

BACHELOR CREATIVE TECHNOLOGIES & AI / MULTIMEDIA & CREATIVE TECHNOLOGIES

SEMESTER 5 ACADEMIC YEAR 2025-2026

RESPONSIBLES NATHAN SEGERS, PAULA ACUÑA RONCANCIO, WOUTER GEVAERT

CONTRACTPLAN RESEARCHPROJECT LAUREYS INDY

MCT / CTAI

This form is the part of the Innovation & Research Project module. It serves as a contract for your research

howest.be

TABLE OF CONTENTS

1	INTRODUCTION	2
1.1	Identification	2
1.2	Goal	2
2	PLAN OF APPROACH	3
2.1	Scout the workfield and filter	3
2.2	Research question and subquestions	3
2.3	The Research project – Technical research	4
2.4	Handing in your research project	5
2.5	Sources	5
3	SIGNATURE	6

1 INTRODUCTION

1.1 IDENTIFICATION

Date: 11/12/2025.

Signed by: Laureys Indy

Internal coach Research Project: <Howest Coach: lastname, firstname >

Internal promotor bachelor's Thesis: <Howest Promotor: lastname, firstname>

External promotor bachelor's Thesis: <External promotor: lastname, firstname>

1.2 GOAL

In the Innovation & Research Project and Bachelor's Thesis modules, you will dive deeper into technical competences and combine them with some general competences. By the end of this module, you'll be:

- Able to formulate a question from professional field
- Work structured towards a goal
- Get results by own, technical research
- Take conclusions from your technical research
- Reflect on the conclusions
- Formulate advise
- Present your thesis for a jury of specialists
- Create an attitude for Lifelong Learning

How are we going to start?

1. You start by formulating a **research question**. It could be from an internship company, from an inspirational list ... A team of teachers will check the level of your question.
2. You perform the **practical research** at school. The question will be fully researched and technically implemented during the **Innovation & Research Project** module in a span of maximum four weeks.
You'll create/research your own solution/design/prototype. It could be pushed into a specific direction by your question.
3. In the **bachelor's Thesis** you will reflect individually with experts from the industry (for example in your internship companies) and with community members that have a great knowledge of your project.

Below, you will find a few of the different steps. Your goal is to think critically about the different phases of your research. You will create a plan of approach and think about your process. Try to fill in the form fields as extensively as possible. You will notice that a great and thorough preparation is a great support during the creation of your research project and bachelor's thesis.

2 PLAN OF APPROACH

2.1 SCOUT THE WORKFIELD AND FILTER

You have received your research question from your teachers, from an internship company, from someone else ... but now you need to get some more information about this topic. Most likely, you'll already have a little bit of knowledge about this. In some cases, it's a completely new topic. Maybe the question that you have received is still too broad, wide, or generic. You'll have to dive deeper into your topic to get comfortable.

Read, read and read some sources and fetch information. Keep track of all the sources you have encountered during your research. The more you read into your topic, the clearer your vision will get. As it gets clearer, you can easily define your topic further. Narrowing down is very important: What exactly are you going to research? Where is your topic located? What perspective are you going to research? Who are the actors that benefit from this research? ...

2.2 RESEARCH QUESTION AND SUBQUESTIONS

This is your main research questions: What question do you wish to research and answer?

How can a multi-agent system run on local LLMs improve efficiency in planning business trips?

2.3 SUB QUESTIONS

Write down a bunch of sub questions to structure your project. It will make sure you can split your research in chunks with theoretical and practical parts. Some questions will be answered by a literature study. Other questions will only be answered by practically researching everything.

Try to get a minimum of 5 and a maximum of 10 sub questions. It can be a few smaller and some bigger questions if needed.

1. What is the impact of adding the Time Management Agent on planning success rate and total iterations compared to a system with only Trip Orchestrator, Flight, Hotel, and Policy agents?
2. What is the average number of feedback loops between the Policy Compliance Agent and booking agents before achieving a valid trip plan, and how does this vary with policy strictness?
3. How many message exchanges are required between agents for successful trip planning across different trip complexity levels?
4. How does trip complexity (number of cities, budget constraints, policy violations) affect end-to-end planning time in the multi-agent system?

5. How does prompt specificity (generic task description vs. domain-expert descriptions) affect policy violation rate and booking accuracy when using the same LLM?

2.4 THE RESEARCH PROJECT – TECHNICAL RESEARCH

Goal: Your research question will be technically implemented individually (or in a team of two people) during the practical weeks in January, during a period of maximum four weeks. You'll create/research your own solution/design/prototype.

This is the first real practical step as soon as you have formulated your research and sub questions. You clearly defined what way you want to go to, and now you can formulate all the different steps to get to that goal. What **components** are necessary to reach your goal? How are you going to build these components?

TIP: Write down a mind map (or brainstorm) to structure your approach. Talk this through with experts/your coach.

What are you going to create as technical research? Make sure your context is well defined, go into detail where necessary. Use a plan of approach and include images. Don't forget any important elements! **Warning: Innovation & Research Project in MCT is always a technical realisation. Only including a literature study is not enough.**

- Which data will you use?
 - What case will you work out?
 - Which evaluation or comparison criteria will you use?
 - What are the minimal requirements of your project / app?
 - How do you make sure your application is relevant?
-

What am I building?

This project develops a proof-of-concept multi-agent system that uses local LLMs to automate business trip planning. The system employs four specialized AI agents that work together to find flights, hotels, and ensure everything follows company travel policies. Unlike traditional sequential approaches, this architecture enables parallel processing and iterative refinement through bidirectional feedback loops.

Technical components

The architecture consists of five specialized agents working in a hub-and-spoke pattern:

- Trip Orchestrator
- Flight Agent
- Hotel Agent
- Policy Compliance Agent
- Time Management Agent

The Trip Orchestrator will serve as a central coordinator, managing workflow and communication between agents. The Flight Agent handles flight search and price optimization, while the Hotel Agent finds suitable accommodations near business locations. The Policy Compliance Agent validates all bookings against company rules and can make agents redo their work if violations occur. The Time Management Agent will ensure that meetings and travel times do not overlap. It will consider the travel time from the

airport to the hotel for example. It will calculate the distances using longitudes and latitudes from locations.

What sets this apart from a waterfall approach is the coordination model. Flight and Hotel agents execute operate simultaneously rather than serial. When the Policy agent sees any violation, it sends feedback through the Orchestrator to agents for other options without restarting the entire process.

The system will run on a local Ollama model (not yet sure what model), utilizing system prompts to give each agent domain-specific expertise. All the agents share the same base model, but they receive different prompts and instructions specifically chosen for their role. This way, memory usage will remain at the lower end.

For communication, RabbitMQ handles messages between agents. Redis maintains a shared state accessible to all agents. The complete technology includes Python with FastAPI for the backend, LangGraph for agent workflow management, and Ollama for local model serving. A basic HTML, CSS and Javascript web interface will be created for user interaction.

Data Sources

The project uses fully synthetic data for both flights and hotels across four cities: New York City, San Francisco, Chicago, and Boston. While real-world APIs are possible, they add extra complexity such as rate limits and costs.

The dataset is designed to be realistic. It includes plausible flight and hotel prices, and actual geographical coordinates for location. At the same time it allows us to create challenging test cases to push the agents and see how well they handle conflicts.

2.5 TECHNICAL RESEARCH: SUCCESS CRITERIA

Now that you have well defined how your project will be made, it is important to define some goals and success criteria. **When is your project finished** according to your standards? Describe a few of your results that you want to achieve. Use a list.

What will your technical demo or proof-of-concept contain? When is your project finished? What if you're done in a few weeks, and you want to do some alternatives?

Technical Performance Targets

The system is designed to make multi-city business trip planning faster and more efficient. Success will be measured as follows:

- Simple trips should be planned within a few minutes, compared to 30-40 minutes manually.
- The system should be able to identify bookings that are within budget
- All five agents must work together smoothly
- Messages sent via RabbitMQ should be delivered consistently
- Redis state should remain accurate and conflict free

- Meeting and travel times should not overlap with one another; conflicts will trigger adjustments

Functional Requirements

The system should contain the following:

- Users can enter trip requirements using a web interface built with HTML, CSS and JavaScript
- The system returns complete trips with flight and booking information
- Any violations are flagged, with explanations so users understand why certain options are rejected
- Performance metrics must be collected for each scenario and statistical analysis should be done to show that a multi-agent system performs better than manual bookings

Technical Demo

The technical demo will show the system planning trips in real-time using the synthetic dataset of flights and hotels. The demo will include:

- User input of trip requirements
- Dynamic coordination between all agents
- Display of results including flights, hotels, and runtime
- Metrics visualization for speed and efficiency

Extras

If the project is completed before schedule, these are some extra goals:

- **Adding multiple business trips in one go**
- **Adding more cities**
- **PDF export of the final trip planned out**

2.6 HANDING IN YOUR RESEARCH PROJECT

In the end of the Innovation & Research Project, you should hand in all of these required things:

- **User manual** – How can someone use the project that you have developed? What are all the things that one should think of when using this project?
- **Installation manual** – How can someone install this project on their own setup? Where are the pitfalls in the installation?
- **Source code** – During the development of an application, or when writing any code, hand everything in.

A few more optional things:

- Technical schema's
- Graphical representations of technologies
- Other illustrations that can be interesting for your project
- Video's of your demonstration that you created

Talk to your coach about what to hand in in your situation.

2.7 BACHELORS THESIS

Goal: The bachelor's thesis is an individual document consisting of the following parts:

de bachelorproef is een individueel document bestaande uit volgende onderdelen:

- 1 Introduction
- 2 Research
- 3 Technical results
- 4 Reflection
- 5 Advise
- 6 Conclusion
- 7 References of good sources
- 8 Addendum

The bachelor's thesis begins with the technical description of the result of the research project.

- What did your research in the research project consist of in order to answer the research question?
- Include (relevant) new technical background information where necessary.
- Describe the motivation for any technical choices made.
- Describe the technical implementation.

In the bachelor's thesis, you then **evaluate the achieved result** in relation to the **professional field and community**.

Reflecting on the research result in the bachelor's thesis takes place **in parallel with the internship period**.

Detailed information will be provided during the **Professional Career Week**.

This reflection includes:

- What are the **strengths and weaknesses** of the result from the research project?
- Is the **project result** (including methodology) **usable in the professional world**?
 - What are the possible **implementation obstacles**?
 - What is the **added value for the company**?
- What **alternatives or suggestions** do companies and/or the community provide?
- Is there **social, economic, or socio-economic added value**?
- What are your **suggestions for possible follow-up research**?

An **advice section** includes **concrete recommendations for the professional field**. You may address:

- Which **recommendations** can the professional field undertake based on your research results?
- What **action plan** could the professional field use for this purpose?
- How does your **advice align with your conclusions**?
- Which **tools** have you developed for the professional field?
- The **usability and applicability** of your proposed solutions.
- Other **relevant recommendations** for the professional field, based on your research.

A **reference list**: this demonstrates that you have based your findings on existing scientific research and reliable sources.

Final Deliverables of the Bachelor's Thesis:

For this module, you must submit the following items:

- **Digital version of the bachelor's thesis** (mandatory)
- **Final presentation** (mandatory)

Further information will be communicated later via **Leho**.

2.8 SOURCES

Write down at least 5 different sources that you used to create this contract. **(Use the IEEE¹ style)**

When referring to AI-generated content, add the full chat history as an addendum on Leho and refer in a similar way in IEEE style.

[1] K.-T. Tran et al., "Multi-Agent Collaboration Mechanisms: A Survey of LLMs," arXiv:2501.06322, Jan. 2025.

[2] T. Guo et al., "Large Language Model based Multi-Agents: Survey," arXiv:2402.01680, 2024.

[3] M. Schäfer et al., "OpenSky: Large-scale ADS-B Sensor Network," IEEE/ACM IPSN, 2014.

[4] D. Brandenbourger et al., "Message-oriented Middleware," IEEE INDIN, 2018.

[5] A. Chen et al., "TravelAgent: AI for Travel Planning," arXiv:2409.08069, 2024.

[6] K. Zhu et al., "MultiAgentBench: LLM Collaboration Eval," arXiv:2503.01935, 2025.

[7] "Hotel booking datasets," ScienceDirect, 2019.

[8] "Building Effective AI Agents," Anthropic, 2024.

[9] "Business Trip Challenges," GBTA, 2025.

¹

IEEE (Institute of Electrical and Electronics Engineers)-style is a reference style that is often used in technical studies like IT and electrotechnics.

[10] Meta, "Llama 3.2: Revolutionizing edge AI and vision," Meta AI Blog, 2024.

3 SIGNATURE

I hereby declare that I will complete my project according to the defined planning like above.

Your (digital) signature:

Surname and name:

Date: