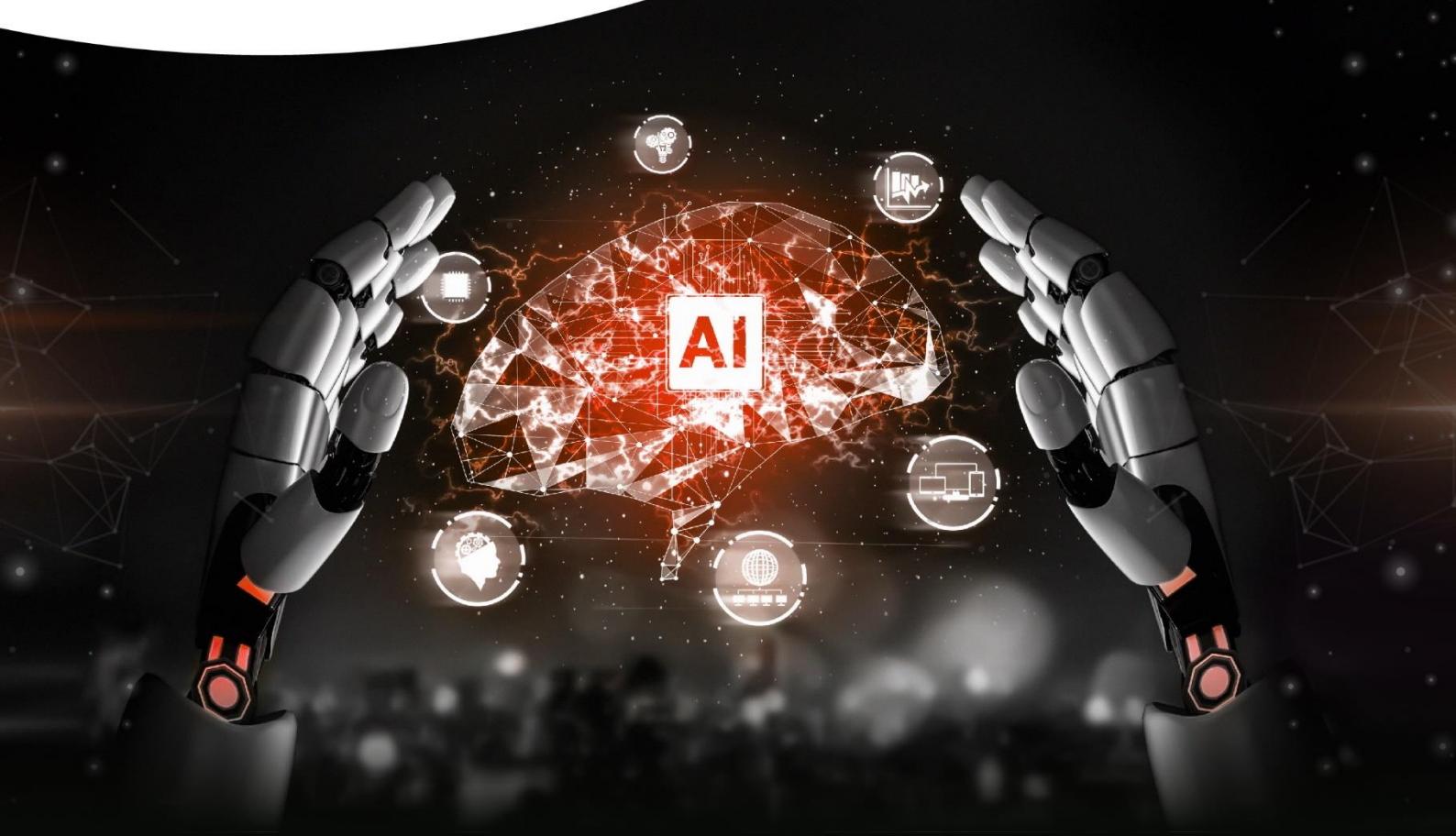
AGIMUS

INNOVATIVE ROBOTICS FOR AGILE PRODUCTION

Interview Guide



PROJECT ACRONYM: AGIMUS

PROGRAMME: Horizon Europe
GRANT AGREEMENT: No 101070165
TYPE OF ACTION: Horizon Research & Innovation Actions
START DATE: 1 October 2022
DURATION: 48 months

Funded by the European Union

Grant Agreement 101070165

Interview guide

January 20 2023

AGIMUS in a nutshell

AGIMUS aims to deliver open-source breakthrough innovation in AI-powered agile production, introducing solutions that push the limits of perception, planning, and control in robotics, enabling general-purpose robots to be quick to set up, autonomous and easily adaptable to changes in the manufacturing process.

To achieve such agile production, AGIMUS leverages cutting-edge technologies and goes beyond the state-of-the-art to equip current mobile manipulators with a combination of (i) an advanced task and motion planner that can learn from online available video demonstrations; (ii) optimal control policies obtained from advances in reinforcement learning based on efficient differentiable physics simulations of the manufacturing process; as well as (iii) advanced perception algorithms able to handle objects and situations unseen during initial training. Along the way, optimising energy efficiency and using 5G technology will support further pushing the limits of autonomy.

The AGIMUS solutions and their impact will be demonstrated and thoroughly stress tested in 3 testing zones, as well as 3 industrial pilots in Europe, under numerous diverse real-world case studies and scenarios (different tools, environments, processes, etc.). In every step, and from the very beginning, AGIMUS will go beyond current norms and involve a wide range of stakeholders, starting from the production line itself, to identify the essential ethical-by-design principles and guidelines that can maximise acceptance and impact.

Scope of the analysis

Based on the ongoing desk research, a deep dive into the versatile robotics for agile production paradigm, understanding in more detail the needs, challenges & requirements of manufacturing lines that have adopted or need such principles was endeavoured.

Our aim is to shed light on (i) agile production as a new trend, (ii) its industrial needs and challenges, (iii) available or forthcoming technological solutions such as versatile robotics, (iv) key actors (industry, policy and research arena), (v) openly available resources for extending research activities, uncover barriers and drivers across key framework conditions which may influence uptake in the shop floor (e.g. culture, access to properly skilled human capital, regulations, policy support, etc.).

To gain the necessary knowledge more effectively, semi-structured interviews will be performed with key experts in AI, Data, Robotics, and Manufacturing from AGIMUS industrial partners and external stakeholders. The workforce from the AGIMUS industrial pilots and external key stakeholders will be actively involved towards better understanding their needs, concerns and acceptance barriers. Potential interviewees will also include people involved in the shop floors, following recent research insights that suggest that active workforce involvement during the design phase (i.e., drawing on the workers' knowledge) can lead to not only better productivity results, as they have the required knowledge for the details, but also higher acceptance rates for production robotics.

The objective of the interviews

The main target of the interviewing activities is to offer profound insights to AGIMUS, allowing a more accurate and high-performance design of the envisioned autonomous robotic solution, but also to introduce major long-term impact to the shop floor such as an increase in productivity, reduction in deficits and waste of materials and high acceptance rates.

By actively involving key stakeholders across the “AI, data and Robotics” supply chain through interviews (and surveys later on), a concrete foundation will be created on the actual needs and potential of improved perception and understanding of an agile production line that uses versatile robots, while working safely at the same shopfloor with workers, without or with limited supervision.

These findings will support implementation through a shopfloor-driven, user-centred approach, ensure increased autonomy and an arsenal of augmented capabilities for safe and efficient manufacturing processes.

During the interviews, any openly available platforms, databases, datasets, etc., that can bring value during the implementation phase will be documented. The valuable feedback of the interviewees will enable us to identify any dimensions not previously envisaged and fuel the development of a questionnaire to be administered to a broader group of experts, including the employees of AGIMUS’ 3 industrial pilots. This questionnaire will cross-reference findings and reveal disparity points that may require further investigation.

Ultimately, interviews will help us define certain requirements that will be transformed into specific functional and non-functional (social, privacy, etc.) technical requirements of AGIMUS system architecture.

To summarise, the interviews’ objectives are:

1. Extract insights to validate, complete or even correct the ongoing desk research and literature review (iterative process);
2. Enhance the knowledge provided by key stakeholders across the “AI, data and Robotics” supply chain to support the design of the questionnaire survey that will follow later, giving insights on the topics that should be covered by it and people that should be reached;
3. Elucidate issues that may arise in AGIMUS industrial pilot cases, take them into account and potentially prevent them;
4. Shed light on various aspects of robotic-driven agile production, such as business, economics, technology, management and ethics, from the viewpoint of all involved stakeholders, i.e., workers, managers/experts, and decision takers;
5. Inform the main aspects and parameters that should be considered for AGIMUS system requirements and architecture;

QUESTIONNAIRE

General information of the interviewee

	INTERVIEWEE's PROFILE		
Demographics	**Age Range**	**Gender**	**Education**
	30-40	Female	*PhD*
Organisation type	Academia		
Positioning in the organisation	Research Scientist		
Level of expertise in robotics	**EXPERT**		
Level of experience in production (agile or otherwise)	**INTERMEDIATE**		
Country	France		

The interviewees may be experts, executive officers, managers or workers. The questions that will be posed may differ slightly according to the respective target group. All notes may be kept in the area that is foreseen after each question below. If need be, the transcripts should be translated into English before being delivered to Q-PLAN.

Questions

No	Interview's topics/questions	Notes for interviewers *(to activate/trigger the dialogue, or give some hints, explanations, or examples)*
1	**What is the definition you would give on agile production?**	Guide the interviewee if his/her definition is ambiguous. Indicative definition: *"Agile production is a term applied to an organization that has created the processes, tools, and training to enable it to respond quickly to customer needs and market changes while still controlling costs and quality. It is seen as the next step after lean manufacturing in the evolution of production methodology."*
	A production that can be reconfigured without too much extra cost according to the production needs	
2	**How do you envision versatile robotics could address the agile production line needs?**	Indicative definition: "*Versatile robotics are robotic systems able to quickly adjust and adapt to many different functions, activities or changes, causing minimum interruption to the production process.*"
	The robot downloads new policies, or new paths and work sequences, depending on the objects produced. Therefore, the robot must integrate with the system that manages the produced parts, to know for each product what to do.	
3	**Are you aware of any versatile robotics solutions for agile production?**	Goal: to find out about the competition e.g., advanced perception algorithms, Task-And-Motion

No	Interview's topics/questions	Notes for interviewers *(to activate/trigger the dialogue, or give some hints, explanations, or examples)*
	Are you aware of any available or forthcoming technological solutions for agile production?	Planner, Cloud systems and Internet of Things
	At the "research" level but not really on solutions deployed in industry.	
4	**Which are the 5 most important needs of agile production lines in your opinion? Why? Does the use of versatile robotics create more/different needs? Why?**	-
	I don't know much about production lines, but from what I do know it is the interface of the robotic systems with the automatic production line, and the information management system that follows the product life cycle and manufacturing. The robot control system must be integrated into the company's software architecture. Personally, I don't see any major problems with robot control, it's more a matter of software integration and the coexistence of different information management systems: at the low level, industrial sensors are on buses, exchanging data with protocols, which is not at all what is done in the laboratories with ROS or ROS2 systems. The lack of standard seems to me to be a problem: if it is true that on the robotics side we may standardize with ROS2, on the industrial side each system has its own standard or practice. If we use a Siemens system, it is not the same thing as a competitor. On the fact of reconfiguring production lines in an agile way, I think that humans will be able to do it better than robots, but they must be able to delegate tasks to the robot when necessary, and this means creating appropriate man-machine interfaces, which is not always the case in robotics.	
5	**What kind of technologies were you using instead of robotics? When did you first use robotic systems? What kind of robotics did you use?**	-
	On the academic side, I have worked with humanoid robots on legs and wheels, manipulators with fixed base, manipulators with floating base on mobile base. To study "production" and assembly tasks I used Kinova Jaco, KUKA iiwa and Franka arms.	
6	**Which were/are the most important drivers of implementing agile production in general and versatile robotics in particular? Why?**	e.g., Industry, customers' requirements, infrastructure, government policies, company interests, other

No	Interview's topics/questions	Notes for interviewers *(to activate/trigger the dialogue, or give some hints, explanations, or examples)*
	The industry and its cost reduction objectives.	
7	**How were technology changes in your production process seen by the employees? What allowed them to take place? What did perhaps decelerate/accelerate their progress or reduce/increase their acceptance?**	-
	Not a question for me because I am from the academy. From what I have heard from my industrial partners, the workers are quite open to the introduction of robots and new technologies because they are already used to seeing them in the production lines. They prefer exoskeletons because they are perceived as personal assistance devices (against RSI, improved ergonomics). On the other hand, they are afraid when they see that the technologies replace their work. At the production level, I have heard little fear of manipulator arms because they are often out of order (seen with my eyes!) and because they consider that certain gestures and quality operations cannot be given to machines. On the other hand, I heard a lot of bad things about the AVGs, because they saw that the forklift drivers had lost their jobs, and the introduction of the AVGs imposed constraints on the spaces (safety corridors, etc.)	
8	**Do you have in mind any measurable changes depicting the impact of introducing agile production methods in general and the use of versatile robotics in particular?**	with respect to productivity, efficiency, quality, profit, other
	No	
9	**Which are the 5 most important challenges that agile production lines face in your opinion? Why?** **Does the use of versatile robotics create more/different challenges? Why?**	e.g., culture, access to properly skilled human capital, technology, regulations, policy support e.g., excessive deployment time, maintenance, costs, any other particularity

No	Interview's topics/questions	Notes for interviewers *(to activate/trigger the dialogue, or give some hints, explanations, or examples)*
	Difficulty of implementation and cost of the solution too high compared to the benefits. For me, the ROI has yet to be proven in the long term.	
10	**To which extend are AI-powered solutions beneficial for the employees? Which employee category do you expect to oppose to the deployment of AI-powered solution?**	e.g., impact on the work life quality, specialized training and abilities may be needed in order to integrate robots in the production line and work with them, patiently teaching a robot how to carry out repetitive tasks may be required
	AI can do a lot of things, but if we want to deploy it, we have to rethink the human-machine interface, the user-experience, and think about what the user needs to know how to use it. A worker can teach a robot very well how to do a task, by demonstration, but then you need the architecture around it to show how his demonstration is used, how to trigger it automatically. I've seen demos of interfaces built around teaching by demonstration, and I'm not sure that an alpha worker would use it.	
11	**What would you consider as sufficient guarantee regarding the responsibility and accountability of an AI-powered solution, before integrating it into the production line?**	e.g., performance metrics; safety guarantee about the behavior of the robot; explicability of the robot behavior (for example displayed on an external screen or leading to interpretable movements); safety measures in case of failure; time-to-reset metrics
	Guarantee of safety for people and objects handled. Explicability of actions and decisions.	

No	Interview's topics/questions	Notes for interviewers *(to activate/trigger the dialogue, or give some hints, explanations, or examples)*
12	**How reliable do you consider AI-powered compared to classical engineering-based solutions? How reliable would you like an AI-powered solution to be in order to consider integrating it or replacing your current solution?**	The interviewee should provide a quantitative metric (e.g., the success rate regarding a specific task) if possible
	It depends on the task and the tolerance allowed, but I would say at least comparable in % to the reliability of the engineering solution. Let's imagine a vision module that has to identify defects for airplane wings, I would like 100% reliability.	
13	**Have you considered the environmental & energy cost of deploying AI-powered solutions to your company/organisation? If you are already using AI-powered solutions, have you considered using more efficient algorithms to reduce the environmental impact?**	e.g., energy consumption, type of energy used by the data centres, hidden costs of cloud-based solutions
	The energy impact of computations and computer clusters - we take this into account, and we aim for data-efficient and "light" algorithms in terms of computation resources.	
14	**There are concerns that AI-powered solutions, such as versatile autonomous robots, will replace workers. What is your point of view and which do you consider to be an ethical approach to this deployment?**	-
	Do we really need to replace humans? What is the consequence? If it makes us gain 0.01% of productivity, maybe we have to ask ourselves from a "global" point of view if it is a good solution for the society. We risk losing jobs, we risk minimizing the human value. I understand using robots to replace humans where humans can't go or don't want to go when it's too dangerous, but on production lines this is not the case. It causes people to be unemployed, people who will not necessarily find another job, and from the point of view of society it is not desirable	
15	**AGIMUS' framework results are expected to be the foundation of an open-source, international, robotics software consortium. What kind of benefits would your company/organisation expect to participate in it?**	-

No	Interview's topics/questions	Notes for interviewers *(to activate/trigger the dialogue, or give some hints, explanations, or examples)*
	Re-use the code and improve it, avoid "reinventing the wheel".	
16	**What issues do you expect to arise with the broad use of cloud applications and 5G for online & offline training of an AI-powered solution?**	-
	Everything in the cloud is too risky for companies. A few months ago a data center caught fire and hundreds of companies lost their data. There is a network problem and nothing works anymore. This is a huge liability. I'm not against 5G or doing things online, but it has to make sense. You can't do it just because you can. There are energy costs to consider.	
17	**From the 7 key requirements defined by the EU ethics guidelines for trustworthy AI, which do you consider to be the most important? Please elaborate how this could be applied in the case of versatile robotics for agile production.**	EU ethics guidelines for trustworthy AI key requirements: 1. Human agency and oversight 2. Technical robustness and safety 3. Privacy and data governance 4. Transparency 5. Diversity, non-discrimination and fairness 6. Societal and environmental wellbeing 7. Accountability
	Human agency and supervision. For me the key decisions must be made by humans. This is the recurring element I have found in all my HRI experiences.	
18	**Would you consider any additional aspect of agile production & implementation of versatile autonomous robotics that we did not manage to address?**	Goal: to check the completeness of the questionnaire & make adjustments; to receive

No	Interview's topics/questions	Notes for interviewers *(to activate/trigger the dialogue, or give some hints, explanations, or examples)*
		feedback on aspects not covered
	How to take into account the human in the loop. It must always be the human who decides, otherwise the human is useless.	