Project Management Plan
Pentagos

by

Group 1

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Contents

1 Introduction

This document will describe how the project will be executed throughout its life cycle, it's important configuration and precisely why this endeavor will be a success. We begin by laying down who the most important people involved are. Then, we will show the exact work that needs to be done together with the time and costs estimates for each work package. This section will clearly state how quality and project success is assessed. The organization of the workforce will be described in chapter 4. In the subsequent chapter, the tasks will be put together in the project timeline, thus describing how the work will be executed from start to finish. The process management including how documents and communications will be operated is the subject of the penultimate point. Finally, all the risks associated with this planning will be described and relevant mitigation strategies will be put in place.

1.1 Context & Problem definition

Currently, the Netherlands is experiencing a serious lack of student housing. In Delft alone, there is already a shortage of 1,500 rooms, with the expectation that this will increase to 3,600 by 2028[1]. This forces students to continue living with their parents, resulting in longer public transportation commutes. Public transport in the Netherlands is already overloaded, and now 1,500 more students are being added to the mix. Additionally, moving out is an important step in the development of adulthood. Due to the current housing shortage, some students are deprived of this opportunity.

The shortage of rooms is also a major problem for international students. They don't have the option to live at home, forcing them sometimes to rent overly expensive rooms or apartments far away from campus. The costs related to transportation, especially for groups not eligible for student financing, put a lot of strain on their financial situation. On top of this, the travel times often take up a significant portion of the day.

Another problem that is also more than relevant is the TU's goal of adopting a sustainable approach within each building on the campus by 2040. The average temperature in the Netherlands has been steadily increasing over the years (Berkeley Earth & ERA5-Land). Bounded by the Climate Action Program, 2021-2030 the university has a vision of a sustainable, livable, and inclusive campus. Being adaptive to changes caused by climate or societal needs is important.

1.2 Solution

This project aims to provide relief from this housing crisis, while at the same time working towards the sustainability goals of TU Delft. Project Pentagos will repurpose Building 22 (location pictured in Figure 1) of the campus into a sustainable housing unit, providing accommodations for over 500 students. Necessities and amenities like washing machines, dryers, a cafe, and common places will also be an integral part of this project. What's more, some of the building's wings will be repurposed for administrative purposes and offices, which would further support the needs of the campus. The renovation will extend to the surrounding areas of the building, with a focus on achieving carbon neutrality throughout the project.

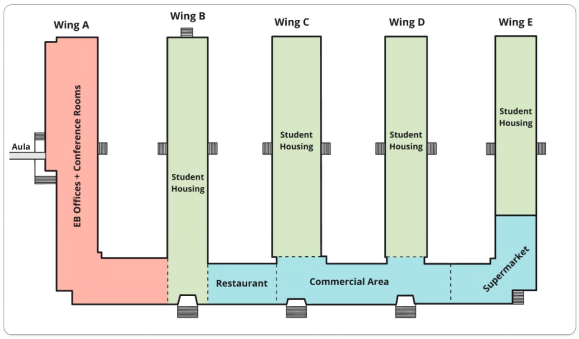

Figure 1: General Floor Plan; Wing F has student housing on the upper floors

1.3 Goals

The Pentagos project is designed to align with TU Delft's Campus Vision 2040[2], addressing multiple key objectives while providing significant value to the university community. The main key objectives are: to alleviate student housing shortage, help TU reach carbon neutrality, create a "lobby" area in Campus Midden, and increase commercial activity in Mekel Park.

These can be summarized in the following bullet points:

- more student housing
- reducing carbon emissions
- improving the global image of TU Delft
- increasing commercial activity

1.4 Scope of work

Included in scope	NOT in scope
Exterior works: • Add extra insulation for better energy consumption • Install solar panels • Change aesthetic from brutalist to green and futuristic • Additional scope elements by contractor to improve sustainability; must be agreed on by Project Team and not include major structural reworks Interior works: • Stripping the building to a shell • Retrofit plumbing, electrical networks • Sound-insulated dividing walls based on type of space • Furnishing with modern housing or office furniture • Shell left for lessor in case of the commercial spaces	• Rework of surrounding infrastructure • Adjustments to other buildings • Major expansions of Building 22 • Work related to the nearby Library parking lot • Dedicating a part of Building Pentagos to generating electricity for a net profit • Dedicating a part of Building Pentagos to educational spaces such as lecture halls • Adding new automobile parking lots • Provide permanent residence for tenants • Provide new sports facilities • Provide accommodation for employees or teachers • Permanently accommodate any of the current inhabitants of Building 22

2 Stakeholders

In any project, identifying and engaging key stakeholders is crucial to ensuring its success. For the Pentagos project, understanding and mapping the influence and interests of different stakeholders is particularly important. The power-interest grid is an effective tool to categorize stakeholders based on their level of influence and their level of interest in the project's outcomes. The stakeholders with high power and interest are key for the success of Pentagos. In Figure 1 the power-interest grid can be seen followed by the most important stakeholders of the project.

2.1 Stakeholder Power-Interest Grid

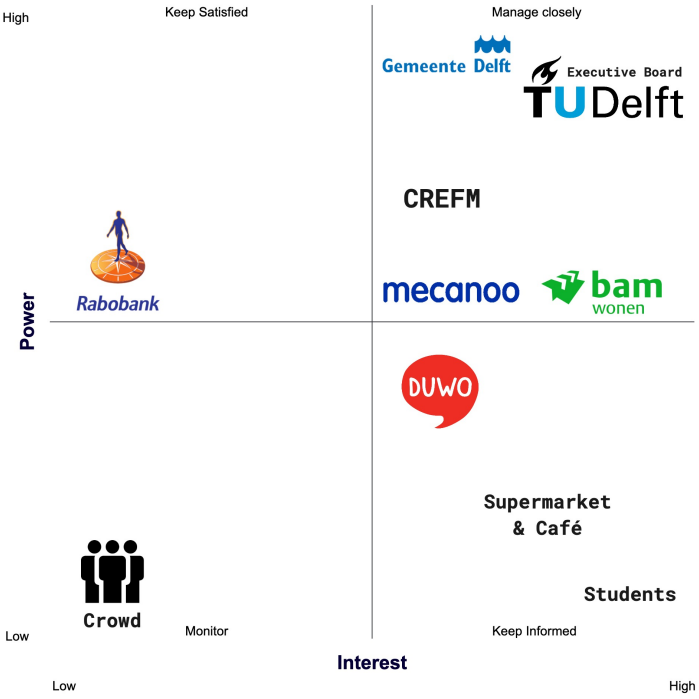

Figure 2: Stakeholder power-interest grid

2.2 Key Stakeholders

- **Executive Board of TU Delft**
  The Executive Board holds high power as the ultimate decision-makers regarding the project's alignment with the university's strategic vision. Their strong interest stems from the project's direct impact on their relocation to Building 22, making their support essential for project success. They are closely involved in setting strategic direction and rely on project updates to ensure alignment with university goals. Their attitude is generally supportive but could shift if key objectives or budget constraints are compromised.

- **Campus Real Estate & Facility Management (CREFM)**
  CREFM possesses high power due to its authority over campus development and real estate management. Their interest is also high, as they are responsible for ensuring that the project aligns with sustainability goals and overall campus planning. CREFM is actively involved in technical oversight and coordination, with a positive attitude as long as sustainability standards are maintained and campus impact is minimized.

- **Delft Municipality**
  The municipality has high power due to its control over permits and regulatory compliance, but their interest is medium, primarily focused on adherence to regulations rather than specific project benefits. However, they are also supportive due to the project's potential to alleviate the student housing shortage in Delft. They are involved during compliance phases and maintain a supportive attitude, provided the project meets legal and environmental standards. Non-compliance, however, would prompt intervention.

- **Mecanoo (Architect and Construction Partner)**
  Mecanoo, chosen for their longstanding collaboration with TU Delft, holds medium-high power through control of design and structure and has medium-high interest in seeing the project enhance their portfolio. They are highly involved in the architectural aspects and have a positive attitude, as a successful project reinforces their reputation in campus development.

- **BAM Wonen (Construction Contractor)**
  BAM Wonen's interest is high due to their role in executing the project and ensuring it meets deadlines and quality standards. Their power is also high, as they control the construction timeline and resource allocation. They are fully engaged in the construction phase and maintain a supportive attitude, as project success directly impacts their performance metrics.

To successfully navigate project Pentagos, a comprehensive stakeholder engagement strategy will be implemented, encompassing extensive deliverables, defined work packages with clear input and output specifications, precise time and cost estimates for each task, and critical project management artifacts including the Work Breakdown Structure (WBS), Organizational Breakdown Structure (OBS), a detailed RACI matrix to clarify roles and responsibilities, and a comprehensive Gantt chart for timeline visualization, thereby ensuring transparent communication, strategic alignment, and collaborative project execution that empowers key stakeholders with the information necessary to support and drive the project's success.

3 Work packages and tasks

This section will describe the work packages' inputs, outputs and deliverables, to ensure that work is done according to standards and expectations.

3.1 WBS

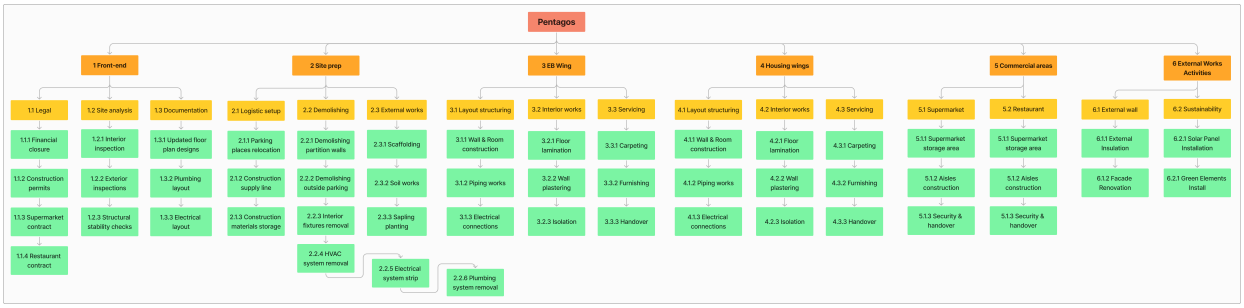

Figure 3: Work Breakdown Structure

Figure 3 shows the Work Breakdown Structure of the project. There are 6 main activities: Front-end Development, Site Preparation, EB Wing, Housing Wings, Commercial Areas and External Works. **Cost and time estimates for each task can be seen in Table 5** (in Appendix).

3.2 Work packages

The work that needs to be done is divided into work packages. Each WP requires inputs before it can begin, and provides certain outputs once it is done or partially completed. Table 1 shows the relevant information.

Table 1: Work package inputs and outputs

WP	Inputs	Outputs
FED Phase	• Legal and formative restrictions • Campus vision • Financial & legal teams • Sustainability requirements	• Signed contracts with partners and client • Project Execution Plan • Certified assessment of building stability • Documentation of plumbing and electrical layouts • Executive summary for the client • Sustainability design approvals
Site Preparations	• Parking usage information • Construction materials, tools and equipment • Construction & engineering teams • Botanists & Saplings • Systems removal plan	• Alternative park spots • Gardening around building 22 • Warehouse with tools & construction materials • Finalisation of construction preparation • Cleared building systems (HVAC, electrical, plumbing)
EB Wing	• EB requirements and expectations • Insulation materials • Furniture and laminate • Interior design, construction teams	• Furnished working space for the EB • Handover documents • Emergency escape routes for EB Wing
Housing Wings	• Student expectations and requirements • Insulation materials • Furniture and laminate • Interior design, construction teams	• Living spaces, rooms • Utility areas • Handover documents • Emergency escape routes for housing wings
Commercial	• Supermarket operators requirements & expectations • Commercial and rental contract • TU Delft logistics & road network	• Commercial area in the building • Handover • Planned supply logistic routines
External Works	• Energy efficiency requirements • Sustainable design guidelines • Solar panel specifications • Facade renovation plans • Green elements design	• Improved building insulation • Renovated modern facade • Installed solar panel system • Integrated green elements • Energy performance certificates • Sustainability compliance documentation

The work packages follow a structured sequence with defined inputs and outputs.
The execution order is:

1. Front-End Development (45 weeks, €411,000): Establishes legal framework, permits, technical assessments, and comprehensive designs.
2. Site Preparation (13 weeks, €396,000): Prepares construction site, including demolition and systems removal.

3. Parallel construction and renovation phase:
    - EB Wing (35 weeks, €479,000): Executive offices and meeting spaces
    - Housing Wings (180 weeks, €2,395,000): Student accommodations
    - External Works (120 weeks, €1,665,000): Insulation, facade renovation, and sustainability features
4. Commercial Areas (30 weeks, €336,000): Retail spaces development

Each package has specific deliverables and dependencies that are managed through coordination meetings and handover points. The parallel execution of EB Wing, Housing Wings, and External Works optimizes the overall project timeline. The project spans 266 weeks with a total budget of €5,682,000, including significant investment in sustainability and energy efficiency measures.

4 Organization

The organization of Project Pentagos is structured to ensure clear lines of authority, efficient decision-making, and effective coordination among all stakeholders. This section outlines the organizational structure through two complementary frameworks: the Organizational Breakdown Structure (OBS) showing hierarchical relationships and reporting lines, and the RACI matrix defining roles and responsibilities for key project activities.

4.1 OBS Chart

The Organizational Breakdown Structure divides project management into five key departments, each led by specialized teams reporting to the Project Manager. The Legal/Planning Department handles permits and contracts, while the Engineering/Design Department oversees technical aspects. The Construction Department manages on-site operations through multiple specialized teams. Support/Quality and Post-Construction departments ensure project standards are met and facilitate smooth handover. This structure enables clear communication channels and efficient resource allocation across all project phases.

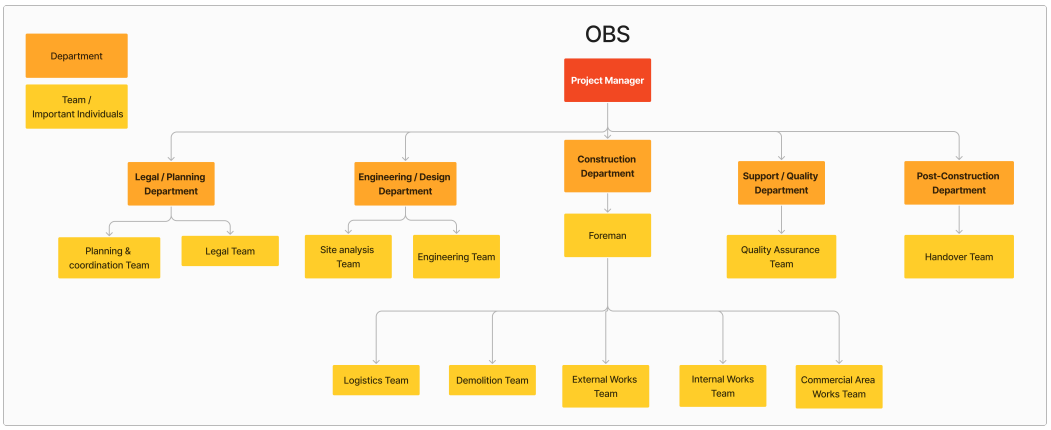

Figure 4: Organizational Breakdown Structure

4.2 RACI Chart

The RACI matrix defines specific roles and responsibilities across project stakeholders for each major task. This framework ensures accountability by clearly stating who is Responsible for execution, Accountable for decisions, Consulted for input, and Informed of progress. The matrix covers all project phases from preparation through completion, with particular attention to critical interfaces between technical work, stakeholder requirements, and regulatory compliance. Key relationships include CREFM's accountability for technical decisions, the Executive Board's authority over Wing A, and DUWO's leadership in student housing matters.

Table 2: Project Pentagos RACI Chart

Task	PM	CREFM	EB	DUWO	Mun.	Contr.	Arch.	Legal
1. Preparation Phase								
1.1 Legal	C	C	I	C	C	I	I	RA
1.2 Site Analysis	C	RA	I	C	C	R	R	I
1.3 Documentation	RA	C	I	C	C	R	R	C
2. Demolition Phase								
2.1 Logistic Setup	C	C	I	I	I	RA	C	C
2.2 Demolishing	C	C	I	I	I	RA	C	C
2.3 External Works	C	RA	I	I	C	R	R	C
3. Wing A (Executive Offices)								
3.1 Layout Structuring	C	C	RA	I	C	R	R	I
3.2 Interior Works	C	C	RA	I	I	R	R	I
3.3 Servicing	C	RA	C	I	C	R	C	I
4. Wings B-E (Student Housing)								
4.1 Layout Structuring	C	C	I	RA	C	R	R	I
4.2 Interior Works	C	C	I	RA	I	R	R	I
4.3 Servicing	C	RA	I	C	C	R	C	I
5. Wing F (Commercial)								
5.1 Supermarket	C	RA	I	C	C	R	R	C
5.2 Restaurant	C	RA	I	C	C	R	R	C

Table 3: RACI Chart Legend and Notes

RACI Legend	
R	Responsible (Does the work)
A	Accountable (Ultimate approver)
C	Consulted (In the loop)
I	Informed (Kept up to date)
Important Notes	
1. PM = Project Manager, EB = Executive Board, Mun. = Municipality, Contr. = Contractor, Arch. = Architect	
2. CREFM is Accountable for most technical and facility-related decisions	
3. Executive Board is Accountable for Wing A decisions	
4. DUWO is Accountable for student housing-related decisions	
5. Contractor is Responsible for execution of most physical work	
6. Legal Team is Accountable for all legal/permit matters	
7. Municipality is primarily Consulted for compliance and permits	
8. Architect is Responsible for design-related tasks	

5 Logistics & Planning

The successful execution of this building renovation project requires careful planning and precise coordination of various activities across multiple phases. This chapter outlines the project's timeline, key milestones, and resource allocation strategies spanning from early 2027 to late 2029. With current residents vacating the building between late 2027 and early 2028, construction work is scheduled to commence in 2028. The project encompasses the renovation of multiple housing wings, an EB wing, and commercial spaces, with our planning approach focusing on parallel execution where possible while maintaining logical dependencies. The timeline begins with comprehensive legal and analysis activities in 2027, followed by strategic overlapping of the EB wing and housing construction to optimize completion. The schedule targets completion in October 2029, incorporating a two-month contingency period before final handover.

5.1 GANTT

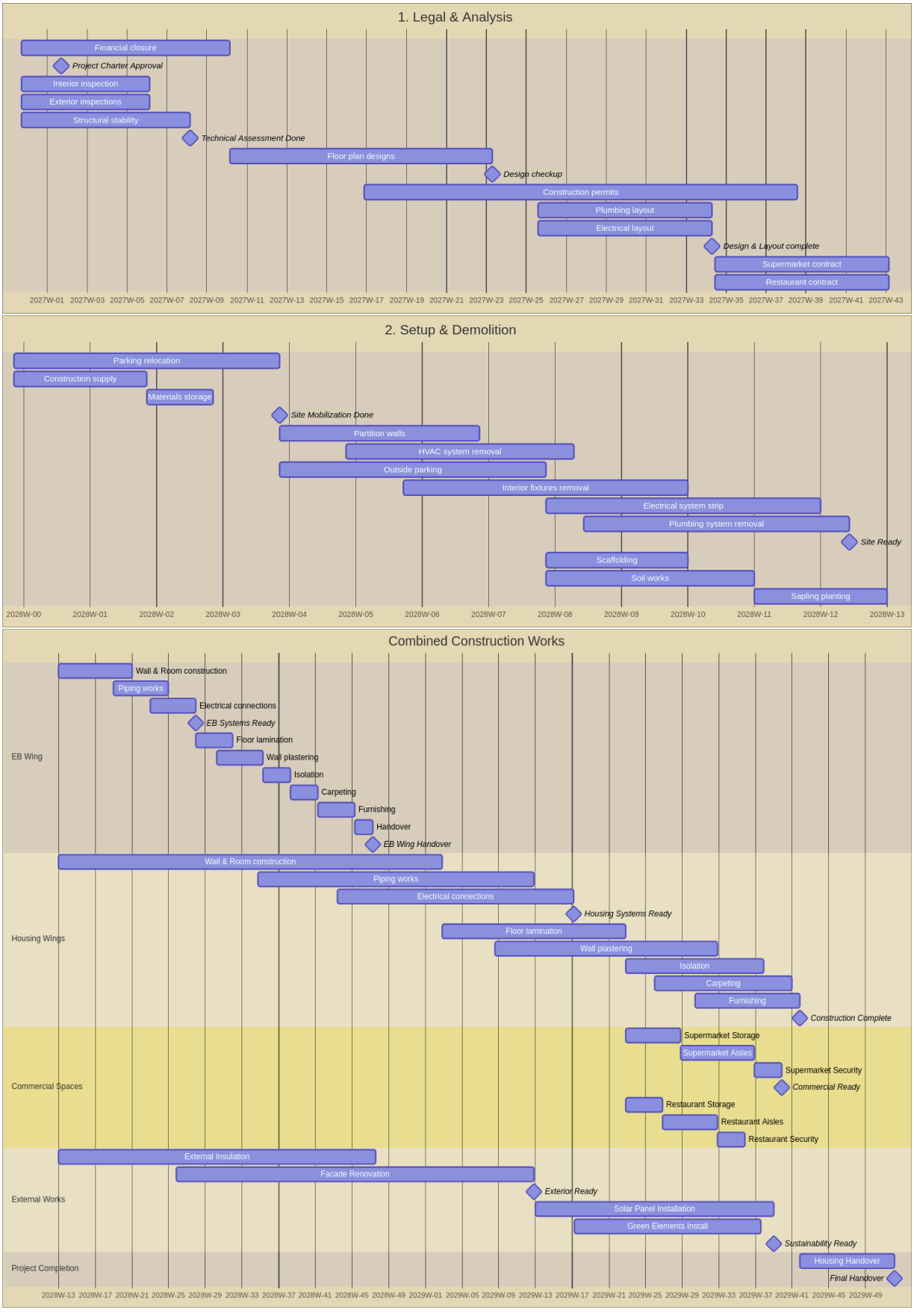

Figure 5: Project stages GANTT charts

5.2 Project Milestones

5.2.1 Phase 1: Project Initiation and Planning (2027)

- **M1.1 Project Charter Approval** (2027-01-15)
  Deliverables: Approved charter and stakeholder register
- **M1.2 Technical Assessment Done** (2027-03-01)
  Deliverables: Inspection reports and structural analysis
- **M1.3 Design Checkup** (2027-06-15)
  Deliverables: Verified floor plans and initial designs
- **M1.4 Design & Layout Complete** (2027-08-31)
  Deliverables: Final MEP layouts and design documentation

5.2.2 Phase 2: Site Preparation (2028 Q1)

- **M2.1 Site Mobilization Done** (2028-01-29)
  Deliverables: Site facilities and initial demolition setup
- **M2.2 Systems Removal Complete** (2028-03-29)
  Deliverables: HVAC, electrical, and plumbing systems removed
- **M2.3 Site Ready** (2028-04-02)
  Deliverables: Demolition complete, temporary facilities installed

5.2.3 Phase 3: Construction Execution (2028-2029)

- **M3.1 EB Wing Systems Ready** (2028-07-16)
  Deliverables: Structure and MEP systems complete
- **M3.2 EB Wing Handover** (2028-11-28)
  Deliverables: Finished interiors and occupancy certificate
- **M3.3 Exterior Design Ready** (2029-03-31)
  Deliverables: Facade renovation and insulation complete
- **M3.4 Housing Wings Systems Ready** (2029-04-30)
  Deliverables: All housing structures and systems
- **M3.5 Commercial Ready** (2029-10-06)
  Deliverables: Retail spaces ready for tenants
- **M3.6 Sustainability Ready** (2029-10-20)
  Deliverables: Solar panels and green elements installed
- **M3.7 Construction Complete** (2029-10-20)
  Deliverables: All construction and finishing work complete

5.2.4 Phase 4: Project Closure (2029 Q4)

- **M4.1 Final Handover** (2029-12-31)
  Deliverables: Documentation, warranties, and client acceptance

6 Process Management

6.1 Documentation Management

All project documentation will be managed through a centralized system with standardized naming convention: PENTAGOS_[Department]_[DocumentType]_[Version]. Documents require stakeholder approval as per RACI chart, with version control differentiating major (1.0) and minor (1.1) changes. Critical documentation will be retained for 7 years post-completion with both on-site and cloud backup.

6.2 Communication and Way of Working

Communication will be structured through:

- Weekly project team meetings led by Project Manager
- Bi-weekly stakeholder updates with Executive Board, CREFM, and DUWO
- Monthly progress reviews with all key stakeholders
- Daily construction team stand-ups during active phases

Official communications will use standardized email subject lines [PENTAGOS][Type][Priority], with urgent matters requiring phone confirmation. Site communications will be documented through daily logs.

6.3 Quality Control

Quality control procedures include pre-construction material inspection. This way we will verify that all materials meet specified standards and are certified for use in sustainable construction. To be sure that we actually follow the specifications and standards, all quality-related documentation, including inspection reports and test results, will require formal sign-off by:

- The relevant functional group manager
- Relevant stakeholders as defined in the RACI chart.
- Municipal inspectors, where applicable, to ensure compliance with regulatory requirements.

Later in the project, careful inspections will be performed at each milestone described above to ensure that the delivered building is adhering to high quality standards and also adhering to specifications. During the later milestones, critical systems were tested, such as HVAC, energy efficiency installations, and water management systems, before continuing.

In the end, we will be inspecting all aspects of the completed project in a final quality check to confirm compliance with quality standards, design specifications, and stakeholder expectations.

7 Risk Management

Project Pentagos faces several operational and organizational risks that need to be actively managed throughout its 4-year duration. While our previous planning sections laid out the ideal execution path, this section addresses the uncertainties and challenges we expect to encounter during project implementation. The goal is to identify these risks early and establish clear mitigation strategies.

7.1 Risk Identification Process

Our risk assessment focused on four key areas:

1. Project organization (roles, responsibilities, and interfaces)
2. Construction operations (work coordination and safety)
3. Schedule dependencies (critical path and sequencing)
4. Stakeholder management (coordination and communication)

7.2 Risk Analysis

Table 4 presents our updated risk register. The likelihood and impact are rated on a scale of 1-5, with the risk value calculated as their product. The most significant risks identified are:

1. Work Team Coordination (Risk #2, value 15): Managing simultaneous work in multiple wings presents significant operational challenges. Without proper coordination, we risk work conflicts and reduced efficiency. Daily team leader meetings will be essential for preventing these issues.

2. Contractor Interface Management (Risk #4, value 12): With multiple contractors working on different wings, clear interface management is crucial. Weekly contractor meetings and detailed interface matrices will help prevent work package delays.

3. Critical Path Dependencies (Risk #3, value 12): The sequential nature of wing construction, particularly in the housing wings, creates schedule vulnerabilities. We'll implement critical chain buffering and conduct bi-weekly schedule reviews to manage this risk.

7.3 Risk Management Strategy

For each identified risk, we've assigned:

- A clear owner responsible for monitoring and managing the risk
- Specific mitigation actions
- Regular review points

Most risks will be treated through active management, with only safety protocol conflicts (Risk #5) being terminated through a comprehensive site-wide safety system. Lower-value risks, such as partial occupancy issues (Risk #6, value 6), will still be monitored but receive less intensive management focus.

7.4 Risk Monitoring

Risk monitoring will occur through:

1. Weekly risk review meetings with risk owners
2. Monthly risk register updates
3. Quarterly risk strategy reassessments

This systematic approach to risk management will help ensure project success by preventing or minimizing the impact of potential issues before they can significantly affect the project's schedule or budget.

Number	Category	Cause	Event	Consequence	Likelihood	Impact	Total risk value	Mitigation	Responsible
1	Human Resources	Complex RACI matrix with multiple stakeholders	Unclear responsibilities leading to task delays	Schedule delays and rework	3	3	9	**Treat**: Regular RACI matrix reviews and clear escalation procedures	Project Manager
2	Operations	Simultaneous work in multiple wings	Poor coordination between work teams	Work conflicts and inefficiencies	3	5	15	**Treat**: Implement detailed work coordination with daily team leader meetings	Operations Manager
3	Technical	Sequential dependencies in wing construction	Critical path delay in housing wings	Project timeline extension	3	4	12	**Treat**: Critical chain buffering, bi-weekly schedule reviews	Planning Manager
4	Contract	Multiple contractor coordination	Interface management issues	Work package delays	4	3	12	**Treat**: Clear interface matrices, weekly contractor meetings	Contract Manager
5	Safety	Simultaneous work in multiple wings	Safety protocol conflicts	Work stoppages	2	5	10	**Terminate**: Implement site-wide safety management system	Safety Officer
6	Operations	Student housing complete before commercial areas	Partial occupancy issues	Operational complications	3	2	6	**Treat**: Develop phased occupancy plan	Operations Manager
7	Stakeholder	DUWO early involvement in housing wing design	Late design changes	Rework and delays	3	4	12	**Treat**: Regular design review meetings with DUWO	Design Manager
8	Quality	Fast-track construction approach	Quality control issues	Rework cycles	3	3	9	**Treat**: Implement strict quality control checkpoints	Quality Manager

Table 4: Project Management Risk Register

References

[1] HOP, Hein Cuppen / Delta, Marjolein van der Veldt. Shortage of 1500 student rooms in delft. https://delta.tudelft.nl/article/tekort-van-1500-studentenkamers-delft, 2021. Accessed: 2024-09-27.

[2] Technische Universiteit Delft. Campus vision 2040 - tu delft campus. https://www.tudelftcampus.nl/campus-development-old/campusvisie-2040/, 2024. Accessed: 2024-09-27.

A Appendix

Code	Activity	Duration	Cost (€)
1. Front-end Development Activities			
1.1.1	Financial closure	10 weeks	47,000
1.1.2	Construction permits	20 weeks	77,000
1.1.3	Supermarket contract	8 weeks	18,000
1.1.4	Restaurant contract	8 weeks	18,000
1.2.1	Interior inspection	6 weeks	22,500
1.2.2	Exterior inspections	6 weeks	22,500
1.2.3	Structural stability checks	8 weeks	48,000
1.3.1	Updated floor plan designs	12 weeks	84,000
1.3.2	Plumbing layout	8 weeks	37,000
1.3.3	Electrical layout	8 weeks	37,000
2. Site Prep Activities			
2.1.1	Parking places relocation	4 weeks	41,000
2.1.2	Construction supply line	2 weeks	23,000
2.1.3	Construction materials storage	1 week	9,000
2.2.1	Demolishing partition walls	3 weeks	32,000
2.2.2	Demolishing outside parking	4 weeks	46,000
2.2.3	Interior fixtures removal	4 weeks	35,000
2.2.4	HVAC system removal	3.5 weeks	45,000
2.2.5	Electrical system strip	4 weeks	42,000
2.2.6	Plumbing system removal	4 weeks	44,000
2.3.1	Scaffolding	2 weeks	28,000
2.3.2	Soil works	3 weeks	37,000
2.3.3	Sapling planting	2 weeks	14,000
3. EB Wing Activities			
3.1.1	Wall & Room construction	8 weeks	110,000
3.1.2	Piping works	6 weeks	74,000
3.1.3	Electrical connections	5 weeks	65,000
3.2.1	Floor lamination	4 weeks	41,000
3.2.2	Wall plastering	5 weeks	37,000
3.2.3	Isolation	3 weeks	32,000
3.3.1	Carpeting	3 weeks	28,000
3.3.2	Furnishing	4 weeks	83,000
3.3.3	Handover	2 weeks	9,000
4. Housing Wings Activities			
4.1.1	Wall & Room construction	40 weeks	550,000
4.1.2	Piping works	30 weeks	370,000
4.1.3	Electrical connections	25 weeks	325,000
4.2.1	Floor lamination	20 weeks	205,000
4.2.2	Wall plastering	25 weeks	185,000
4.2.3	Isolation	15 weeks	160,000
4.3.1	Carpeting	15 weeks	140,000
4.3.2	Furnishing	20 weeks	415,000
4.3.3	Handover	10 weeks	45,000
5. Commercial Areas Activities			
5.1.1	Supermarket storage area	6 weeks	74,000
5.1.2	Aisles construction	8 weeks	92,000
5.1.3	Security & handover	3 weeks	23,000
5.2.1	Restaurant storage area	4 weeks	55,000
5.2.2	Aisles construction	6 weeks	69,000
5.2.3	Security & handover	3 weeks	23,000
6. External Works Activities			
6.1.1	External Insulation	35 weeks	485,000
6.1.2	Facade Renovation	39 weeks	520,000
6.2.1	Solar Panel Installation	26 weeks	385,000
6.2.2	Green Elements Install	20 weeks	275,000

Table 5: Project Activities Cost Distribution