption						
0	**1**	**2**	**3**	**4**	**5**	**0-5**
No impact on journey making choices and practices.	Will require relatively modest changes to people's journey making choices and practices. People will change the way they travel to some degree but not for most: destinations; trip purposes; times of day; day of week. The change will involve long-term change in behaviour for beneficiary households.	Will require appreciable changes to people's journey making choices and practices. People will choose to change the way they travel for a limited number of: destinations; trip purposes; times of day; day of week. The change will involve a long-term change in behaviour for an appreciable number of households.	Will require significant changes to people's journey making choices and practices. People will choose to change the way they travel for some but not all: destinations; trip purposes; times of day; day of week. A reduction in car use should be evident. The change will involve long term change in behaviour for a significant number of households.	Will require substantial changes to people's journey making choices and practices. People will choose to change the way they travel for a majority of their journeys but may not make exceptions for some: destinations; trip purposes; times of day; day of week. Innovation will reduce car use appreciably. The change will involve long term change in behaviour for a substantial number of households.	Will require radical / revolutionary changes to people's journey making choices and practices. People will change the way they plan journeys travel for almost all: destinations; trip purposes; times of day; day of week. Innovation will impact on the journey making of everyone in society. Innovation will reduce car use significantly. The change will involve long term change in behaviour across society.	

Social innovation 2. *(impacting on all of society vs social or demographic groups with particular challenges)*						**Score for project**
Level of change or disruption						
0	**1**	**2**	**3**	**4**	**5**	**0-5**
No impact on journey making choices and practice.	Innovation will tend to benefit one or two social or demographic groups with particular mobility challenges (e.g. the elderly, the young, disabled, low income, students, job-seekers). Will require direct engagement and awareness raising with impacted groups.	Innovation will tend to benefit or impact on social or demographic groups with mobility challenges and others who currently rely on public transport. May require modest and targeted public engagement and information to educate users about, and enable to use, innovation.	Innovation will widen the travel choices of most social or demographic groups. Will require appreciable public engagement and information campaign to educate and enable them to understand how to use innovation.	Innovation will impact on the journey making of most social and demographic groups. Will require significant public engagement to educate and enable them to understand how to use innovation.	Will require radical / revolutionary changes to people's journey making choices and practices. Will require substantial public engagement and information campaign to educate and enable them to understand how to use innovation.	

3.0

FINDINGS

3.1 Overall scoring

This section details the findings of the scoring. It first summarises the scores and looks at overall levels of disruption of change caused by the various innovations within the G-PaTRA project.

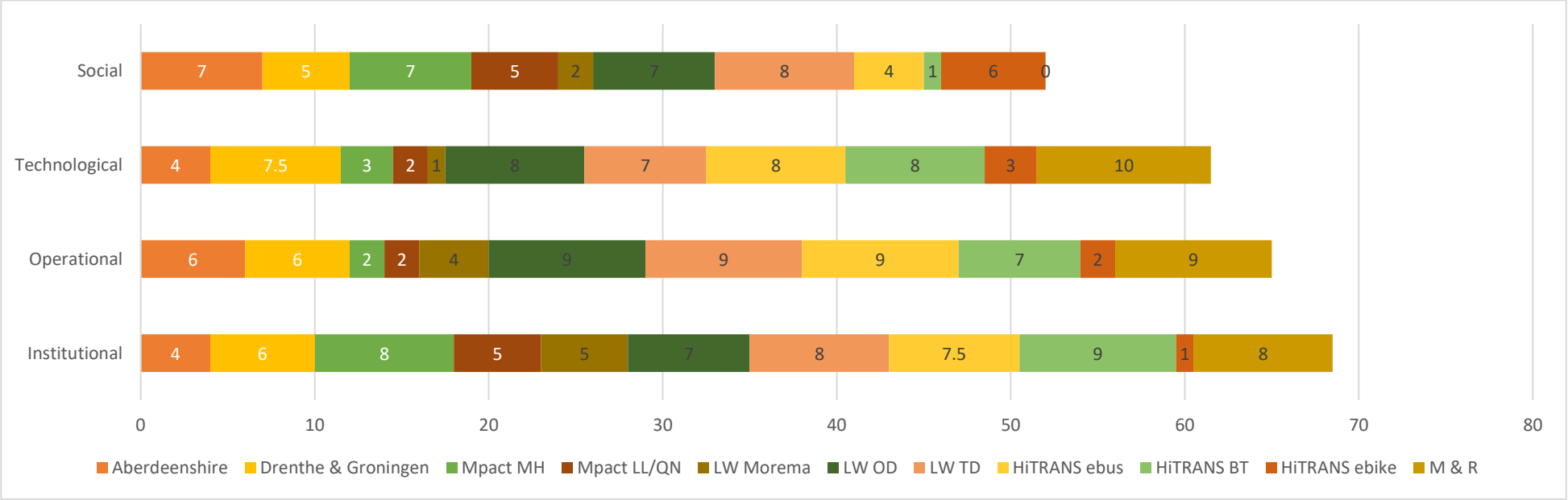
Next, it takes a closer look at the four different types of innovation and the scores achieved by each lighthouse demonstration project or business use case.

As can be seen in the first table below and the following bar chart, the area which caused the most disruption was institutional, closely followed by operational, and then technological. The social category scored last overall.

	Technological	Institutional	Operational	Social Combined	Social 1 [(a)]	Social 2 [(b)]	Total
Aberdeenshire	4	4	6	7	3	4	21
Drenthe & Groningen (D&G)	7.5	6	6	5	1	4	24.5
Mpact - Mobility hub (MH)	3	8	2	7	3	4	20
Mpact - Living labs/ Quality Neighbourhoods (LL/QN)	2	5	2	5	1	4	14
Leine Weser - Morema	1	5	4	2	1	1	12
Leine Weser - On-Demand Hameln-Pyrmont (LW OD)	8	7	9	7	3	4	31
Leine Weser - Traffic Data (LW TD)	7	8	9	8	4	4	32
HiTRANS - ebus	8	7.5	9	4	2	2	28.5
HiTRANS - Battery Train (BT)	8	9	7	1	1	0	25
HiTRANS – ebike	3	1	2	6	3	3	12
More and Rohmsdal (M&R)	10	8	9	0	0	0	27
Total	61.5	68.5	65	52	22	30	

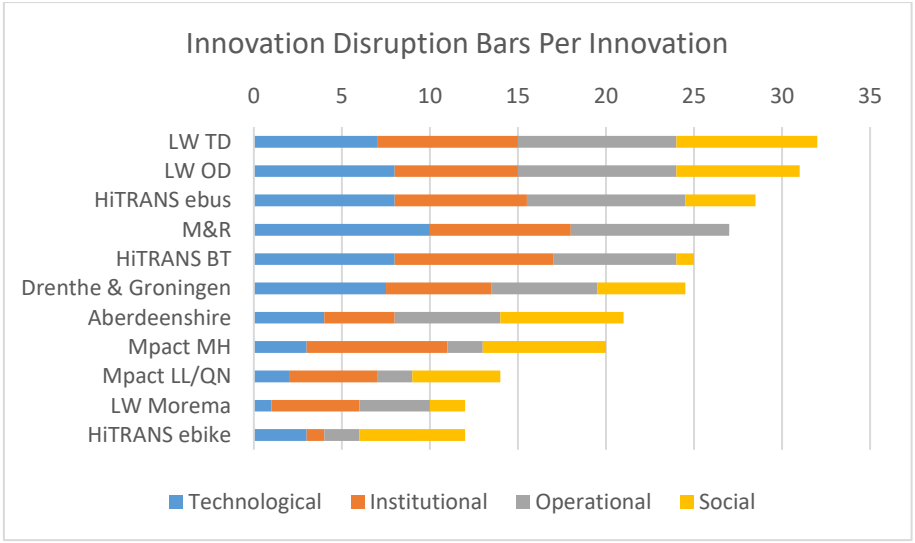
[(a)] Social innovation 1 - impacting on travel behaviour of journey makers.

[(b)] Social innovation 2 - impacting on all of society vs social or demographic groups with particular challenges.



3.2 Overall levels of innovation disruption

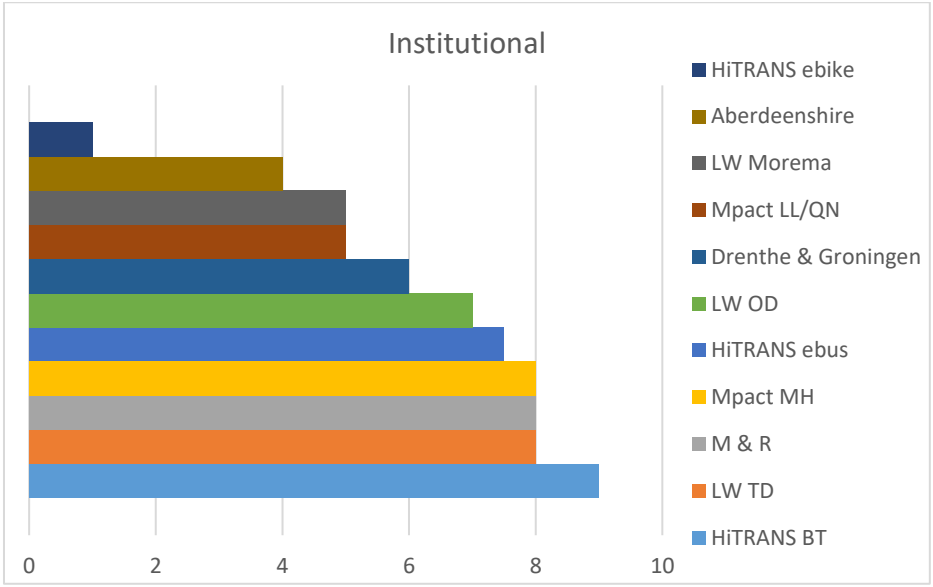
Next, we consider the overall scores for each innovation within the project. As can be seen in the chart, , the Office for Regional Development Leine and Weser Region projects **'traffic data' and 'on-demand Hameln-Pyrmont' projects scored highly overall** (followed by **HiTRANS 'e-bus' project**). This indicates high levels of disruption for these types of innovations compared with others trialled as part of the G-PaTRA project with a large degree of disruption and change to the current transport provision and way of doing things.

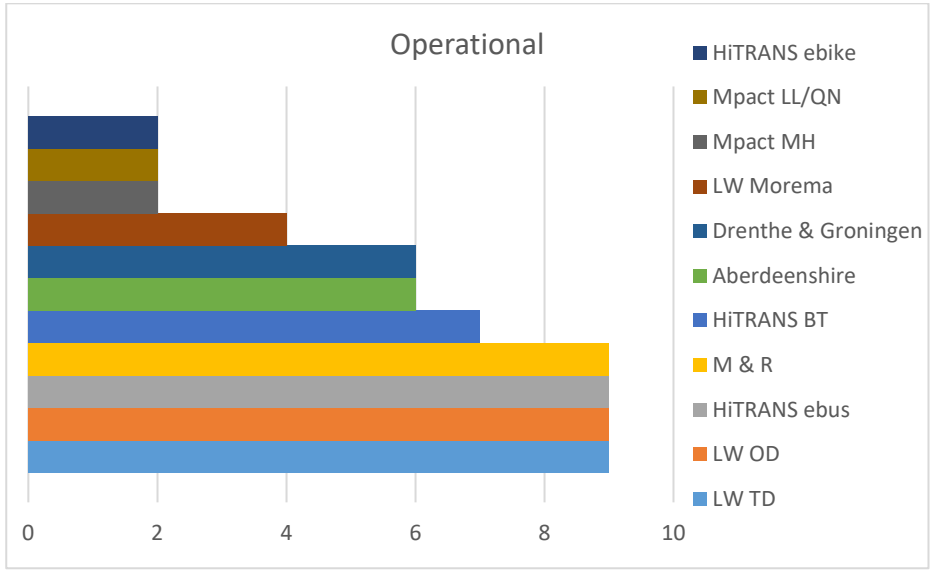


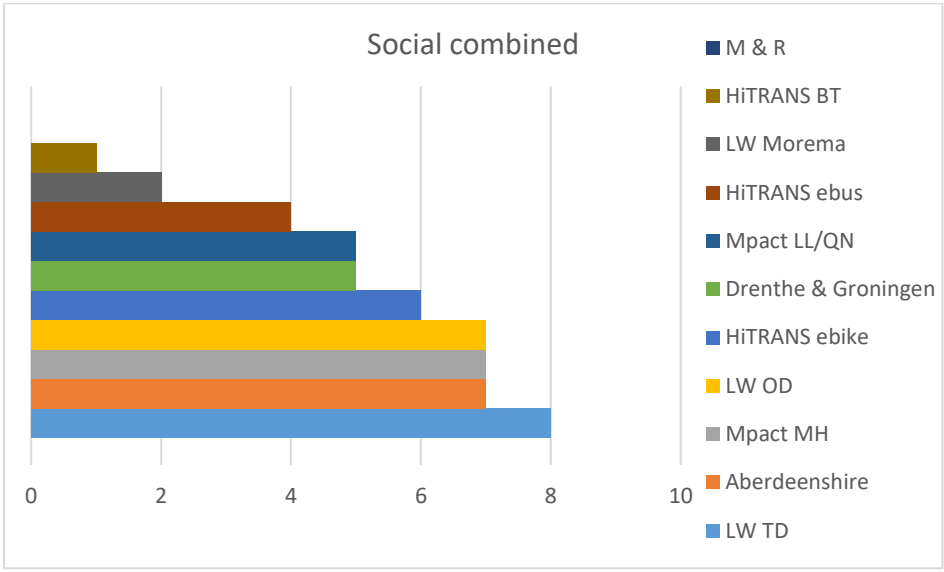
By contrast, **the HiTRANS 'e-bike' scheme, Leine and Weser Region's 'Morema', and Mpact's Living Labs innovation all scored much lower overall.** This indicates that these innovations are less disruptive, and don't involve as much change to current transport options.

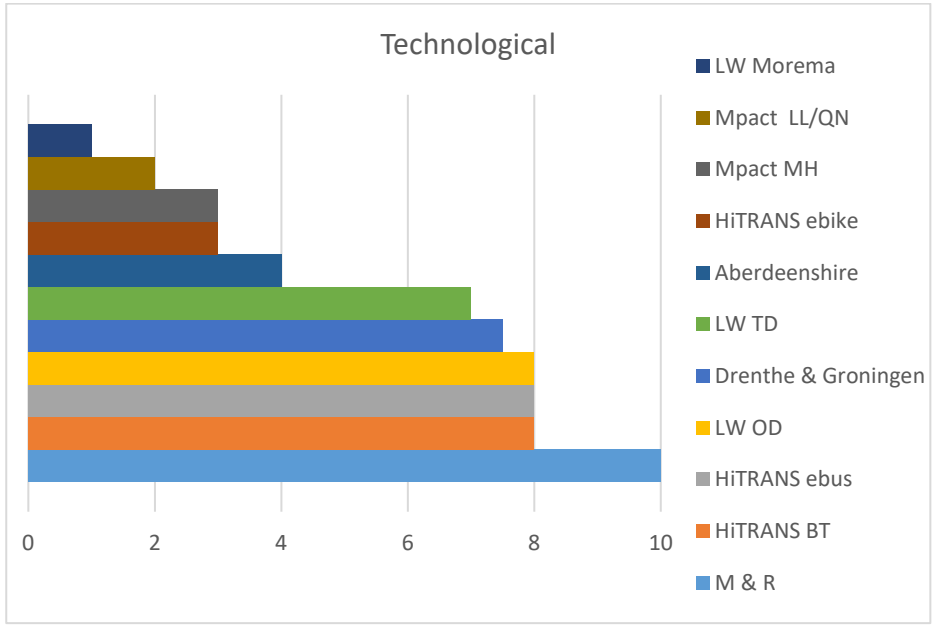
3.3 Types of innovation disruption per project

The next four graphs detail the innovation disruption scores by type and by project. These graphs allow the reader to quickly establish which are the most and least disruptive innovations per type.



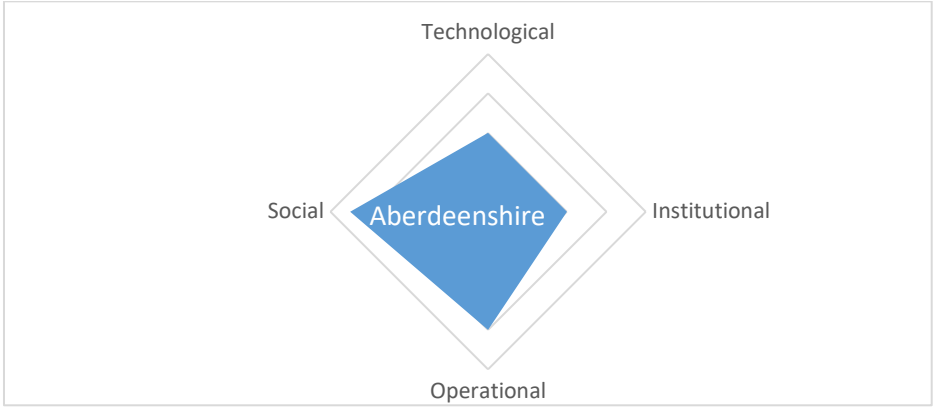

Operational
HiTRANS ebike
Mpact LL/QN
Mpact MH
LW Morema
Drenthe & Groningen
Aberdeenshire
HiTRANS BT
M & R
HiTRANS ebus
LW OD
LW TD
0
2
4
6
8
10

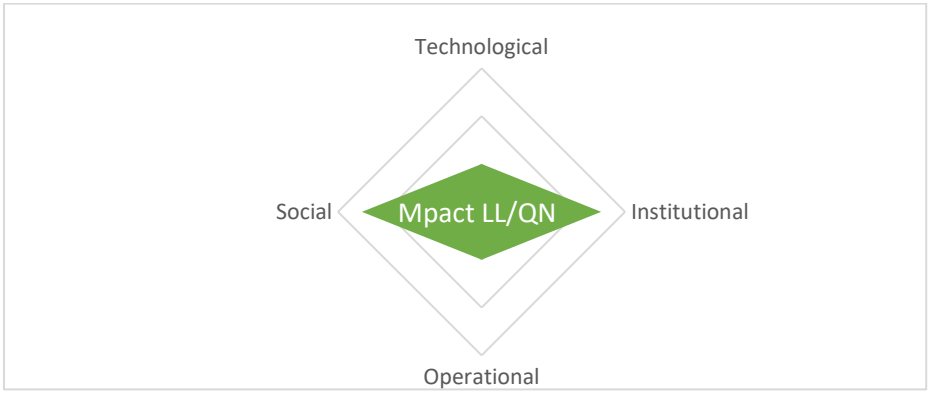

Social combined
M & R
HiTRANS BT
LW Morema
HiTRANS ebus
Mpact LL/QN
Drenthe & Groningen
HiTRANS ebike
LW OD
Mpact MH
Aberdeenshire
LW TD
0
2
4
6
8
10

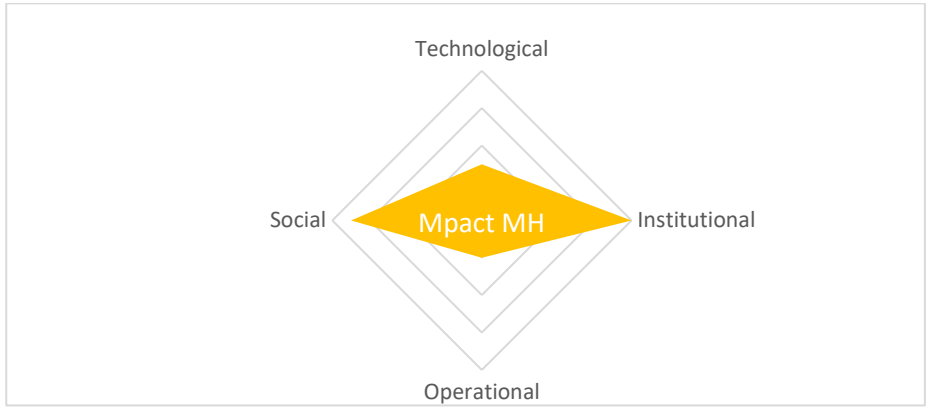

Technological
LW Morema
Mpact LL/QN
Mpact MH
HiTRANS ebike
Aberdeenshire
LW TD
Drenthe & Groningen
LW OD
HiTRANS ebus
HiTRANS BT
M & R
0
2
4
6
8
10

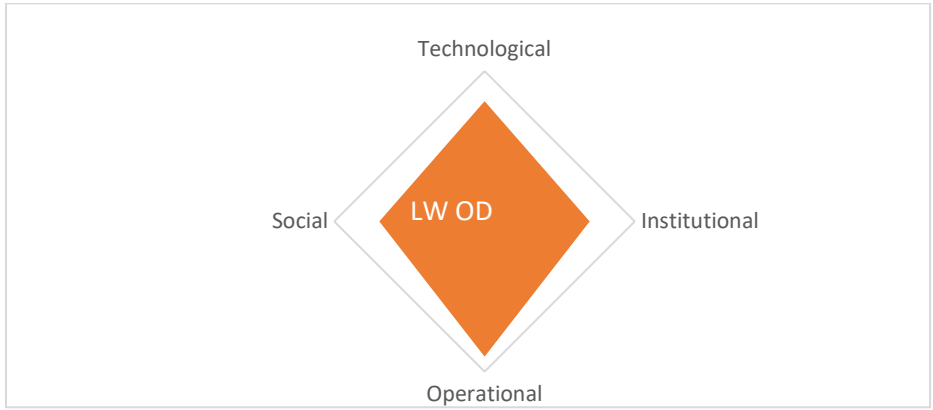
3.4 Radar graphs of disruption per project

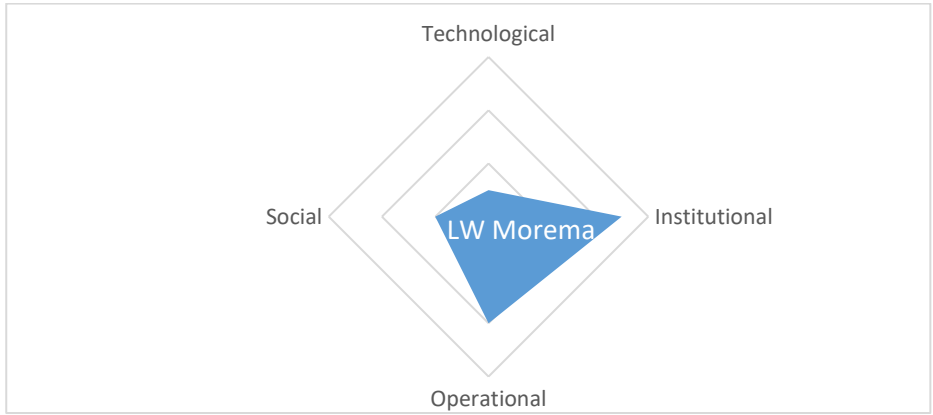
In order to get a better sense of the disruption levels per project, radar graphs for each are given below. As can be seen in the graphs, while overall the highest scores were for institutional and operational factors, the disruption from lighthouse demonstration projects and business use cases appear to have a unique footprint. Some, like the LW OD (Leine Weser On-Demand Hameln-Pyrmont) project have a relatively balanced surface area covered in the graph, with medium or high scores for all four dimensions, others are minimally disruptive in some areas and very disruptive in others. For example, the two Mpact projects both score highly on social and institutional disruption, but low on technological and operational.

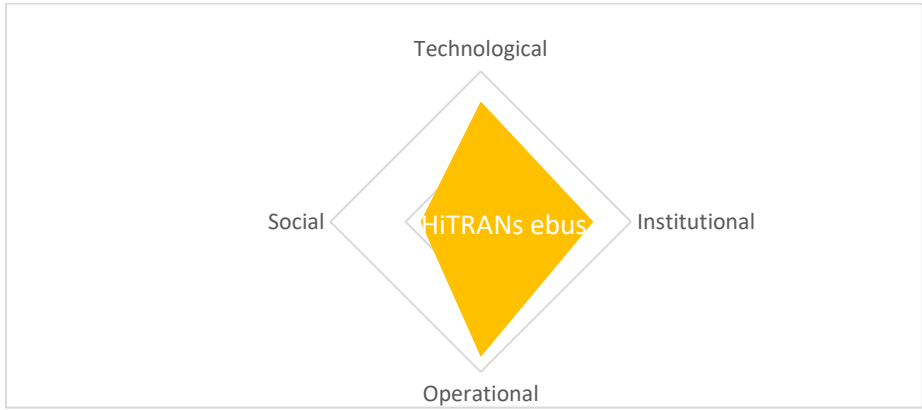


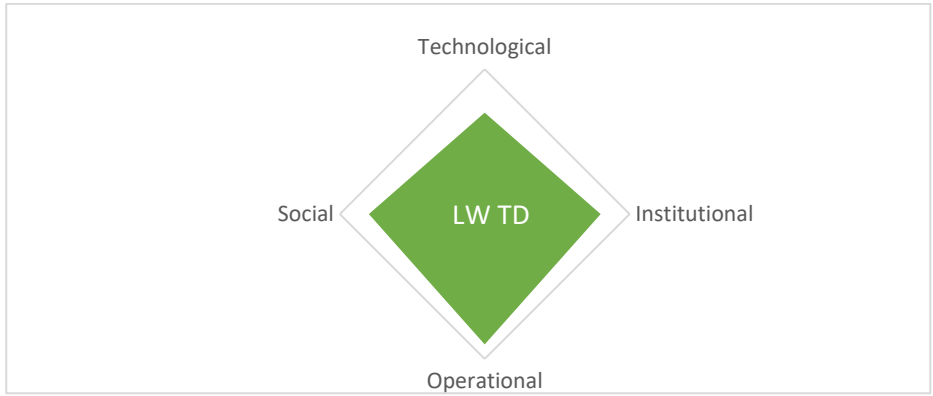


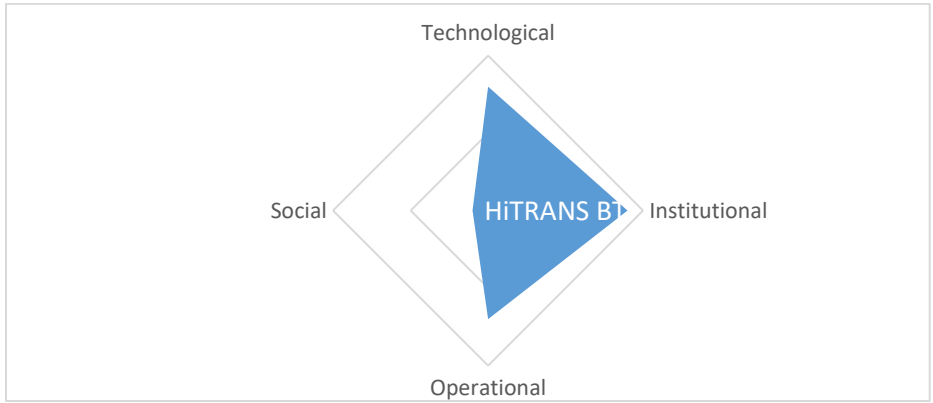

Technological
Social
Mpact MH
Institutional
Operational

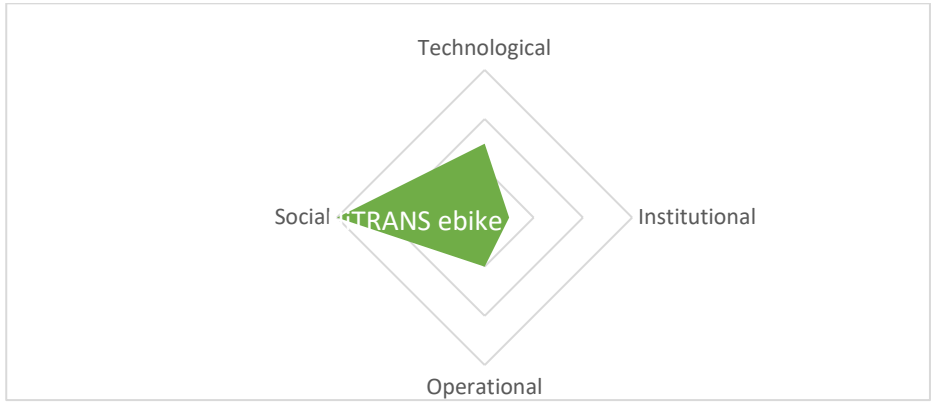

Technological
Social
LW OD
Institutional
Operational

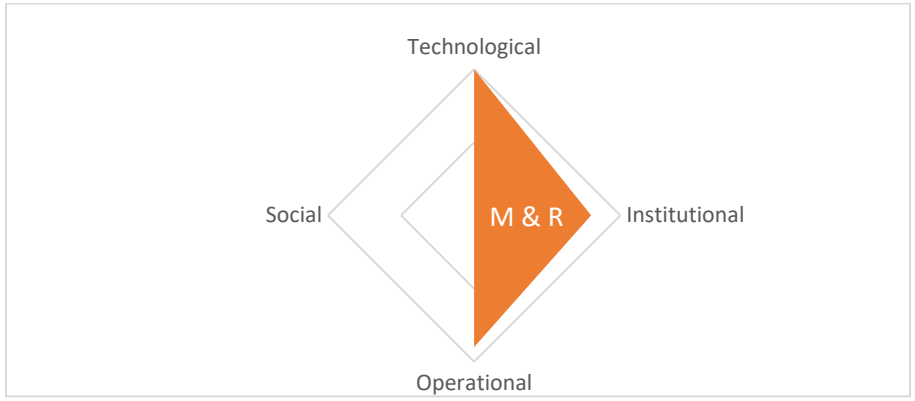

Technological
Social
LW Morema
Institutional
Operational


Technological
Social
HiTRANs ebus
Institutional
Operational


Technological
Social
LW TD
Institutional
Operational


Technological
Social
HiTRANS BT
Institutional
Operational


Technological
Social
TRANS ebike
Institutional
Operational


Technological
Social
M & R
Institutional
Operational

4.0

DISCUSSION

As can be seen in the previous sections, this scoring exercise attempted to shed light on the amount of change or disruption involved in G-PaTRA project lighthouse demonstrations or business cases. The disruption was differentiated into: Technological; Social; Operational; and Institutional disruption.

What emerged clearly is that:

- Institutional disruption scored highly across **all** demonstration projects and business cases (from hydrogen ferries, through demand responsive transport and electric buses to using software to optimise the use of available vehicles and drivers).
- Operational disruption was next high scoring, then technological.
- Social disruption was less significant but still scored 52 out of a possible total of 110 marks.

Institutional disruption and inertia were also seen as the key barrier to implementing, scaling up and mainstreaming innovation in low carbon passenger transport in rural areas. According to the discussions during this scoring exercise, this type of disruption in particular may involve:

- Opposition to changing the way things are currently done now in a municipality;
- Colleagues not being motivated to do things that are not 'core business';
- Lack of interest in moving from a demonstration project to 'business as usual';
- Lack of interest outside core demonstration team among other colleagues, in other teams, whose involvement or buy in is crucial to scaling up and mainstreaming operations;
- Lack of interest/motivation among busy senior managers in organisation (dealing with post COVID) to focus resources on scaling up innovation;
- Feet dragging from procurement or contracting teams (who might be required to change their processes or tackle a difficult problem);
- Sceptical politicians being unwilling to spend money;
- Getting buy in from delivery partners, or other key institutions (e.g. education or, health care providers) for whom transport is not core business.

In practical terms, these findings have a number of consequences upon the success or otherwise of green passenger transport innovations and further work needs to be done to identify institutional barriers and find solutions to overcome these hurdles.

5.0

CONCLUDING REMARKS

This report sets out the origination, development, and testing of a scoring rubric designed to allow comparison of different innovations in the field of transport, particularly public transport services. It began as a way to describe and frame the types of disruption seen when developing, trialling, implementing and scaling-up new ways of delivering transport services. It then evolved into a shared project language – terminology that could be used to compare and contrast the different challenges and opportunities involved in consideration of green passenger transport solutions.

The four dimensions of innovation and the rubric gave project partners a structured and comparable way to discuss their projects, allowing those working on very different types of projects to come together to share learning and brainstorm ideas for overcoming barriers.

It is hoped that the rubric could be tested beyond the confines of the G-PaTRA project in a follow-up piece of work in the future. This would further test and corroborate the results found here.

Further work to identify institutional and operational barriers and find practical solutions to overcome these is already underway by the project team. This is as a direct result of the scoring exercise, which highlighted the institutional and operational difficulties of adoption and scaling of some of the innovations discussed in this report.

G-PaTRA's ultimate goal was to reduce CO2 emissions by proposing low carbon solutions. However, through the work of WP5 in particular, the project team has identified many barriers to that goal. The final project event proposes to find some solutions for those barriers and workshop some examples of future scenarios.

Visit the project website to view complementary work which ran alongside the activity detailed in this report, and to catch up on the latest outputs and findings from the project.

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