Deliverable 2.2: State-of-the-Art - Robotics and Automation in Business

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1.0	Nov. 2021	Robots as a service.
2.0	20.3.2023	Extended to include Lapland application domains and highlight potential business opportunities.

Contents

1. Introduction

Until recently, the term "robotics" evoked images of futuristic science fiction characters or monotonous mechanical arms performing repetitive tasks on assembly lines. However, with the recent progress in Artificial Intelligence (AI), particularly in the field of Machine Learning, and the advent of powerful sensor technologies, robotics has become an appealing prospect for businesses across a wide range of sectors. While universities and municipalities with ample resources can take advantage of the many possibilities presented by robotics, the Lapland region should identify and focus on industries that utilize its unique geographical position, as it has more limited resources than other regions.

This report explores various business models for robotics that are suitable for the Lapland region. Doing so will help it avoid falling behind other regions in the field and establish a technical advantage in robotics as a regional competency. To identify viable business cases, we first identified the qualities that set Lapland apart from other regions of Finland. By leveraging these qualities, robotics ventures can not only become promising businesses that boost the local economy but also serve as a means to attract and retain talent in the region, thus ensuring its competitiveness in the robotics domain.

2. Lapland Application Domains

Four domains that provide excellent opportunities for robotics-based business models in Lapland have been identified. These domains are tied to the region's unique characteristics:

- Manufacturing: Lapland's natural resources, particularly timber, provide a strong foundation for manufacturing companies to locate close to the source of their raw materials. The use of robotics in this sector could increase efficiency, reduce costs, and improve product quality.
- Tourism: Lapland's breathtaking scenery attracts a large number of tourists each year. Robotics could be employed in the tourism sector to enhance the visitor experience, improve safety, and reduce labor costs.
- Winter maintenance: Snow and ice present particular challenges in the Lapland region. Autonomous or semi-autonomous robots could provide solutions to address the issue with lower cost and better service levels.
- Search and rescue / Climate Research: Lapland's harsh climate presents a pressing global issue that demands innovative solutions. Robotics can play a crucial role in addressing climate change by facilitating environmental

monitoring, aiding in search and rescue operations, and improving energy efficiency.

Based on these qualities and discussion with local businesses and agencies, we have identified several business case possibilities.

2.1 Manufacturing Industry

Lapland is a region with an abundance of natural resources, including forests as a source of raw materials, which makes it an ideal location for the manufacturing of wood products. However, successful businesses in Lapland may face financial incentives to relocate their operations to factories with better access to emerging technologies, including industrial robotics. The lack of industrial robotics resources in Lapland may put the region at a disadvantage, as robots integral to the manufacturing process are often deployed in regions close to major technology and manufacturing centers. Rather than aiming for fully automated production lines, initial steps for Lapland manufacturing industries may be through the integration of collaborative robots, or cobots, into the manufacturing process.

2.1.1 Cobots

Cobots are robots designed specifically to work closely with people in industrial settings. While standard industrial robots are generally designed to handle material away from human workers for safety reasons, cobots are meant to collaborate closely and in physical proximity with their human partners. By introducing robots that can handle heavy loads and dangerous equipment while they themselves are safe to work close to, cobots can take over tasks that presently require human labor.

Cobots can fit into the manufacturing ecosystem in an ideal manner to sustain the base already in Lapland. Moreover, the challenges in introducing and integrating cobots into the manufacturing base in Lapland presents an ideal business opportunity for the region in becoming a center for expertise in the technology of cobots. The versatility of cobots allows a broad array of target businesses and the lack of specialization mitigates the investment involved. A potential business opportunity exists for a Lapland-based hybrid consultancy company to help small and medium companies transition into cobot technology.

Figure 1. Cobot collaborating with a human worker.

2.2 Tourism Industry

Tourism industry application areas for robots include indoor environments such as hotels and museums, as well as outdoor environments during activities such as cross country skiing, snowmobiling and hiking.

2.2.1 Robots in Hotels and Museums

Globally, there are a variety of robots being used in the tourism industry, for example:

1. Hotel robots: Many hotels now use robots as a concierge service, which can assist guests with information about the hotel and the surrounding area. They typically use natural language processing and other artificial intelligence techniques to understand and respond to guest requests. For example, the SoftBank Robotics Pepper robot is widely used in hotels, airports, and other tourist locations to welcome guests, answer questions and provide recommendations.

2. Museum robots: Robots are increasingly being used in museums and other cultural attractions to provide interactive tours and educational experiences. For example, the RoboThespian developed by Engineered Arts is used in some museums and theme parks to provide visitors with a more engaging and interactive tour experience.

3. Theme park robots: Robots are also used in theme parks as characters and in attractions, such as robotic dinosaurs or other creatures in thematic zones, providing a unique experience for visitors.

4. Drones: There's a growing trend of using drones for aerial tours in the tourism industry. Some companies are offering tours of scenic areas such as national parks, using drones equipped with cameras that can capture video and still images. See e.g. the Arctic Airborne 3D project.

5. Tour guide robots: Autonomous robots can also be used as tour guides, leading visitors around a city or other location, providing information and answering questions. There are several companies that are developing robots for this purpose, equipped with sensors and cameras to navigate and provide information. See e.g. ROBOHON and Persephone.

6. Customer service robots: These are robots or chatbots that are used to help customers with information, bookings and other customer service related tasks. See example use cases.

In general, the use of robots in the tourism industry has the potential to improve the customer experience, make the industry more efficient, and save costs by reducing the need for human staff. The use of robots in the tourism industry raises various ethical and regulatory issues. It also raises technical and logistical challenges, e.g., safety and data protection.

Overall, the use of robots in the tourism industry is still in its early stages, but it has a lot of potential to improve the customer experience and make the industry more efficient.

The cost of replacing a customer service operator with a robot in the hotel industry will depend on a number of factors, including the type of robot and its capabilities. For example, a robot like Pepper can cost around €20,000, plus additional costs for implementation, training and support. Less advanced robots or chatbots may be less costly, e.g. some thousands of Euros. In addition, maintaining and upgrading the robot will bring additional costs. Some companies may offer service contracts or other support packages that can help to spread these costs.

2.2.2 Robots Supporting Outdoor Tourism Activities

Robots could potentially support both winter and summer outdoor tourism activities.

Winter ski and snowmobile track maintenance

The natural scenery of Lapland is a major selling point for the tourist industry in the region. Maintaining winter sports snow trails to optimize their use is a challenge given

the labor intensive nature of trail maintenance work. Autonomous maintenance vehicles may offer a potential solution.

For example, maintaining 40 km of snowmobile trails requires approximately six person hours a day, leading to seasonal maintenance costs in excess of 30,000€. In addition to human safety overhead, having robots perform the task would be ideal. Given the long winter months and the abundance of ungroomed trails for experimentation, Lapland could be a leader in investigations into these solutions. In addition to purely autonomous robots, research into teleoperated maintenance systems is needed, as human oversight will help ensure safety requirements are met.

Robot hiking guides

Human guides can be expensive, limited in terms of knowledge, difficult to schedule, and, in some cases, perceived to limit the ability of tourists to feel completely relaxed. The use of robotic guides could address these issues and offer a greater range of activities. For example, the Unitree robot dog offers a form factor that is both fun and versatile. In Finland this is distributed by Probot Oy, and includes the weatherproofed (IP68) Unitree B1 robot dog. The Unitree robot dog is capable of negotiating uneven surfaces and challenging terrain. With internal GPS and programmed knowledge, the robot dog could guide tourists to remote locations during the summer months and provide fully customized tours in the wild, based entirely on the tourists' interests. A potential business opportunity exists, specializing in preparing the robots and coordinating with the local communities and authorities to build a distinctive robotics company that is well integrated into the needs of the local economies as well as demands of tourists.

Figure 3: The Unitree dog could be a suitable outdoor tourist guide

2.3 Search and Rescue / Climate Research

Lapland is geographically positioned to capitalize on the use of Unmanned Aerial Vehicles (UAV), or more popularly referred to as drones, to deal with issues arising from its northerly climate. For example, when people are lost in the wilderness, the climate may make it difficult and costly to mount search and rescue missions. The use of UAVs to conduct thorough surveys as well as more detailed inspections is both efficient and effective. Because the arctic conditions present specific challenges, research into strategies and tactics make this area ideal as a collaboration between business and university researchers. By using the latest battery technologies to power the UAVs, flight time of over twenty minutes in the cold climate can be possible, allowing for a high degree of assurances that a successful connection can be established aerially when ground-based means are ineffective.

Robots can also be an essential tool for detecting and measuring minute changes in the environment in the Arctic region. In addition to aerial vehicles that scan for visual and thermal fluctuations, autonomous vehicles designed to propel and navigate the ocean surface can gather data on sea surface temperatures, water salinity levels, ocean stratification, and currents. Leveraging the possibility of collaboration with the University of Lapland's Arctic Center there is potential to develop towards a leadership position in the area of climate monitoring robotics.

2.4 Winter Maintenance

Robots can be used for snow maintenance activities, including snow removal, snow plowing, and ice control. These autonomous robots can navigate through parking lots, sidewalks, and other areas to clear snow. Such robots are equipped with plows or brushes to help move the snow, and some can even use salt or other deicing materials to help melt the snow and ice. For ice control, robots are equipped with infrared cameras and thermal sensors to detect the presence of ice and take the necessary actions. They can also be equipped with de-icing agents or materials to help prevent the formation of ice.

Commercial examples of snow clearing robots include the SnowBot which is a commercial scale robotic snow plow that can be used to clear sidewalks, parking lots, and other areas of snow. The robot is equipped with a plow blade and can be programmed to follow a specific route, ensuring that snow is cleared from the areas that are most important. It is equipped with sensors like cameras, lidar, and GPS which enable the robot to navigate and avoid obstacles. On a scale suitable for individual households, Yarbro offers a robot with attachments for snow clearing and other garden maintenance tasks, such as leaf blowing.

Clever Machines' IceBot is a small mobile robot that can be equipped with various de-icing agents, salt or sand to prevent ice formation and make surfaces safer. It uses thermal sensors, cameras and other sensors to navigate and detect the presence of ice. Similarly the Canadian IceFree robotuses thermal imaging and AI-based algorithms to detect ice on surfaces and apply the appropriate amount of deicing materials.

Some drone-based solutions for snow removal are available, e.g. Flyability's Elios 2 that can be used to inspect and clear snow from hard-to-reach areas such as rooftops and bridges. Chemical means of snow removal is used, typically salt dispersed using an agricultural crop spraying attachment. One particular use case of interest is cleaning and removing snow from roof mounted solar panels, e.g. https://ktvworkingdrone.com/.

The use of robots for snow maintenance is still a relatively new field, and challenges such as cost, scalability and reliability and the integration with the existing infrastructure need to be addressed

3. Robots as a Service

3.1. Changes in business models

The robot market, based on product-centered sales concepts, has long been the traditional way that the market operates. Companies using the traditional business model sell their machines directly or through dealer networks. This model is used especially by large companies, such as ABB and Huyndai Robotics.

However, the business models of many companies are now changing and there will be an increasing shift towards circular economy business models. Reasons for this include aspects such as increased environmental values; the introduction of a circular economy in business also encourages companies to make better quality products that can be reused. Circular economy business models also help to deepen customer relationships. Client focused approach has become even more important and customers are demanding a more personalized service.

3.2. Robots-as-a-Service

Traditional business models have recently been replaced by new, more service-oriented models. Robotics-as-a-Service (or Robot-as-a-Service), or RaaS, is based on new business models that offer robotics as a service. It offers scalability,

flexibility, and lower costs compared to traditional robot systems. Robots can also be deployed quickly without large investments, therefore freeing up capital for other projects. Additionally, Robotics-as-a-Service allows services to be quickly adapted to changing conditions in the markets.

RaaS is currently most prevalent in the US, but there are also RaaS-players in Europe, including Germany, Denmark and Finland. Robot as a Service also offers more opportunities for small and medium-sized companies to use robotics in their business, due to its flexibility and lower costs.

The five most popular industries using the RaaS model are transportation, cleaning & hygiene, warehouse automation, factory automation, and security (Rlist, 2021). These are industries that have existing clear costs, e.g., transportation fees or hourly wages, which can be re-optimized.

There are numerous RaaS models, such as monthly rental, leasing, hourly charging, and pay-per-pick or pay-per-task. From a vendor's perspective, challenges for a RaaS company may include the initial investment that is more expensive, and some buyers may be resistant to the idea of monitoring their operations and collecting data via cloud networks. The table below lists some of the benefits of the RaaS model, as well as some of the potential challenges from the perspective of the buyer:

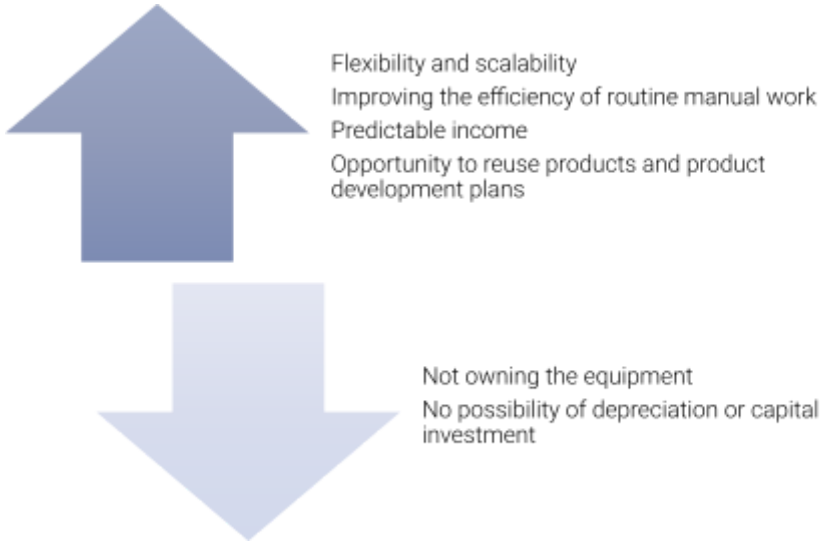

Figure 4 Potential benefits of Robots as a service

3.3 RaaS Companies Globally

Robotics-as-a-Service is rapidly gaining ground in the business world and will continue to grow in popularity in the future. Global RaaS companies include Fetch Robotics, inVia Robotics, and KUKA, among others. Fetch Robotics offers various cost-effective

solutions for warehouse automation. The company utilizes a cloud-based autonomous mobile robot that is suitable for goods handling and data collection in warehousing and intralogistics environments.

InVia Robotics also offers solutions for warehouse automation. The company website states that their service, delivered on a RaaS model, provides a service team that will actively monitor the customer's systems in real time.

One of the newest RaaS players is Kuka, an industrial robotics company that rents robots and offers robotics as a service to companies. Kuka robots are sold via network dealers in Finland by companies such as Ferob and Avertas Robotics. In addition, Kuka is planning to launch the SmartFactory as a Service initiative, offering its customers the possibility to rent up to an entire robot-operated automated factory.

3.3 RaaS Companies in Finland

The above-mentioned Avertas Robotics offers automation equipment to customers in Finland on a rental or leasing basis. Other examples of RaaS companies in Finland include Skaler, CGI FI and Solteq.

According to CGI's website, the company offers RaaS software robotics to customers as a flexible all-in-one service. SKALER, on the other hand, offers automation solutions for a wide range of business needs. The company uses cloud-based infrastructure and a complete service based on the RaaS model.

Solteq has customers in industry, energy, retail, services and more, and is well into autonomous service robotics. One of Solteq's RaaS-enabled services is the Solteq Retail Robot. It is a retail robot with a service delivered on a RaaS model, with the aim of reducing manual work, increasing sales, reducing waste, and improving working capital efficiency, among other things.

3.4. The Robotics Business in Lapland

According to the respondents to the survey produced by the Lapland Robotics project in 2021, companies operating in Lapland currently have, for example, production, storage and demolition robots in use. According to the survey, companies feel that they have a need for new skills, focusing on programming, design, networking and other skills, as well as demonstration and additional information. The survey also showed an interest in selling or presenting implementations to other companies.

The use of RaaS models, for example in tourism and leisure services in Lapland, would help in the future to speed up and personalize service processes and to develop not

only energy-efficient but also more ecological solutions. Robots as a service can be a viable alternative for the tourism sector, which tends to be seasonal. In other words, RaaS can be scaled up fast to meet high demand without the need to invest in equipment that is not used in the low season. One example could be the robots that maintain ski runs.

In the future, using service-oriented and circular business models in robotics, sustainable solutions can also be tailored to businesses in Lapland at lower cost and lower risk. In addition, the different challenges of Lapland, such as sparsely populated areas or Lapland's weather conditions, can be taken into consideration more precisely.

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Further reading:

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New Robotics: Shifting Business Models (prnewswire.com)

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