# Final Report of
# **AI for Construction Project Management**
## summer school

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# Introduction

The Summer School on AI for Construction Project Management, organized under the auspices of CIB, and as a collaboration of Politecnico di Milano, University of Florida, and Technical University of Lisbon, took place from September 3rd to September 19th of 2024, in hybrid mode, with Politecnico di Milano as the main venue.

With 162 registered participants from all over the world, ranging from practitioners in the industry to early career researchers, PhD candidate and graduate students, this summer school was one of the biggest events in its kind. It offered an in-depth exploration into how artificial intelligence (AI) is revolutionizing the construction industry. This program brought together renowned experts from academia and industry to provide attendees with cutting-edge knowledge and tools.

This event, as the winner of the CIB's Vistas funding, aimed to bridge the gap between theoretical advancements and real-world applications of AI within the realm of Construction Project Management (CPM). As AI technologies are increasingly integrated into construction processes, professionals must develop a deep understanding of the transformative potential AI holds for the industry, particularly in improving efficiency, safety, and decision-making in large-scale projects.

Each session comprised the following:

1. An introductory presentation on the key topics and techniques of the session, with a primary focus on one or more AI tools and project management knowledge areas.
2. A hands-on exercise applying the discussed techniques to a practical case, aiming to make the topic more tangible.
3. A guest lecture delivered by a leading practitioner or researcher in the field, exposing participants to real-world applications of the discussed topics and technologies.

# Session Overview

*Session 1: Machine Learning-based Assessment of Construction Projects' Performance*

**Instructor**: *Prof. Fulvio Re Cecconi, Politecnico di Milano*

The opening session, led by Prof. Fulvio Re Cecconi, introduced participants to the potential of Machine Learning (ML) in evaluating the performance of construction projects. This session focused on how ML algorithms can be used to predict project outcomes, such as schedule adherence, cost efficiency, and quality control. Through real-world case studies and practical applications, Prof. Re Cecconi demonstrated how data-driven methods are superior to traditional project performance assessments, enabling more accurate and proactive decision-making in construction management.

*Session 2: Probabilistic Graphical Modeling for Assessing Risks, Delays, and Cost Overruns in Construction Projects*

**Instructor: *Dr. Ania Khodabakhshian, Politecnico di Milano***

Dr. Ania Khodabakhshian delivered an insightful session on the application of Probabilistic Graphical Models (PGMs), such as Bayesian Networks, for risk assessment in construction projects. Participants explored how these models can quantify and assess the likelihood of delays and cost overruns, taking

into account the uncertainty inherent in complex construction environments. The session provided hands-on training on how to implement PGMs to improve risk management strategies and optimize project outcomes.

### Session 3: Machine Learning and Image Processing for Safety Management in Construction Projects

**Instructor**: *Prof. Masoud Jalayer, Politecnico di Milano*

In this session, Prof. Masoud Jalayer discussed the integration of Machine Learning and image processing techniques for enhancing safety management in construction projects. He presented innovative approaches using AI to monitor worksite conditions in real-time, automatically detect safety hazards, and provide early warnings. Participants gained valuable insights into how AI can mitigate risks, reduce accidents, and ensure compliance with safety standards through advanced image recognition and predictive analytics.

### Session 4: AI for Asset Management

**Instructor**: *Dr. Ana Filipa Ferreira da Silva, Instituto Superior Técnico, Lisbon*

Dr. Ana Filipa Ferreira da Silva explored the role of AI in optimizing asset management for construction and infrastructure projects. This session focused on how AI can enhance the life cycle management of assets, including maintenance scheduling, performance monitoring, and cost control. Dr. Silva demonstrated how predictive maintenance powered by AI can extend the lifespan of assets and reduce operational costs, offering a significant value proposition for construction firms.

### Session 5: Seeing through AI: A Study on Visual Bias in Window Views Using Machine Vision and Text Mining Techniques

**Instructor**: *Eng. Matteo Cavaglià, Politecnico di Milano*

Eng. Matteo Cavaglià introduced an intriguing study on how AI can be used to analyze and address visual bias in architectural design, particularly in the context of window views. By combining machine vision and text mining techniques, Prof. Mainini demonstrated how AI can help architects and planners design more equitable and aesthetically balanced spaces. This session provided participants with an interdisciplinary perspective, highlighting the intersections of AI, architecture, and urban planning.

### Session 6: Machine Learning and Digital Twins

**Instructor**: *Prof. Chimay Anumba, University of Florida*

The final session, led by Prof. Chimay Anumba, focused on the integration of Machine Learning and Digital Twin technology in construction management. Participants were introduced to the concept of Digital Twins—virtual replicas of physical assets that can be used to simulate and optimize construction projects in real-time. Prof. Anumba provided practical examples of how Digital Twins, combined with ML algorithms, can enhance project monitoring, predict maintenance needs, and improve decision-making throughout the project life cycle.

## Guest Lecturers

We were honored to feature five outstanding guest lecturers, each bringing their unique perspectives and expertise to the Summer School sessions:

1. **Fabrizio Degni** (Webuild, Italy)
   - ✓ Lecture subject: Webuild road to AI.
2. **Karla Saldana Ochoa** (University of Florida, USA)
   - ✓ Lecture subject: Machine Learning and Digital Twins
3. **Luca Rampini** (PWC, Switzerland)
   - ✓ Lecture subject: The AI frontier: The Large Language Models to Multi Agent systems
4. **Jónatas Valença** (CERIS, Portugal)
   - ✓ Lecture subject: Computer Vision-based structural health monitorin
5. **Luca Zanetti** (IUSS, Italy)
   - ✓ Lecture subject: Risk in Assessment: Methodological challenges in estimating rare and extreme events

## Participants

A comprehensive survey was conducted among the participants to analyze the key elements and success rate of the summer school.

The first part was about their professional occupations, educational backgrounds, and other relevant demographic information. The aim of this survey was to gain insights into the participants' diverse expertise, experience levels, and how these factors may influence their engagement with the course content. The findings from this survey are detailed below:
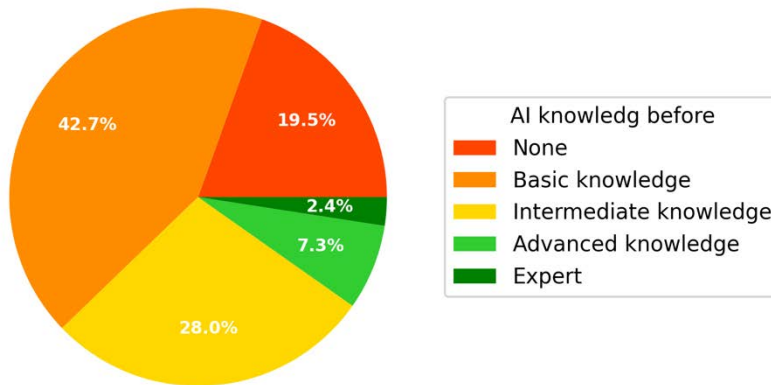
1 Occupation



2 Job title / Study major

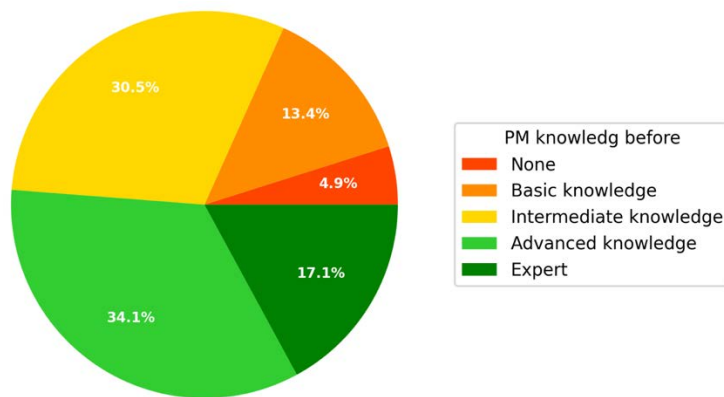## 3  Country of residence
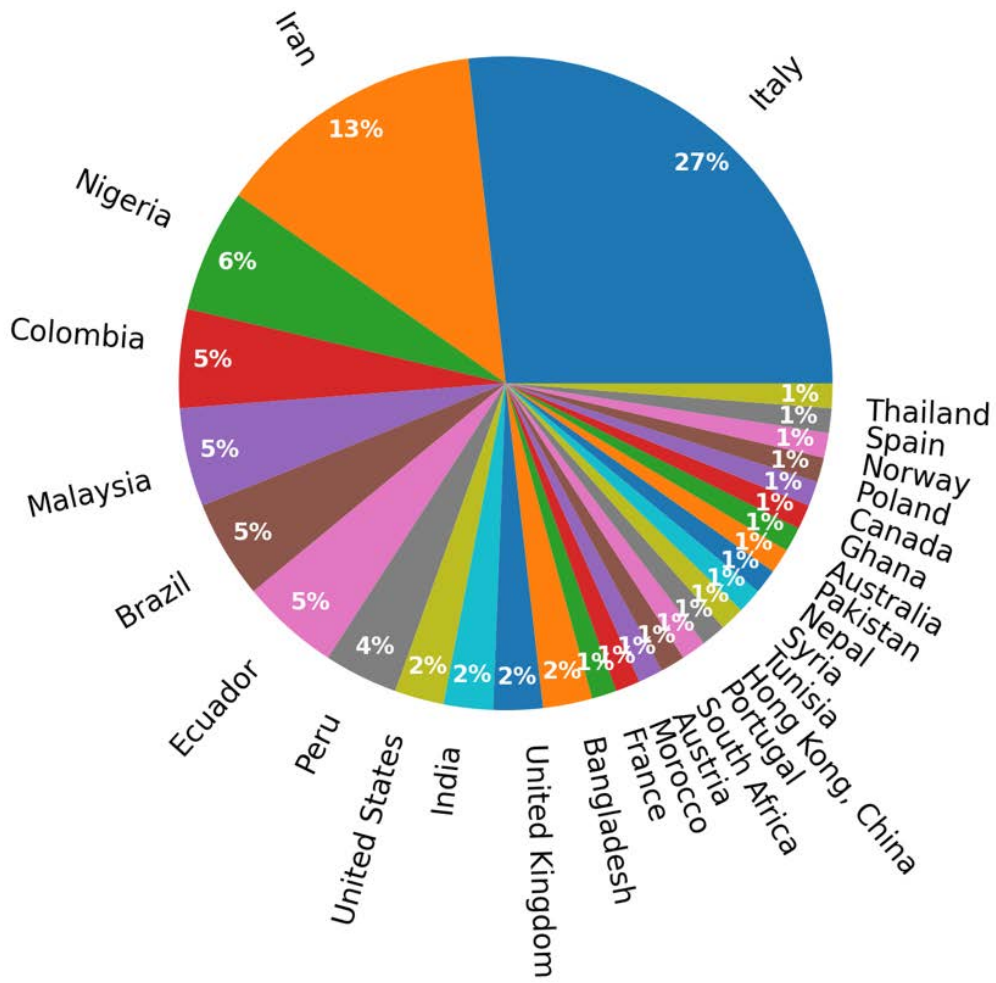


## 4  Age group
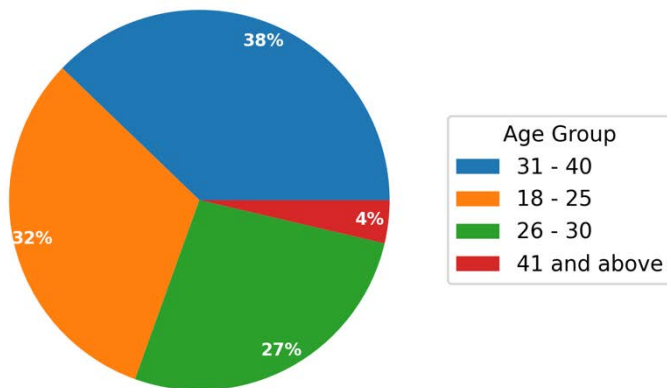
## 5  Year of professional experience in the field
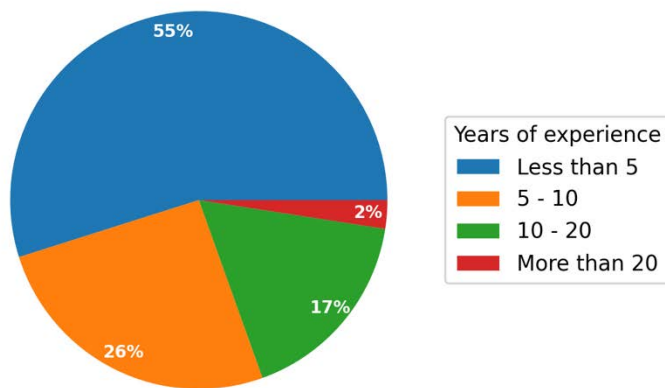


## 6  Level of knowledge in AI before this summer school (1 = None; 5 = Expert)



## 7  Level of knowledge on construction and project management (1 = None; 5 = Expert)

## Organisation

The second part of the survey focused on evaluating the overall organization of the summer school, including the structure of the courses, logistical arrangements, and the suitability of the venue. The results of this section are as follows:

8   How satisfied were you with the structure and organisation of the summer school? (1 = Very Dissatisfied, 5 = Very Satisfied)
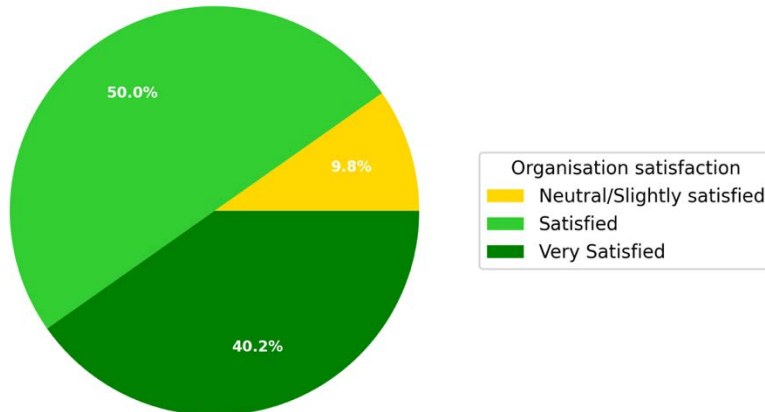


9   How satisfied were you with the logistics of the summer school (classroom, teaching instruments both individual and collective) (1 = Very Dissatisfied, 5 = Very Satisfied)
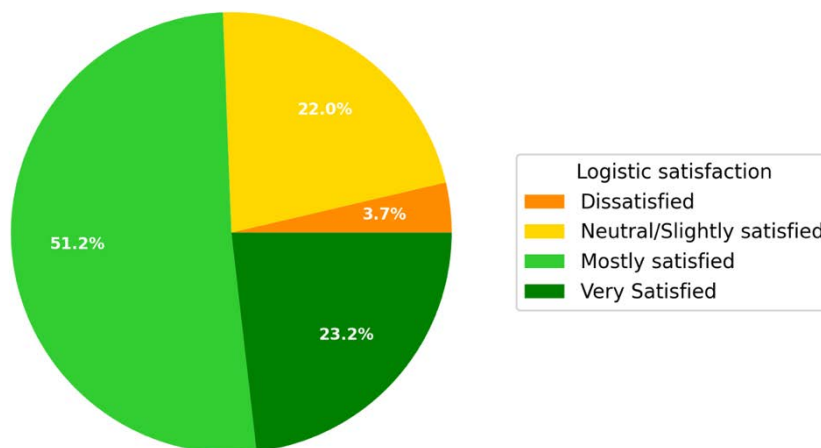


10  How satisfied were you with the organization of the event (registration, communication, scheduling)? (1 = Very Dissatisfied, 5 = Very Satisfied)
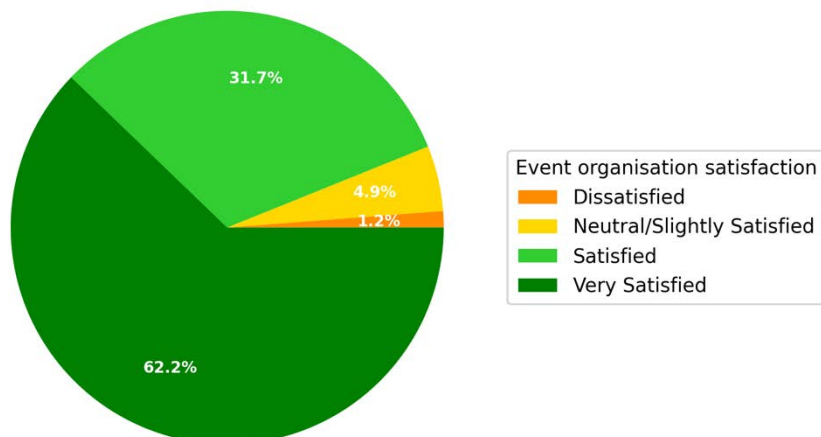
How would you rate the venue and infrastructure (e.g., classrooms, internet access, facilities)? (1 = Very Poor, 5 = Excellent)

11
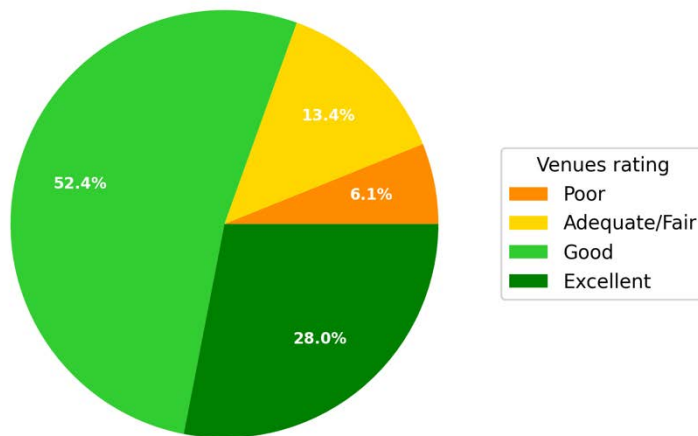
## Sessions and Instructors

The third part of the survey centered on participants' overall assessment and satisfaction with the sessions and instructors. This section aimed to capture participants' perceptions of the content quality, instructional methods, and the expertise of the instructors. Feedback on the relevance, clarity, and practical applicability of the topics covered was also gathered. The results of this assessment are presented below:

12  Was the duration of each session appropriate? (1 = Too Short, 5 = Too Long)
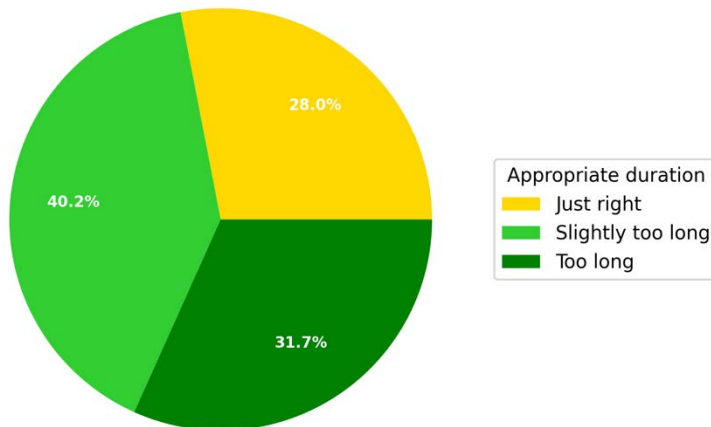


13  How would you rate the overall quality of the instructors throughout the six sessions? (1 = Poor, 5 = Excellent)
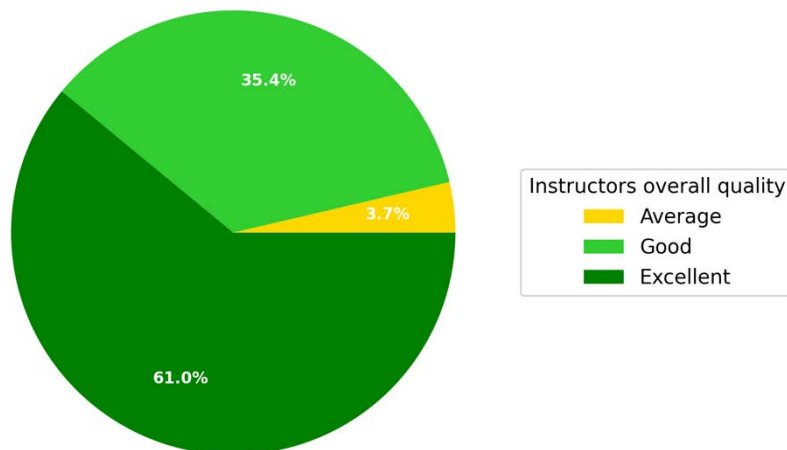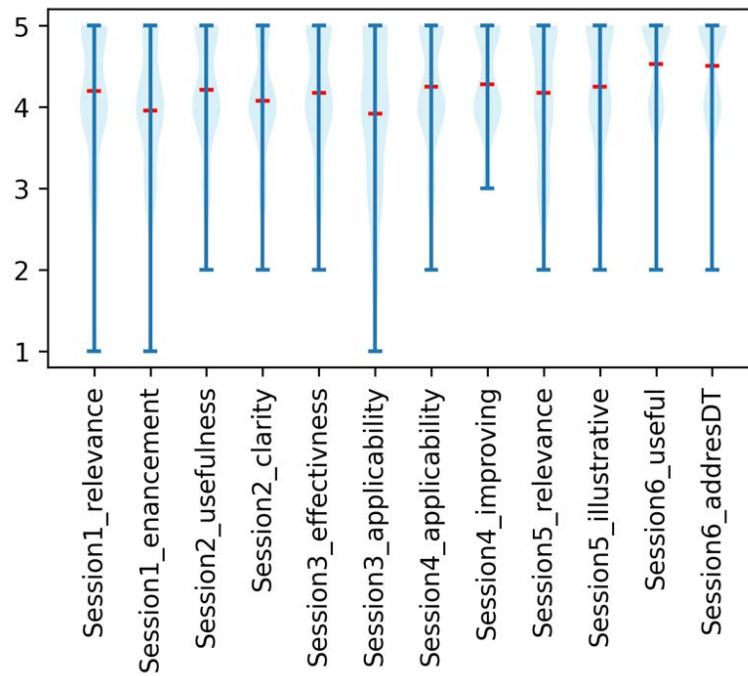


14  Did the instructors encourage active participation and engagement? (1 = Not at All, 5 = Very Much)
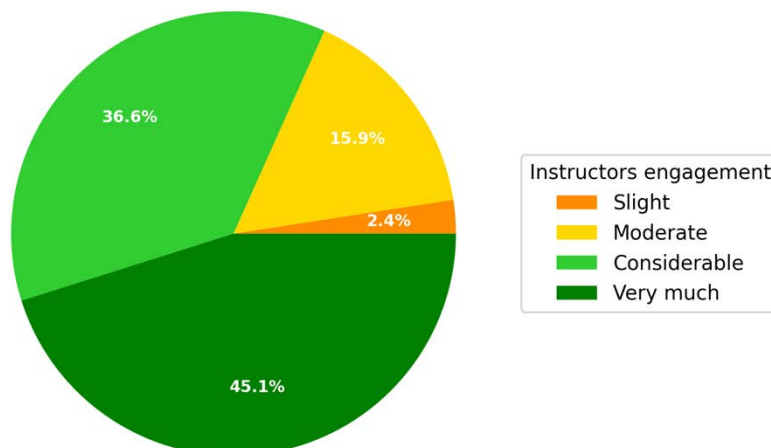
15 Were the instructors knowledgeable and clear in their presentations? (1 = Not at All, 5 = Very Clear)
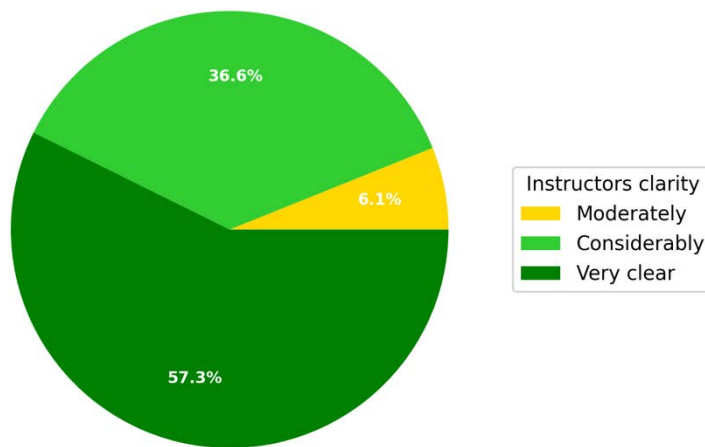


16 Overview of sessions evaluations

## Summer school experience

In the final part of the survey, participants were asked to provide an overall rating of their experience at the summer school. This section aimed to gauge their general impressions, including the quality of the program, the effectiveness of the learning environment, and the value of the knowledge gained. Participants were also encouraged to share any additional feedback or suggestions for future improvements.

17   How would you rate your overall experience at the summer school? (1 = Very Dissatisfied, 5 = Very Satisfied)
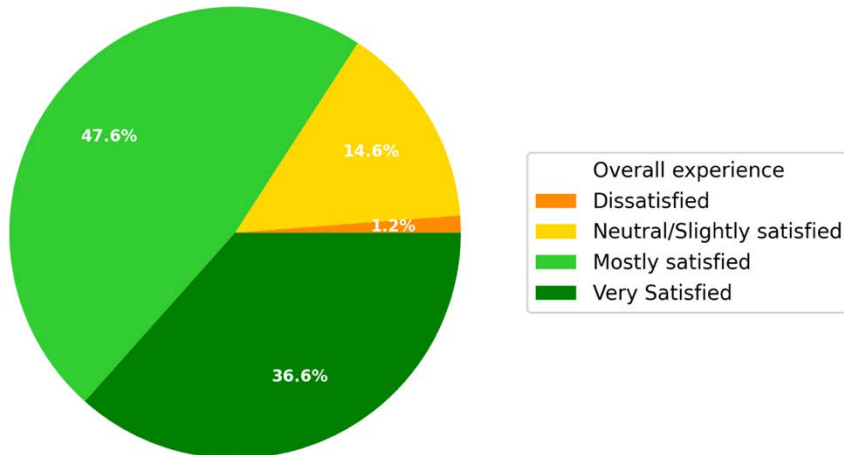


18   How satisfied are you when you compare the skills you have acquired with those you expected to acquire from the start? (1 = Very Dissatisfied, 5 = Very Satisfied)
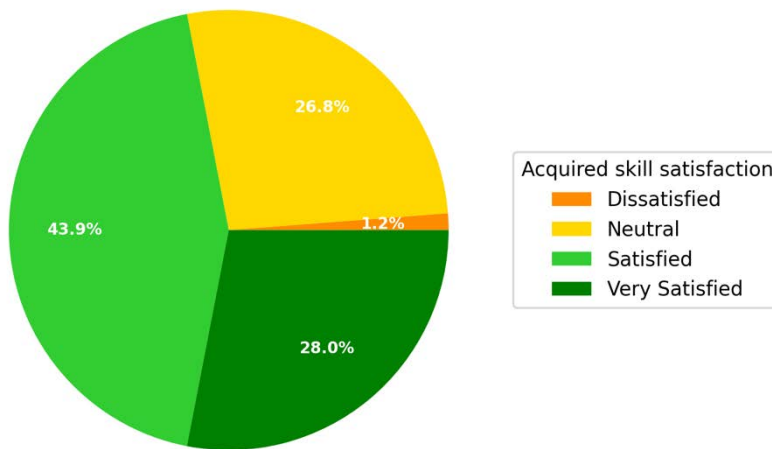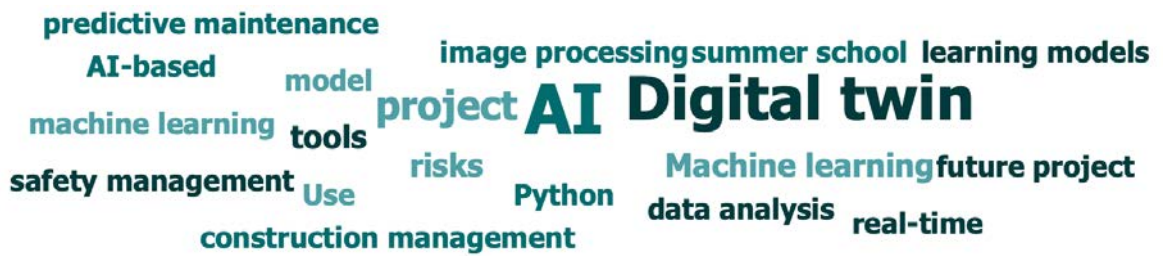
19    How useful were the hands-on activities or practical exercises across all sessions? (1 = Not Useful, 5 = Very Useful)
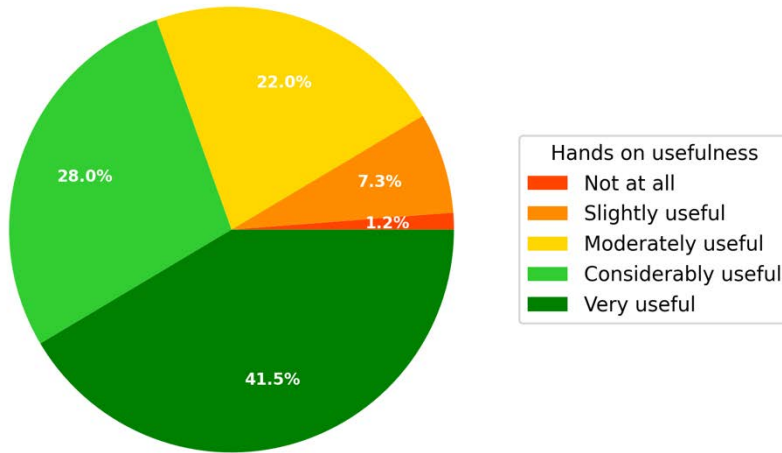


20    Were the tools and technologies demonstrated in the sessions relevant and applicable to your work? (1 = Not at All, 5 = Very Much)
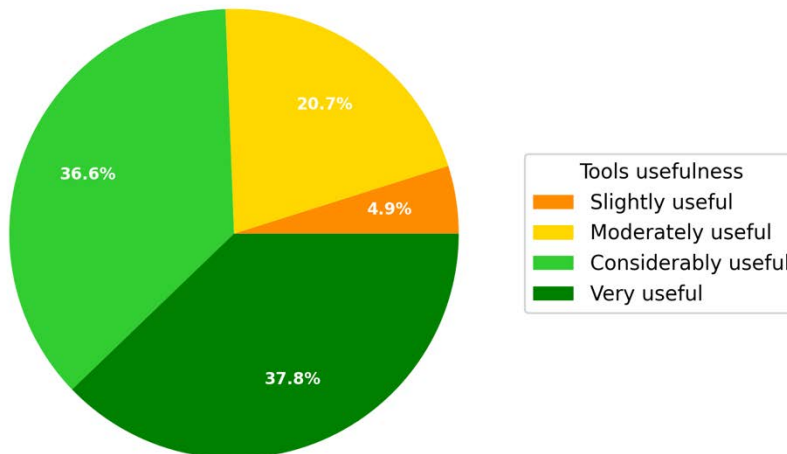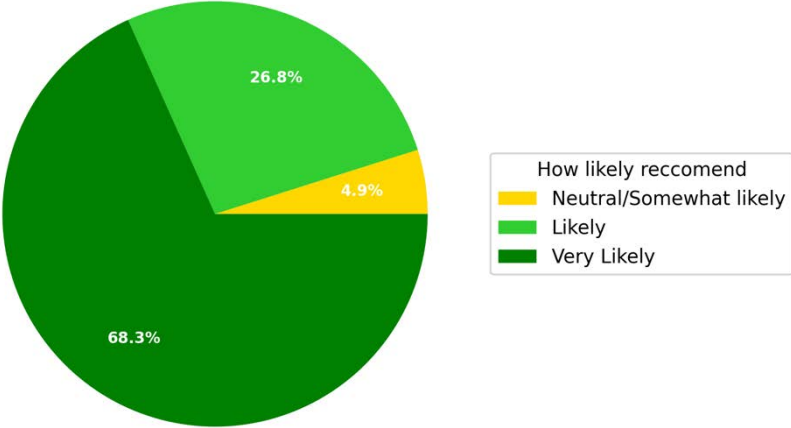


21    Which tools or technologies do you plan to implement in your projects as a result of this summer school?

22 Do you feel more confident in applying AI concepts to construction project management after attending the summer school? (1 = Not at All, 5 = Very Confident)
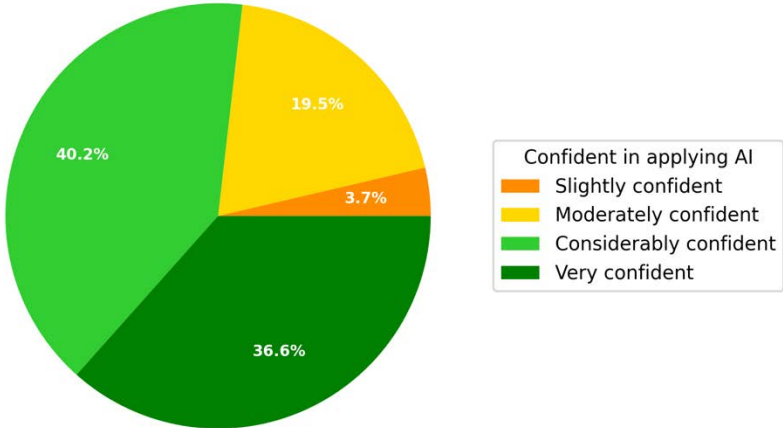


23 How likely are you to recommend this summer school to colleagues or peers? (1 = Not Likely, 5 = Very Likely)



24 Would you participate in a similar event in the future?
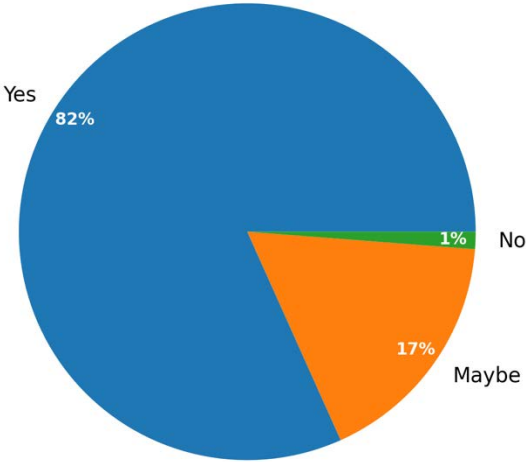
25  Please share any additional feedback or suggestions for improvement



## Student Competition

A student competition challenge was introduced on the first day of the summer school, tasking participants with training a Machine Learning model that could achieve better prediction accuracy than the Artificial Neural Network (ANN) model proposed by Professor Re Cecconi. The aim of this challenge was to inspire students to think creatively and apply the diverse AI and machine learning techniques learned throughout the program, incorporating insights from various instructors. The competition fostered a collaborative yet competitive atmosphere, encouraging participants to push the boundaries of their technical skills. The winner, whose model demonstrated the best performance, was announced during the fifth session, recognizing their innovative approach and mastery of the concepts covered during the summer school.

## Conclusion and Future Work

The overall feedback and participation from the attendees were overwhelmingly positive. Thanks to the funding and support from CIB, and the logistical collaboration of Politecnico di Milano, a total of 162 practitioners and students received high-quality, targeted education on AI applications in construction. This training was highly relevant to both their research and professional practices. Initiatives like this summer school contribute significantly to advancing the digitalization and efficiency of the construction industry.

A more detailed analysis of the survey results, including session-specific feedback and participant insights, and correlational analysis between their background and expertise with the topics they found more useful, will be compiled into a conference paper. This paper is planned for submission to the WBC 2024 conference, with the hope of sharing these findings with the broader CIB community. It will serve as a testament to the success of the Vistas funding initiative and its impact on promoting cutting-edge education in the construction sector.

## Recordings

Some of the lecturer allow for a partial recording of the sessions:
- Session 1 part 1 https://polimi365-my.sharepoint.com/:v:/g/personal/10137763_polimi_it/ETT3DbjoJetPjx0GDu6K4j8BKetrH8YJ4W2YWWw95PpieA?e=OfdaiM
- Session 1 part 2 https://polimi365-my.sharepoint.com/:v:/g/personal/10137763_polimi_it/EV6R7T5i5cBOoJcVlkYal-gBmvngve243UrWPFfH7Wk1kw?e=4uKWs4
- Session 2 part 1 https://polimi365-my.sharepoint.com/:v:/g/personal/10137763_polimi_it/EcTLlf7fkapOr_JMtia01KMBhTeC-0ftClwcgamCsxHskg?e=LPcMDi
- Session 2 part 2 https://polimi365-my.sharepoint.com/:v:/g/personal/10137763_polimi_it/Eacdonq_oBpIpnxTftGpbPMBMR8SY9Yqk3aOTQelrBQLdQ?e=lssTeI
- Session 3 part 1 https://polimi365-my.sharepoint.com/:v:/g/personal/10137763_polimi_it/EVm1pB9bzOBBu431LO_mMyoBIdr4MD9CDRQvl31WaXIeVA?e=BQylbo
- Session 3 part. 2 https://polimi365-my.sharepoint.com/:v:/g/personal/10137763_polimi_it/EQ_K6ZV0a8pDu9YkS2Tu2L8B41NFt_jNHN61RKXDfS2oKg?e=osuBTm
- Session 4 part 1 https://polimi365-my.sharepoint.com/:v:/g/personal/10137763_polimi_it/ESX4nR1A1chAhDzlb-K0vxEBwX6QOidogJvUmuwhDzzhEw?e=ZgRECT
- Session 4 part 2 https://polimi365-my.sharepoint.com/:v:/g/personal/10137763_polimi_it/EU2lVWpo_QBLhRdSYQwumAgBLjLdA4Z_assh6TnU_hmB4w?e=MGVsG2
- Session 5 part 1 https://polimi365-my.sharepoint.com/:v:/g/personal/10137763_polimi_it/EVOQkBbWe25IpK4crE90QjABz4PTAlB6xXSXKAspknjvrA?e=v1Rnzg
- Session 5 part 2 https://polimi365-my.sharepoint.com/:v:/g/personal/10137763_polimi_it/EfmkPphxTJ5KtZTbZSP5qegBD4jPGQIg_elNCEsUvjhJrA?e=nIHjeH
- Session 6 https://polimi365-my.sharepoint.com/:v:/g/personal/10137763_polimi_it/EetqgndyPApIsqEFRFA3v3UBL0NQmSgEMCNcageQ2uiKwA?e=VkRPQV

## Pictures