

Business aspects

Project #1_3 Distributed intelligent production involving remote actors

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Summary

Logistic robots for flexible automation have always been in high demand because of the companies' limited resources and lack of technical services. A response proposed here to this urgent need is to develop a distributed intelligent production technique with remote actors which provides to companies affordable and interoperable AGVs as a service. The combined use of MiR100 robots and IPsec/OpenVPN connections enables both local and remote manufacturing facilities to operate in synchronization. The key idea of the solution is the wireless integration to automation systems of AGVs. This business solution can bring mutual interests and values to all sides (customers and service providers). Instead of having to go through all of the company's bureaucracy to purchase the required equipment, all of the HR hassle of hiring and maintaining an R&D team as they usually do, companies can enjoy reduction in overhead costs of owning assets and incidental services expenses, efficiency, optimization, reliable and secure connectivity and flexible service contract as some of the immediate benefits. On top of that, risk mitigation, technical scalability are some of the in-a-long-run gains that the customers can expect from the solution.

1) Business idea

The business idea is to provide automated logistic solutions based on AGVs (autonomous guided vehicle) to companies that have e.g. logistics centers, warehouses or factories. The automation solution here is about leasing AGVs to customers and integrating the vehicles wirelessly to their existing automation systems. Customers can be manufacturers and OEM (original equipment manufacturer), manufacturers' representatives, distributors, machine builders or system integrators.

We are developing and offering an AGV automation solution based on distributed control for industrial manufacturing and logistics. The benefits for the customers include reduced costs due to reduced need for workforce in warehouses or logistics centers and more flexible and interconnected production or distribution. Other benefits for the customers can be convenience factor, guaranteed support, innovative industrial solution, reliability and faster production.

The AGV automation market is expected to grow in near future, so there should be room in the market for new entrepreneurs as well. The competitive advantages here are offering ready solutions, remote setup and integration with existing automation systems. Also, the AGV robots are leased to the industrial customer companies, so these companies don't need to buy the AGVs themselves, which can be considered as a competitive advantage. Tailored-programmed robot or robot fleet for factories can be offered and these will take care of specific pre-programmed tasks such as sorting products, inventory arrangement and logistics, without requiring extra personnel or technical visits to upgrade or update the software.

The business proposed here will get constant revenue due to service contracts agreed. So, instead of just selling AGV robots, service also is offered for certain periods of time.

2) Product/service

The service offered includes leasing fleets or single MiR 100 robots. Remote control and setup of the robots is provided. The AGVs will be integrated to existing automation systems with remote, secure IPsec or OpenVPN Internet connections. This makes it possible to control or change the robot's programmes or task configurations remotely. This remote capability makes maintenance a lot easier also, and failure diagnostics as well.

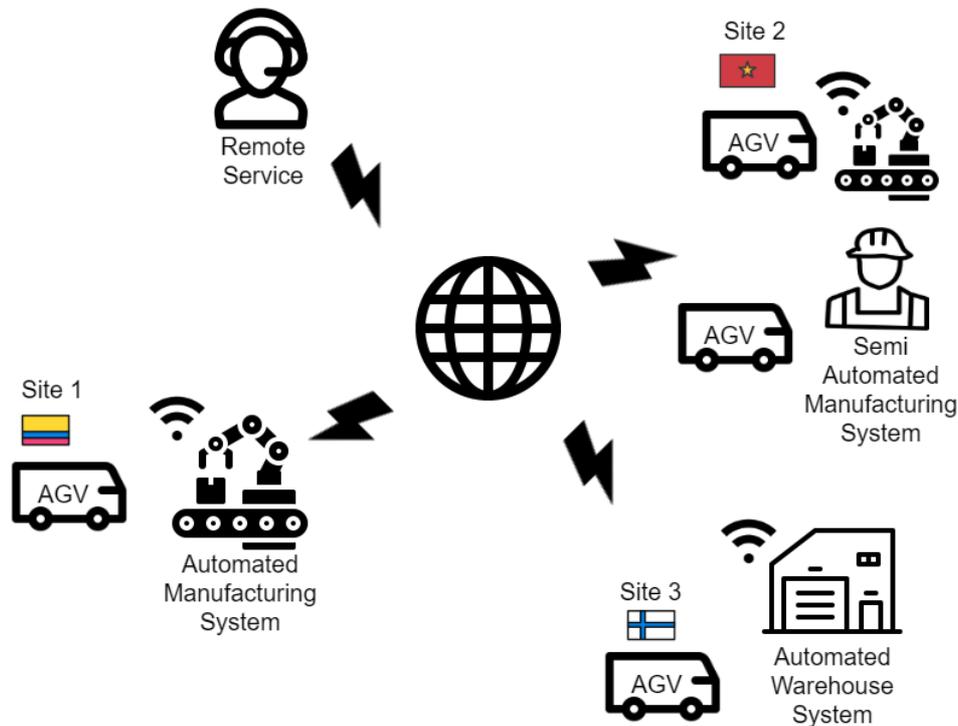


Figure 1. Diagram showing the solution provided for the customer

Leasing and service for agreed periods of time is offered. The service provider company will get stable revenue due to this. The service also includes a software part that is a combination of open-source elements, like REST API or ROS for controlling the AGV, and our own code. The code and software interface developed by the service provider company is licensed for the customer for the defined service period.

The benefits for the customer companies include reduced operational and logistics costs in warehouses or in factories due to the automated smart logistics service provided by AGVs, increased flexibility that can help better follow Lean or 5S production qualifications. The costs are reduced because less workforce is needed due to AGVs. This also increases the customers' own profit, which can lead to lower prices in end-products manufactured. The end-customer, or consumer, can also therefore profit from the use.

The first-time installation and configuration requires one time visit to the customer, but after that most service will be remote. 4 free service visits are offered to the customer company, after that they cost the amount defined in the service contracts. The number of AGVs and time of the period can reduce the money the customer has to use, so the contracts will be negotiated individually, to a certain limit.

3) Market situation and competitors analysis

The Automated Guided Vehicle (AGV) market in 2019 was 3.0 Billion USD (\approx 2.5 Billion Euros), which is expected to grow in future. The whole global industrial automation market size in 2018 was 157.04 Billion USD (\approx 130 Billion Euros), and it is also expected to grow.

Major players in the AGV sale business, and therefore our competitors, include companies like Toyota Industries Corporation, Dematic (part of KION Group), Swisslog (part of KUKA Group) and KMH Fleet Solutions. Some of these have been recently acquired by a larger corporation, like KUKA or KION.

The profitability of the competitor companies varies, but the net sales in them is somewhat hundreds of millions of euros. However, some companies sell a lot more than just AGVs. The realistic goal of the business proposed here is to have sales of 35 Million euros in 5 years, which is roughly over 1 % of the current AGV business size globally. However, it has to be remembered that AGVs are not sold in the proposed business, but instead they are leased with service contracts. The new company is estimated to have tens of potential customers (about 50 - 100) by then, since Dematic told about 6000 installations themselves in their website.

Toyota Industries Corporation is a Japanese company that had in 2019 net sales of 2,214,946 million Yens (\approx 18,000 Million Euros) and operating profit of 134,684 Million Yens (\approx 1,100 Million Euros). Its business includes traditional forklifts too, not just AGVs. Dematic is an American automation company that is owned by German KION Group. In their website, Dematic declares that they have installed over 6000 systems.

KION Group's business is related to integrated supply chains solutions, so it does not just work in AGV business. KION Group had in 2018 revenue 2018 of 7,995.7 Million Euros and net income 2018: 401.6 Million euros.

KHM Fleet Solutions (USA) has many forklift brands that it sells, rentals and offers service. It does not tell about its sales or profits in its website. AGV services are one part of its business according to their website.

Swisslog is now a member of KUKA Group, which is owned by Chinese Midea Group. Swisslog says that they offer logistics related systems, software, consulting service. Swisslog sales revenues were in 2018 (according to KUKA website) 819.3 Million Euros and EBIT in 2018 was -16.3 Million Euros.

It is clear that the main competitors are mainly multinational large corporations that have recently bought smaller AGV businesses. Many of them also offer service and system integration service. But, like KMH Fleet Solutions, which does not manufacture AGVs themselves, so it is possible to enter the AGV market as a service provider. The leasing of MiR robots is a competitive advantage. Also, the fact that the market is growing can offer room for new AGV service companies.

Another outcome that has to be considered is that some larger AGV company, most likely MiR robots manufacturer itself, could buy our service business. As told before, larger companies have

bought smaller businesses and integrated other services as their own (not as competitor) in a similar way.

In the whole global industrial automation market, key players include also companies like ABB, Siemens and Mitsubishi Electric. ABB's revenues in 2018 were 27,662 Million USD (\approx 23,000 Million Euros) and operational EBITA: 3,005 Million USD (\approx 2,500 Million Euros). Siemens had revenues of 28,185 Million Euros in 2018 and net income of 4,547 Million Euros. In the same year, Mitsubishi Electric's net sales were 41,803 Million USD (\approx 35,000 Million Euros) and net income 2,564 Million USD (\approx 2,200 Million Euros).

These large companies are focused on traditional industrial automation and also many other areas, but we still have to consider them as possible competitors also. As an example, ABB just got a contract to deliver an integrated AGV charging system to the new Singapore's port. However, these traditional automation companies may also have to be considered as possible customers for some applications services, as well.

The customer's purchase process most likely goes like this: they request offers from us and from our AGV solutions competitors for some factory or warehouse application. The customer then evaluates the quality and price of the product service between different offers, price is in many cases what the customer wants to be low.

Since the company proposed here is new, competing with very low prices is not desirable against large key players at the moment, but instead, the competitive advantages can come from leasing the MiR 100 robots and their wireless integration into existing systems. Because of leasing, the customer company's assets don't grow too much since they don't own the AGV robots themselves.

4) Intellectual property

Patent laws differ by country and economic zone. A good starting point is to consider the patent laws of Europe and US, which dictate some prerequisites for patent applications. Such prerequisites include e.g. the grace period, which means that should something patentable be invented during the course of this venture, the invention cannot be disclosed to anyone without a signed non-disclosure agreement, or rights to the patent may be lost.

The proposed business plan is unlikely to run into issues with intellectual property, as the business model is to provide a service (analogous to e.g. car rental), and it does not hinge on any new invention, method or technique.

After researching patents, no instance could be found that describes the methodology, software or techniques that are employed in the proposal.

Patents were searched using keywords such as robot, AGV, remote, configuration, operation, tunnel, proxy and variations and combinations thereof.

Parts of the proposed solution employ licenced software. Some software licences (such as GPL v2, used by OpenVPN), will limit the available copyrights developed software. The GPL licence, a form of copyleft licence^[1], requires free distribution of any modifications or extensions made to the OpenVPN source code. This means a source code must be made available, either publicly or by

request, and others cannot be prohibited from copying, using or further modifying or extending the software.

Software developed during the course of the project is possible to distribute with another, stricter licence, as long as it is properly disconnected from other licenced software. This means the software must be implemented in such a way that it uses the provided interfaces to communicate with other programs. If modifications are made to licenced software, the redistributor is subject to the terms stipulated in the licence. In the theoretical case that the software used in this project is implemented in a way that it communicates with a modified version of OpenVPN, the modified version of OpenVPN software must be released publicly, but since the disconnected software is out of the scope of the licence, it may be distributed with any licence.

The proposed business model is not dependent on specific software or hardware implementation. All important parts of the proposal are orthogonal and can be implemented in a multitude of different ways. This means that in the event of an IP conflict, parts of the solution can be switched or modified to resolve these conflicts.

Should a novel invention emerge during the course of the development process, it may be protected by filing a patent application. It is important to note that patents and trademarks are regional. Applications must be made in every region where the invention is to be protected by intellectual property rights.

Inventions that lose their competitive edge if they are made public should be kept as business secrets. The occurrence of such an invention in the scope of this business venture is unlikely.

[1] Copyleft is a form of licencing, which instead of restricting subsequent licensees' rights of redistributing the software, restricts said licensees from imposing stricter conditions in their subsequent re-releases of the software.

<https://www.gnu.org/copyleft/>

5) Product development and technology

Project members have familiarized themselves with the MiR 100 mobile robot; progress has been made in understanding both the REST API and theory of operation. Currently, the team is beginning to develop software for interfacing the robot remotely and abstracting mission control and other key functionality. The interfacing software forms the basis for future development, and hence finalizing this key piece of software is an important milestone towards a commercial product. Soon, work on providing solutions for networking related issues will be commenced as robust and highly functional networking is another key milestone towards commercialization.

Level of competition in the business is relatively high as several very large and capable companies are involved. Obtaining competitive advantage requires a broad set of skills and knowledge. Because of the nature of the planned business model, it is paramount that the team has good understanding of business contract and agreement related topics including, for example, legal matters. As of now, knowledge in these important areas is not yet adequate. However, technological skills and knowledge are on stronger foundations.

The team members have experience in software development, industrial automation and robotics. Specifically, the team has experience in IEC 61499 automation, which could possibly result in a competitive advantage as current commercial adoption of IEC 61499 is low and few companies have IEC 61499 know-how despite the advantages of the standard. Further, the plan is to offer a complete service including remote setup, integration with existing automation systems and leasing of the MiR robots. As of now, such a complete service is not yet common in mobile robotics business.

Provision of the described service requires the following actions and tasks to be taken: finish implementing the software that interfaces and abstracts the MiR robot functionality, and verify that the software behaves according to specification; develop and then securely audit a networking architecture for enabling remote communication between system components, acquire the required knowledge related to business contracts and agreements, and finance and buy additional MiR robots.

Priority (from high to low)	Actors	Actions	Tasks	Other resources
1	Software developers	Implementing the corresponding software	Interfacing and abstracting the MiR robot functionality	
2	Networking developers	Developing and security auditing a networking architecture	Enabling remote communication	Networking hardware
3	Contract counselor	Acquiring the required knowledge towards the matter	Business contract and agreements	Consultants
4	Accounting and finance personnel	Looking into buying additional MiR robots	Plan for future scalability	

6) Conformance

Proposed business plan does not involve modifications to hardware or safety systems of MiR 100. The MiR 100 is compliant with EN 1525, PLd cat. 3, IP 20, ESD approved and CE certified by the manufacturer, and as we are not modifying the robot itself, those certifications hold.

For the software development, standard SFS-ISO/IEC 25010:2019 could be used. This standard is a general quality model to determine which aspects will be considered when evaluating the quality of the software.

Standard ISO 9001:2015 (general quality management) could be useful for the company to be established. For the standardization, the company needs to get compliance from a certification company approved by FINAS.

7) SWOT-analysis

SWOT ANALYSIS

INTERNAL FACTORS	
STRENGTHS (+)	WEAKNESSES (-)
<ul style="list-style-type: none"> - Technological skills - Production quality - Scalability - Uniqueness - Valued member - User-experience - Strong relationship with educational institutions 	<ul style="list-style-type: none"> - Absent of skills - Poor access to distribution - Low customer retention - Slow expansion - Resource limitation - Lack of reputation - Single location means limited reach - Lack of industrial partners
EXTERNAL FACTORS	
OPPORTUNITIES (+)	THREATS (-)
<ul style="list-style-type: none"> - Technological advances - Changes in government politics - New distribution channels - Change in population age - Education networks - Partnership - Emerging markets - Potential product development 	<ul style="list-style-type: none"> - Closing of geographic markets - Potential competitions - Market saturation - Supplier-dependent - New government regulations - Technology theft and hacking - Potentially high R&D expenses - Aging technology infrastructure - Falling demands - Financing gaps

The biggest opportunity is to foster the penetration of AGVs into SMEs, enhancing logistics by autonomous vehicles with high availability, covered by efficient technical services.

Critical success factors are set as follow:

- Position of the company: With proper focus on strengths that are hard to match and clear differentiation between our company and the competitors, a sustainable competitive advantage can be maintained.
- Understanding of targeted customers: Companies buy technology to solve their business problems and overcome obstacles. Tailored solutions are to be expected.
- Customer-focused service strategy: Outstanding customer service is to be delivered at every stage, ranging from initial enquiry to the end of product life.
- Flexible pricing strategy: Service validation and price points can be varied from contract to contract.
- Scalable capability through collaboration: Partnership with AGVs OEM might be required to scale to tackle larger, global business opportunities. Moreover, it is essential when we want to extend our product or service capability and offer customers a more complete solution.

- Knowledge acquisition and communication: Knowledge is necessary in building tighter relationships with end-users by keeping them involved with information, building trust and providing us with insights. This will enable a better process of customizing and personalizing products, communications and the level of service offered.
- Market management: This can be achieved by identifying our competitive advantages, differentiating offers, controlling customer base, researching enterprise markets and interacting with market agility. Ultimately, the more control over the market, the stronger the competitive position.
- Effective channels to market: In order to gain access to an extensive customer base and the ability to deliver a level of service that we would not be able to supply from our own resources, it is essential to have the right channels to the market.
- Culture of innovation: Innovative company culture plays a pivotal role in remaining competitive in the long term. It is considered that the best practice to build a culture where every employee of the company is proactive in developing innovative ideas.
- Easy-to-do business: Achieving a satisfactory level of quality takes a continuous effort to keep enhancing the interaction between the company and customers.
- Sales cycle and marketing management: To be able to market and sell effectively and to make the best utilization of resources, it is utmost important to understand how the customers and prospects buy, and to recognize which stage of the cycle they are currently in.

Risk factors and mitigation methods are identified as follow:

- Environmental impact: At the moment the robots are running on electricity so the environmental impact is somewhat small. Nevertheless, routine check of carbon footprint can be performed, just to create a culture of being responsible for the environment.
- Social well-being: The pros and cons of every project has to be carefully checked before signing the contract. Projects about weapons, harmful substances, etc. have to be carefully taken into account.
- Safety and integrity: The whole working robot fleet has to have automatic shut down sequences when detecting threats. Routine check, routine maintenance and spare parts renewal according to legislation are essential.
- Quality: Quality control and post production monitoring have to be in place. Comparing products, product testing and random checks can reduce this risk to great extend.
- Legal issues: Standards, patents and regulations have to be taken into careful consideration. Seeking help in legal consultants whenever entered a new and tricky market.
- Communications: It is foreseen that there could be communication problems with stakeholders, vendors, suppliers and contractors. More employees can be employed to assist with analyzing and mitigating multicultural risks during the bid and proposal process.
- Economics and finance: There could be higher interest rates than expected, banks rejecting requests for loans, less demand for the product than expected, competition launching a similar product, etc. All of these can only be minimized with a better execution in the whole company, for example better R&D results, better reach outs and networkings, better marketing schemes, etc.
- External factors: These factors might be suppliers' delay, new government regulations, unexpected results in R&D, etc. These unexpected elements can be avoided through a strategic long-term plan, thorough assessment and predictions, etc.

Supplement: Distribution of work and learning outcomes

The distribution work in the group for this document was as follows:

Member / Chapter	Juhani Lähde	Minh Duc Pham	Niko Karhula	Paavo Kajola	Panu Salo
1 Business idea	X	X			
2 Product/service	X				
3 Market analysis	X				
4 Intellectual property				X	
5 Product development			X		
6 Conformance					X
7 SWOT analysis		X			

Our group learnt for example different aspects about how to formulate a business idea and that many different parts have to be considered when starting a new tech business. For the SWOT analysis, it is hard to imagine what are the potential risks and success factors since everything is still at an early stage. However this experience also highlighted the importance of planning and how troublesome the analysis process can be.

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