Automated Vehicles and Vessels Roadmap for Orkney

1. Introduction

- This paper sets out a draft road map for progressing projects to be generated by a collaborative research and development consortium to deliver autonomous transport for Orkney (and the wider Highlands and Islands).
- The roadmap has been developed by Orkney Islands Council, RGU and Hitrans, following two road mapping workshops held in Kirkwall.
- Following this introduction and background, there are eight subsequent sections:
    - Context - high-level SWAT analysis for AV's in Orkney and identification of cross cutting issues and short to medium term *enabler actions* (section 2)
    - Consideration of transport automation themes that will generate projects (section 3).
    - Identification of *project streams* (section 4)
    - Consolidation of activities into a Gantt chart (section 5)
    - Short to medium term action plan (section 6)
    - Resourcing (section 7)
    - Governance (section 8)
    - Co-producers (section 9)

1.1 Background

- Autonomous vehicles have the potential to help address many of the transport challenges in rural and island areas, including how to provide cost effective transport for an ageing population and better manage and optimise local transport resources to accommodate the rise in cruise ship tourist numbers.
- Hitrans, Orkney Islands Council, RGU and Aquatera have all expressed an interest in exploring the autonomous vehicle agenda and putting vehicles on the ground in Orkney (and elsewhere in the Highlands) and vessels in the sea and have agreed to work together in an informal consortium to do so.
- The objectives of the consortium are to:
    - Establish a consortium to collaborate on the delivery and implementation of autonomous vehicles in island and rural settings.
    - Collaborate to create a research and development centre of excellence on Orkney to coordinate the scoping, planning, procurement and delivery of autonomous vehicles in Orkney.
    - Secure funding to establish AV pilot projects in Orkney.
    - Engage in collaborative, longitudinal and reflective research to capture good practice in the planning, procurement and delivery of autonomous vehicles; sustainable businesses cases for financing AVs, including the involvement of existing transport providers; operations and maintenance (including health and safety); and public and stakeholder engagement and behavioural change.
    - Promote an interdisciplinary and inclusive inter-agency approach to research and development activity across the fields of engineering, computing, economics, law, planning, public policy,

social policy, health and social care, tourism, etc., to solve a complex web of policy, technological and industry challenges.
    - Create consultancy and other capacity for commercialising knowledge generated by the collaboration.
    - Provide training to the public, private and voluntary sector.
- The road map set out below aims to identify the key enabling activities and project streams required to establish automated transport in Orkney and an indicative timetable for delivery.

1.2 Automated driving classification

- In considering automated and autonomous transport, it is useful to adopt the automated driving classification (set out in the table below), which differentiates between different levels of driving automation.

Automated driving: classification

Classification	Level of automation	State of the art*
0	No automation	
1	Driver assistance	Inherent in almost all new vehicles
2	Partial automation	Some new vehicles (e.g. Volvos with brake sensors, Teslas with top speed limiter settings)
3	Conditional automation (driver can safely turn attention away from driving tasks, but still required driver, with training and license)	Realistically, the current innovation frontier. Do-able at the moment. (e.g. Siemens' connected lorries, buses in bus lanes.)
4	High automation: when enabled, driver attention not required. driverless operation in certain areas (e.g. where vehicles have their own lane)	Pilot stage - small scale, limited demonstration projects (a number across Europe). Small scale, low speed, very limited networks. Level 4 automation likely with 'AV only' lanes.
5	Full autonomy: driverless operation A-B, fully integrated on public roads	Technology, while advancing rapidly, is still many years away, with a number of barriers to overcome. Somewhere from 2035 (optimistic scenario) to beyond 2050 (skeptical scenario).

*From presentations at ART Forum project (Interreg North Sea Region) inception meeting (see Section 2.3 below)

2. High level SWAT analysis / cross cutting themes

- At the road map workshop, a SWAT analysis was initially carried out for each transport theme.
- These have been consolidated into a high level SWAT analysis for introducing AV's in Orkney (set out in 2.1 below) and a set of key issues (captured in Section 2.2)

2.1 High Level SWAT analyses

Strengths • Innovation culture in Orkney which is already embracing 4th industrial revolution • Track record among local stakeholders in securing funding for innovation projects • Population includes a number of early adopters who are willing to embrace technology (e.g. wind energy and large numbers of EVs). Potentially, less resistance to social change in Orkney among population • Good relationships with Government and national/ European stakeholders • Aligns with current 5G trial so some enabling technology is already in place	*Weaknesses* • Alignment and buy-in required from a range of local stakeholders who are engaged currently in providing a diverse transport mix. • Mass public and stakeholder engagement (and institutional engagement) campaign, potentially increasing costs • Potential loss of jobs among drivers
Opportunities • Potential for fleet optimisation across projects (and sectors) • Long term reduction in fuel costs and subsidy costs for public sector. • Up-skilling & diversifying jobs - controlling rather than driving • Decentralising jobs • Control functions could be on outer isles • Initial capital investment to reduce long term revenue costs • Inter-relationship with other projects in Orkney • Provide services across the full day with gaps in operation that would not be feasible in a driver hours of work environment • Islands systems research environment which can be scalable and transferrable to other islands settings • Existing 5G trial environment in Orkney • Exploitation of current over production of wind energy	*Threats* • Substantial capital costs and revenue costs • Institutional inertia to embracing change which is perceived as either not 'core business' and/or a threat • Resistance to changing travel habits among public • Perception of resilience of technology and impact of bad news stories on confidence • Perception of health issues with 5G

2.2. Key issues from SWAT analysis

1. Mainstreaming AV's in Orkney will require substantial (i) technological, (ii) institutional, (iii) operational and (iv) social change. To deliver, we require a diverse and committed consortium that are capable of generating funds for projects and affecting change across these four areas.
2. Stakeholder and public engagement (winning hearts and minds) will need to be a central short to medium term priority (*short to medium term enabler action 1*).
3. There will be substantial initial capital costs associated with telecommunications infrastructure, which will need to be in place to underpin Orkney-wide pilots. Another short to medium term priority will be to carry out a telecoms scoping study (*short to medium term enabler action 2*)
4. The consortium will require early dialogue and partnership building with vehicle and technology providers and bodies such as Transport Scotland and the Transport Systems Catapult. The consortium should also explore large scale demonstration opportunities with major players in the field (*short to medium term enabler action 3)*
5. There is significant potential for up-skilling, diversifying and decentralising jobs and attracting new people, and returning Orcadians through quality jobs. Controlling and monitoring transport rather than driving it. However, there must be a clear skills strategy (and PR message) to militate against the perception that AV's will replace driver/ carer jobs (*short to medium term enabler action 4)*.
6. There is substantial potential to make explicit links with funded projects in related areas such as green energy and smart energy and data e.g. REFLEX and 5G trials.
7. Convergence:
    - For land-based transport, a number of separate developmental strands have been identified. While the AV agenda will be developed on a pilot by pilot, project by project and - potentially – area by area basis in the first instance, it is anticipated that, in the long term, these projects will ultimately *converge* into a single, flexible AV fleet and operating system comprising a large number of vehicles and Orkney-wide coverage
    - Thus, it would be anticipated that – ultimately – a single AV network, supported by smart data would underpin all public transport (subsidised Council services, cruise ship, tourism, social care, non-emergency health, school transport and the voluntary/ community sectors). This is likely to happen in the 2035-2050 timescale.
    - Assuming systemic convergence, there is also a significant long-term opportunity to explore and optimise new public and private ownership and operating models including:
        - Mobility as a service
        - The closer integration of freight logistics with the movement of people.

- A converged AV system also be characterised by with intelligent links to other systems (ferry and air, tourism, energy, agriculture, etc.)

2.3. ART Forum project

- RGU is a partner in the ART-Forum project, led by the Municipality of Bremen, and funded through the Interreg North Sea Region programme.
- ART Forum is focusing on how transport authorities can work together to prepare for automated road transport, identifying the potential implications for transport policy, spatial planning, street design and regional development planning.
- ART-Forum held its inception meeting in May 2019. The discussion on the state of the art for autonomous vehicles contributed to the *state of the art* commentary in the table in section 2.1.
- The consensus from the first meeting was that partners are quite pessimistic about the time scale for witnessing full level 5 automation in cities. The current limitations of the technology and the scale and complicity of metropolitan transport networks are such that we are unlikely to see level 5 automation in cities much before 2050 if at all.
- Vehicle manufacturers are also starting to urge urging caution on the speed of AV innovation.
- There is also a dystopian view of AVs emerging, with householders using private AVS selfishly, resulting in more 'empty trips' to avoid parking and *increasing* vehicle journeys and congestion.
- Level 4 automation, with AVs having their own lanes in cities and on motorways, is seen as a much more likely game changer in the medium to long term.
- In contrast, given the relatively simple transport networks of rural transport networks and – in particular – small islands, there is real potential to see level 5 automation on islands and in deep rural settings before it is delivered in urban areas. This point is elaborated on in Project Stream 2, in section 4 below.
- In aiming to build the knowledge base of public authorities about automated road transport and to explore the impact on life in cities and regions, there are 4-5 ART-Forum partners that are interested in automated transport in the rural and island context.
- Through ART Forum, any new legislation (and associated legislative barriers) required to facilitate greater automation in transport operations will be identified.
- ART- Forum therefore provides the Orkney partners with opportunities to network with, share knowledge, and to collaborate on project proposals with Municipalities and other organisations that are interested in the application of AVs in the rural and island areas.
- With this in mind, RGU has volunteered to hold a Project meeting and knowledge exchange workshop in Orkney in March or April 2020 (*short to medium term enabler action 5).*

2.4 SUV project

- Hitrans (lead beneficiary) and RGU are also involved in the SUV project, which has also been funded recently by the Interreg North Sea Region programme.
- The project will test AVs in city and regional areas in order to provide local and transport authorities with the knowledge and tools to understand the spatial impact of AV, and to start capturing AV opportunities.
- The project will also offer insights into the relationship between the use of automated vehicles and the provision of public services in general.
- With Hitrans and RGU being project partners, and Hitrans leading, it can be expected that the knowledge generated through SUV will inform the planning associated with the introduction of automated transport in Orkney.

3. Transport automation themes

- The road-mapping workshop identified and elaborated on a number of possible automated and autonomous transport projects. These are set out below

3.1 Public, community and social care transport

3.1.1 Social care

Value proposition	• Reduce the health and social care transport costs associated with an aging population; reduce the ratio of carers to cared for; and mitigating the future burden on the voluntary sector. • Specifically replace carer + driver with carer/ driver • Integrate and optimise transport provided by a range of providers (social care, health board, non-emergency ambulance, voluntary sector), reducing cost and duplication • Meet lots of strands of demand with one system (potential to better and fully integrate public, voluntary health care and social care sectors) • Potential to embed in new models of smart, social housing.
Issues to overcome	• Loss of driver jobs and wider employment in social care sector (and associated PR) • Requires multiagency involvement - and need to overcome historic resistance to cross institution/ sector working
Possible project: short to medium term	• Secure funding for pilot project with vehicle manufacturer (potentially to compliment and align with RGU and OIC's planned mixed housing project in South Ronaldsay)
Possible projects: medium to long term	• Secure funding on a grant-by grant to roll out across sectors and/ or communities
Level of automation	• 3

3.1.2 Public / community: The AV Island

Value proposition	• Optimise supply of public transport • Provide mass flexibility for public transport • Meet more demand and provide better geographic - and social - coverage off main corridors • Derive better value for money (£/per passenger journey) for supported services • Ability to use contracting of supported services (innovation clause) as a lever to drive innovation and uptake of AVs • Encourage aggregate trips by location • Enhanced Road safety
Issues to overcome	• Scepticism among travelling public • Threat to driver jobs and public acceptability Resilience of technology and adverse publicity if any incident – high profile • Education and accessibility
Possible projects: short to medium term	• The AV island: Demonstrate full (level 4/5) automation on an island with a small population and a very limited road network. • Seek funding for the AV island project (years 1-2) • Establish the autonomous island where fully automated vehicles account for more than 50% of the vehicle fleet (years 2-5).
Possible projects: medium to long term	• Establish an autonomous island where AVs account for at least 80% of the vehicle fleet • Scale up autonomous islands (50%+ fleets) to larger islands with bigger populations (5-10 years) • Scale up level 4 automation to the Mainland with 33% AV share of the fleet (10-20 years)
Level of automation	• 4-5

3.2 Tourism management

3.2.1 World Heritage Site Gateway

Value proposition	• Ability to better manage, optimise and smooth peak visitor numbers at world heritage sites and disperse to other sites • Addresses current access issue • Use of smaller hydrogen/ electric AVS rather than a fleet of diesel buses – cleaner and greener • Potential to interactive on-board visitor experience • Aligned with wider smart tourism strategy • Could attract tourism/unique holiday experience
Issues to overcome	• Lack of existing parking/ infrastructure for volume tourism • Level 4 automation will require dedicated vehicle lane - major planning and land use implications within World Heritage Site area. • Big project with substantial capital start-up costs (including wider infrastructure investment to support substantial number of AVs) • Require buy in from a range of stakeholders including NGO's tourism bodies and transport operators
Project: Short to medium term	• Build consortium of the willing, develop detailed delivery plan, identify opportunities for funding • Seek funding for major capital project
Project: medium to long term	• Secure funding and operationalize delivery plan
Level of automation	• 4

3.2.2 Bespoke tourism

Value proposition	• Manage flows at busy sites • Destination management - encourage traffic to quieter attractions • Facilitate dispersal of tourism to outer isles to harness with optimisation of ferry services • Wider dispersal of cruise ship tourism • Encourage slow tourism and potential to tailor for wildlife, adventure, etc. niche tourism

	• Potential for tailored advertising to generate revenue and to enhance market reach of local businesses
	• Add on/ added value to other tourism and smart data projects
	  ○ Compliments RGU/ UHI's smart tourism workshop.
	  ○ Compliments RGU & Hitrans work on optimising ferry operations

Issues to overcome	• Long term – only really possible outside World Heritage Site on small islands or with level 5 automation • Strong offer locally in this area. • Transport is not core business of major tourism stakeholders - resistance to change • Resistance to technology among tourism • Local empires • Need to demonstrate value to cruise operators before they will engage
Project: Short to medium term	• Seek funding for pilot project (on outer isles)
Project: medium to long term	• Seek funding for projects to mainstream AVs on outer islands • Mainstream on mainland when level 5 automation is possible
Level of automation	• 4

3.3 Service delivery drones

Value proposition	• Hub and spoke potential for outer isles • Routes pre-programmable • Can operate in hours of darkness • Perishable goods • Medicines/ veterinary • NHS – bloods/ vaccines • Observation (coastguard/ lifeboat applicability) & emergency response
Issues to overcome	• Knowledge gap: e.g. capacity, range, poor weather ability, reliability etc. of latest generation drones • Conflict with aviation • Conflict with other drones • Sabotage & disruption

Project: Short to medium term	• Technology exists
	• Requires better understanding of capabilities to make operational business case
	• Scoping study
	  ○ Resilience to weather
	  ○ Reliability
	  ○ Operating limits
	  ○ Weight/ capacity

Project: medium to long term	Seek funding to mainstream
Level of automation	• 2-3

3.4 Vessels/ Ferries

Value proposition	• Partial autonomy and inter island ferries - increasing rather than complete autonomy
	• Optimising route finding in different sea, wind and tidal conditions. i.e. using smart technology to choose the fastest / most efficient/ most comfortable/ safest route
	• Optimisation and more data to complement existing tools and knowledge
	• Smart routing could benefit ferry operations in terms of:
	  ○ Reducing fuel costs
	  ○ Improving passenger experience
	  ○ Increasing Journey time predictability
	  ○ Enhancing safety and confidence in darkness & fog
	• Significant opportunity for commercialisation
	• Opportunity for up-skilling crew
	• Longer term potential to increase autonomy, reduce crew numbers and manage costs

Issues to overcome	• Resilience of technology • Union opposition (early engagement required) • Resistance of crew to using new technology
Project: Short to medium term	• Seek pilot funding
Project: medium to long term	• Mainstream across inter-island ferry fleet
Level of automation	• 2-3

4. Project streams (Use Cases)

- Based, on the transport automation themes set out in section 3 above, and the current state of the technology art (in particular the forecast timescales regarding Level 5 automation in cities), the following project streams (UCs) are set out:
    - UC1: Social care
    - UC2: The AV island (level 5 automation)
    - UC3: World heritage gateway (level 4 automation)
    - UC4: Service delivery drones (Level 2-3 automation)
    - UC5: Automating ferries (Level 2-3 automation)

Use Cases	Title	Level of automation	Description	Preparatory 2019-2020	Phase 1 2020-2025	Phase 2 2025-2030	Phase 3 Beyond 2030
UC1	Social care demonstration	3	Technology demonstrator project involving level 3 automation for social care and non-emergency health care, where there is always a carer in the vehicle	• Secure funding for pilot project (2019-2020)	• First Demonstrator project • Secure funding for other social care and public transport projects	• Scale up and mainstream across Orkney to cover social care and non-emergency health transport	• System convergence
UC2	The AV island	5	Given the scepticism around Level 5 AVS in cities (possibly 2050 at best or never), there is an opportunity to start on small islands with small populations, low number of vehicles and a limited road network and make level 4/5 automation work there ('the first level 5 AV island'). Once one island has been cracked, 'island hop' to larger islands with bigger populations in Orkney and the wider Highlands and Islands.	• Identify possible islands, • Engage with communities, • Secure project funding	• Deliver first level 4/5 AV island with AVs accounting for >50% of fleet. • Mixed transport system initially, aiming eventually for AVs to account for > 80% of the fleet. • Parallel planning for scaling up in other islands and Mainland	• Scale up and mainstream across other outer islands • Small scale Level 4/5 public transport demonstrator projects on Mainland	• Level 4/5 automation on mainland • System convergence
UC3	World heritage gateway	4	Use AVs to manage visitor numbers at world heritage sites, sustainably. Monitors and controllers (not drivers) can be	• Create consortium & make the case to stakeholders	• Major capital funding bid (2020- 2021)	• Implementation phase • Extension to Hatston,	• System convergence Bespoke tourism to capitalise on

			located remotely. Separate road lanes for AVs required + park and ride site. Interactive visitor information on board in various languages to enhance visitor experience.	• Prepare detailed proposal		Kirkwall and Stromness 'terminals' by 2030?	level 5 automation
UC4	Service delivery drones	2-3	Using drones to transport perishable goods, medicines etc. to outer islands	• Carry out scoping study on the state of the art • Liaise with airport and air traffic control • Secure pilot funding for demonstration project	• Scaling up, optimisation and mainstreaming across Orkney • Create hub and spoke operation		
UC5	Automating ferries	2-3	Partial autonomy and inter island ferries - increasing rather than complete autonomy Smart routing in first instance	• Carry out scoping study on the state of the art • Secure pilot funding for demonstration project	• Demonstrator project • Scaling up and mainstreaming	• Look for areas where increasing automation (level 3-4) can be applied to ferry operations. • Secure finding for pilot demonstrations	• Mainstream level 3-4 automation within ferry operations • System convergence with land operations?

5. Consolidated Roadmap

- Please see the accompanying Gantt chart

6. Short to medium term action plan

- OIC and Hitrans officials to consult with and seek buy-in from respectively OIC elected members and officials and Hitrans Board (Summer/ autumn 2019).
- 13th September: Road map to be discussed (and approved) by (Hitrans Board meeting.
- November: Road map to be discussed (and approved) by Orkney islands Council Development and Infrastructure Committee.
- Late November: observations from OIC and Hitrans to be included in revised, final version of roadmap to be delivered by the Steering Group (see section 8, below). Hard copies to be printed and circulated to members of Steering Group and key stakeholders.
- Late November: Appoint Chair and members of steering group.
- December: Steering Group to meet;
    - Initiate start of delivery phase of Road map.
    - Identify leads for short to medium term enabler actions and project streams (May 2019)

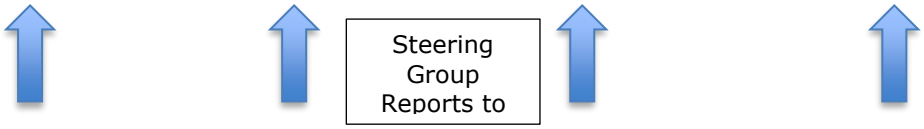
7. Resourcing

RGU	*Project management and research assistance* • Andy Grinnall: (0.5 project manager, October 2019-June 2020), to support initiation of road map delivery • Research Assistants working on ART-Forum and SUV projects *Time commitment, when required* • Prof Paul Hagan, Vice Principal of Research: Time commitment, when required • Prof David Gray, Research Lead, School of Creative and Cultural Business: • Elsa Cox: Orkney Project Development Manager Prof Richard Laing: Research Lead, Scott Sutherland School of Architecture and Build Environment *Planned appointment* Professor of automated transport technology/ engineering based at the research campus in Stromness
OIC	*Time commitment, when required* • Gavin Barr, Director, Development and Infrastructure • Brian Archibald, Head of Marine Services, Engineering and Transportation • Laura Cromarty, Transport Manager • Shona Croy, Strategic Advisor Renewables and Connectivity
Hitrans	*Research and Development budget* Hitrans will prepare a report on the funding landscape for AVs *Time commitment, when required* • Ranald Robertson, Partnership Director • Neil MacRae, Partnership manager • Jayne Golding, Projects and Policy Officer

8. Governance

- Role of the steering group

Orkney Community Planning Board (via Development & Infrastructure Committee)	Hitrans Board	RGU Executive Group and Board	HIE [TBC]



Steering group - chaired by OIC Chair of Development and Infrastructure			
Orkney Islands Council Director of Development & Infrastructure	Hitrans Partnership Director	RGU Vice Principal Research	HIE [TBC]

Steering group oversees					
Enabling actions	*Use cases*				
	Use case 1	Use case 2	Use case 3	Use case 4	Use case 5
	Social care	The AV island	World heritage gateway	Service delivery drones	Automating ferries
Short to medium term enabling actions 1-5	Lead partner assigned by Steering group	Lead partner assigned by Steering group	Lead partner assigned by Steering group	Lead partner assigned by Steering group	Lead partner assigned by Steering group

Work streams: on-going activities, funded projects, proposal development, events, etc.

9. Co-producers

Project partners	*Communities & sectors*	*Strategies*	*Projects*	*Initiatives*
Role: to collaborate on delivering AV roadmap	Role: potential beneficiaries of AV technology to engage with	Objective: to align with and – subsequently – inform relevant strategies	Action: to share knowledge and create new partnerships	Role: initiatives that that can assist in maximising opportunities
OIC Hitrans RGU HIE OREF Aquatera EMEC Local transport providers Tech providers Transport Scotland Historic Environment Scotland	Private sector NHS NGOs Third & voluntary sector Community Councils Tourism sector Cruise ship operators	Orkney Community Planning Partnership OIC Digital strategy RGU research strategy Hitrans RTP OIC Local Transport Strategy Arctic strategy OIC Electric Vehicle MaaS – MaaS strategy Smart social housing World Heritage Site Master Plan Orkney Internal Connectivity: • Capital Outline Business Case • Final Business Case Community Led support	ReFLEX Interreg: • Art Forum • SUV • MOVE • G-PaTRA	AV catapult Orkney Cloud Islands Deal UKRI – Innovate UK Scotland Europa Data lab

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