



Innovate  
UK

# Innovate UK Global Expert Mission Report

## Artificial Intelligence in Construction – Switzerland

June 2023



**PUBLIC**

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## 02. Executive Summary

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Innovative use of artificial intelligence (AI) in the construction sector has the potential to increase efficiency, reduce carbon emissions and improve safety. Construction has been identified as a high-growth potential sector within Innovate UK's **Bridge AI Programme**, as the industry has notably low AI adoption rates despite a wide range of possible use cases. This low adoption is seen internationally, providing opportunities for global partnerships with key economies, such as Switzerland, a leading country in the field of AI.

To explore this, in June 2023, as part of Innovate UK's Global Expert Mission (GEM) programme and with funding from the Bridge AI Programme, a team of UK experts led by Innovate UK visited Switzerland to improve our understanding of the research and innovation landscape in the field of AI in construction applications.

The UK team, consisting of representatives from Innovate UK, government, and industry, visited institutions and organisations in Switzerland focused on using AI and related technologies in construction and the built environment.

The GEM team had the opportunity to visit a wide range of stakeholders and locations that feature prominently on the Swiss AI and construction landscape, including both federal engineering institutions, innovation parks, and the NEST flagship construction research facility. While the federal institutions tend to focus on early-stage AI research, other institutions such as IDIAP and EMPA are more involved in late-stage research and technology transfer to industry. The team had the opportunity to observe several examples of cutting-edge construction methods and applications in the later stages of research and development, most notably at the National Center for Competence in Research Digital Fabrication Lab and at NEST.

The breadth of stakeholders that the team met during the GEM reflects the relative complexity of the Swiss AI landscape, which is driven from the bottom up by industry and academia. Unlike the UK, there is no policy for funding innovation within industry.

Differences in size and approach invariably mean there are some challenges with the discoverability of opportunities and direct transference of networking models to the UK. However, the team came away with several practical recommendations to further build on connections established during the GEM. Taken together, these recommendations aim to help the UK develop a more robust connection to the Swiss innovation ecosystem, share knowledge and best practices, and leverage AI to remain competitive in the global construction industry.

## 03. Acronyms

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<b>B2B</b>	Business to Business
<b>B2C</b>	Business to Consumer
<b>BIM</b>	Building Information Modelling
<b>CNAI</b>	Swiss Competence Network for Artificial Intelligence
<b>DBT</b>	Department for Business and Trade
<b>DSIT</b>	Department for Science, Innovation and Technology
<b>EMPA</b>	Swiss Federal Laboratories for Material Science and Technology
<b>EPFL</b>	Federal Institute of Technology in Lausanne
<b>ETH</b>	Swiss Federal Institute of Technology
<b>FCDO</b>	Foreign, Commonwealth and Development Office
<b>FSO</b>	Swiss Federal Statistics Office
<b>GBIP</b>	Global Business Innovation Programme
<b>GEM</b>	Global Expert Mission
<b>IDIAP</b>	Dalle Molle Institute for Perceptive Artificial Intelligence
<b>IDSIA</b>	Dalle Molle Institute for the Study of Artificial Intelligence
<b>NEST</b>	Next Evolution in Sustainable Building Technologies
<b>NCCR</b>	National Center of Competence in Research
<b>SBB</b>	Swiss Federal Railways
<b>SERI</b>	State Secretariat for Education, Research, and Innovation
<b>SIN</b>	Science and Innovation Network
<b>UKRI</b>	UK Research and Innovation

Note: Swiss acronyms have been translated to English from French, German, or Italian.

## 04. Introduction

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### Summary

Innovate UK delivered a Global Expert Mission (GEM), bringing together key stakeholders from the UK and Switzerland to exchange knowledge and showcase developments in Artificial Intelligence (AI). Switzerland is ranked first in the world in the Global Innovation Index<sup>1</sup> and, alongside the UK, is recognised as a European leader in the field of AI. This GEM is built on the Memorandum of Understanding signed between the UK and Switzerland, which particularly focuses on deep science and deep tech, including AI.<sup>2</sup>

The GEM explored the technology and innovation landscape of Swiss collaboration partners in AI for the construction sector, including skills sharing, supply chain contacts, and compliance, regulatory and policy frameworks. Construction was chosen as it has been identified as one of four priority sectors for support under the BridgeAI programme. Priority sectors are those identified as having low AI maturity but high growth potential.

Furthermore, construction accounts for 18% of large particle pollution in the UK<sup>3</sup> and contributes around 38% of the world's total global emissions.<sup>4</sup> Given the urgency to deliver clean growth in the UK and Swiss construction industry, AI can greatly improve efficiency and reduce waste in the sector.

<sup>1</sup> <https://analytics.dkv.global/AI-in-Switzerland-2021-Q4/Report.pdf>

<sup>2</sup> <https://www.gov.uk/government/news/uk-signs-major-science-co-operation-agreement-with-switzerland>

<sup>3</sup> <https://urbanhealth.org.uk/insights/reports/reducing-air-pollution-from-construction-sites>

<sup>4</sup> <https://www.weforum.org/agenda/2021/07/construction-industry-doesn-t-know-where-it-stands-when-it-comes-to-carbon-emissions/>

## Innovate UK, Innovate UK and the Global Expert Missions

Innovate UK supports business-led innovation and is part of UK Research and Innovation (UKRI).<sup>5</sup> UKRI convenes, catalyses, and invests in close collaboration with others to build a thriving, inclusive research and innovation system. To this end, Innovate UK helps businesses to identify the commercial potential in new technologies and turn them into new products and services that will generate economic growth and increase productivity. With a strong business focus, Innovate UK drives growth by working with companies to de-risk, enable and support innovation. Innovate UK exists to connect innovators with new partners and new opportunities beyond their existing thinking – accelerating ambitious ideas into real-world solutions. Innovate UK is part of the Innovate UK group.

As innovation is increasingly a global endeavour and the ambition of UK businesses to become truly international enterprises is at its highest, Innovate UK established its Global Expert Mission (GEM)<sup>6</sup> programme in 2017. Delivered by Innovate UK, in partnership with the FCDO Science and Innovation Network (SIN)<sup>7</sup>, GEMs help further Innovate UK's global strategy by providing the evidence base for where it should invest, by providing the opportunities for UK businesses to build partnerships and collaborations with key economies.

<sup>5</sup> <https://www.ukri.org/>

<sup>6</sup> <https://iuk.ktn-uk.org/programme/global-expert-missions/>

<sup>7</sup> <https://www.gov.uk/world/organisations/uk-science-and-innovation-network>

## Mission Scope

Built around UK business, policy and research representation, the outcomes of the GEM are intended to achieve the following:

### 1. Informing UK businesses and government

The findings and opinions of experts on the topic of the GEMs are made available to UK businesses and government departments. These inform UK businesses about potential opportunities for innovation in the country and the UK government on how it can help UK businesses make the most of those opportunities.

### 2. Building International Collaborations

The expert insights will help inform how Innovate UK can best help UK businesses find and exploit the opportunities for innovation partnerships. The GEM creates connections with key organisations and people that will deepen and widen the collaboration with the partner country to benefit UK business.

### 3. Sharing UK Capabilities

During the Mission, the delegation of experts will use the opportunity to promote and share the UK's innovation strengths.



## Mission Overview and Objectives

### The overarching Mission objectives were:

- To help determine how Innovate UK can best support UK businesses more effectively and efficiently when considering innovation partnerships with Switzerland.
- To provide insights into where there are synergies between the two countries in AI and determine whether there is an appetite for further collaboration.
- To identify and showcase key future market opportunities for innovative products and services to UK businesses that may be interested in collaborating with Switzerland.
- To capture key UK R&I and emerging market opportunities/challenges for developing innovative products and services when considering collaboration with Switzerland.

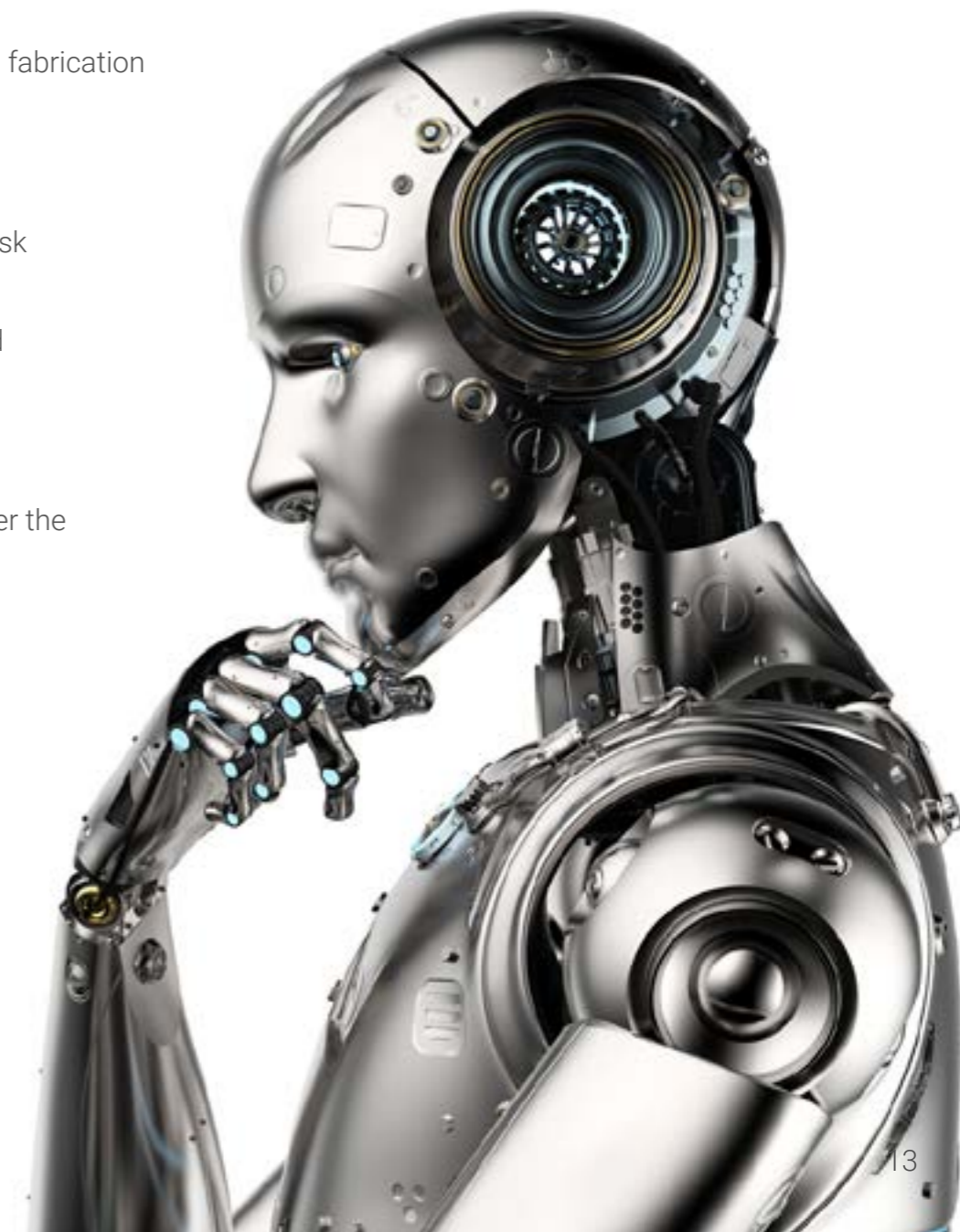
### Sector-specific objectives:

- **Skills Development** – Exploring how both countries can work together to address the skills gap.
- **Standards collaboration** – Addressing the need for international standards for the adoption of AI in the construction sector.
- **Funding and support** – Exploring funding models to ease access to facilitate international collaboration.
- **Data Sharing and Privacy** – How to address the requirement for data sharing to support rapid AI development.
- **Sector acceleration** – Exploring challenges and opportunities around the adoption of AI, leveraging work already done in sectors more advanced in AI adoption.
- **Awareness raising** – Building awareness and acceptance of AI capabilities in the construction sector.
- **Developer understanding** – Delving into the challenges the developer and startup community faces to gain access and trust in the construction sector.

The GEM team also identified the following areas within the construction sector to explore the potential for AI collaboration:

- Architecture
- Robotics
- 3D Printing/Large scale fabrication
- Materials
- Energy efficiency
- Project management/risk identification
- Tunnelling underground
- Maintenance
- Supply chain

The GEM was funded under the BridgeAI programme.



## 05. Sector Overview

The construction sector is a major contributor to the global economy but is also responsible for a significant share of global carbon emissions. As the UK acts on its net zero ambitions, there is an urgent need for the sector to become more sustainable and efficient. AI has the potential to improve the quality of construction, reduce energy consumption and increase productivity. It can also enhance the efficiency of supply chains and increase workplace safety through monitoring building and workplace conditions.

The UK has been a market leader in AI and sustainable construction practices, setting out ambitious targets to improve green technology in the sector. Switzerland currently ranks first globally in knowledge and technology outputs<sup>8</sup> and is also recognised as a leader in the field of AI.

With a recent Memorandum of Understanding between the UK and Switzerland, there is a good opportunity to strengthen the UK-Switzerland relationship through R&I collaboration on AI to support the UK's Net Zero goals and combat Climate Change via the construction sector. Furthermore, this presented the opportunity to increase the market footprint for one of BridgeAI's key sectors and to increase the visibility of appropriate partners for collaboration.

The UK and Switzerland have similar needs and capabilities, with ageing infrastructure assets that require maintenance, safety regulation, and quality control in the face of skills shortages. AI can help predict and prevent failures, identify risks, and improve efficiency within the whole value chain. Switzerland and the UK also share a similar focus on regulation in AI, balanced against a desire to support innovations within the field.

<sup>8</sup> [https://www.wipo.int/pressroom/en/articles/2022/article\\_0011.html#:~:text=Switzerland%20remains%20the%20world's%20leader,and%20production%20and%20export%20complexity.](https://www.wipo.int/pressroom/en/articles/2022/article_0011.html#:~:text=Switzerland%20remains%20the%20world's%20leader,and%20production%20and%20export%20complexity.)



## UK Strategy

The UK is focused on embedding green technologies in the construction sector, with it being the central focus of the government's Construction 2025 strategy.<sup>9</sup> The UK's national AI Strategy works in partnership with this by calling for pro-innovation regulation and cites AI as one of the five critical technologies for the UK.<sup>10</sup>

### UK strategies & programmes for the adoption of AI in construction

Many strategies, businesses and programmes focus on the adoption of AI in construction. An inexhaustive list of these can be found opposite:

<sup>9</sup> <https://www.gov.uk/government/publications/construction-2025-strategy>

<sup>10</sup> <https://www.gov.uk/government/publications/national-ai-strategy>

## Government Departments

### Office for Artificial Intelligence

The office within the Department for Science Innovation and Technology, responsible for overseeing the implementation of the National AI Strategy.

### National Infrastructure Commission

Part of HM Treasury, NIC informs the UK government on improving and sustaining national infrastructure.

## Research & Investment Institutions

### Turing Artificial Intelligence Fellowships

A £46 million initiative to attract, maintain and develop the best talent in artificial intelligence

### UK Collaboratorium for Research on Infrastructure and Cities

An integrated research capability for the renewal and improvement of infrastructure and cities in the UK by engaging government, industry, academia and end users.

## Accelerators & Innovation Programmes

**BridgeAI** – An Innovate UK programme to help businesses in high-growth potential sectors of agriculture, construction, creative and transport industries to adopt AI technology. The programme has £100 million in funding is available, and over 50,000 organisations in their innovation network.

### Transforming Construction Challenge

A £420 million investment from UKRI and industry to accelerate the shift in construction towards manufacturing and digital processes, and a value outcome approach.

### Construction Innovation Hub

A partnership with over 600 organisations, industry bodies, policy-makers, practitioners and academics to drive innovation throughout construction.

### Digital Twin Hub

Based at the Connected Places Catapult, the DT Hub connects companies to experts and innovators to help push innovation in construction.

## Switzerland Strategy

Switzerland is ranked first in the world in the Global Innovation Index, and for publications on AI,<sup>11</sup> and is also the regional leader in innovation outputs, ranking first worldwide in Knowledge and Technology outputs.

Switzerland's universities and research institutes are world-renowned for their contribution to AI innovations, with a strong regulatory environment and focus on protecting individual privacy and ethical use of technology. The Federal Council has encouraged this by aligning regulation with international norms,<sup>12</sup> and the development of national AI strategies.<sup>13</sup>



<sup>11</sup> <https://analytics.dkv.global/AI-in-Switzerland-2021-Q4/Report.pdf>

<sup>12</sup> <https://www.admin.ch/gov/en/start/documentation/media-releases.msg-id-88019.html>

<sup>13</sup> <https://www.sbf.admin.ch/sbf/en/home/eri-policy/eri-21-24/cross-cutting-themes/digitalisation-eri/artificial-intelligence.html>

## AI in Switzerland at-a-glance



<sup>14</sup>

<sup>14</sup> <https://analytics.dkv.global/AI-in-Switzerland-2021-Q4/Report.pdf>



### Distribution of AI in Switzerland

The country does not have an integrated national strategy for developing or adopting AI, either on a general basis or targeted at the construction industry. Instead, there are many organisations, businesses and government programmes that focus on the adoption of AI in construction. These are described in the In-country Stakeholders section.

Top 5 Cantons by number of AI companies, Q4 2021 <sup>15</sup>

<sup>15</sup> <https://analytics.dkv.global/AI-in-Switzerland-2021-Q4/Report.pdf>

## Funding programmes

### National Research Programme on Digital Transformation (NRP 77)

The National Research Programmes (NRPs) generate scientific knowledge aimed at solving Switzerland's most pressing problems. The topics are specified by the Federal Council with a focus on interdisciplinary and transdisciplinary research. The individual research projects and groups work towards a predefined overall goal.

The National Research Programme **"Digital Transformation" (NRP 77)** has been established to investigate the interrelationships and concrete effects of digital transformation in Switzerland. It comprises CHF 30 million (£27 million) worth of investment supporting research and innovation in the field of digital transformation, including automation, data analytics and machine learning. NRP 77 is open until November 2023.

### White Papers and Policies

In recognition of the pace of development, AI was made a core theme of the ongoing "Digital Switzerland" strategy in 2018,<sup>16</sup> and a working group was set up under the guidance of the Secretariat for Education, Research, and Innovation (SERI).

In 2020, the working group published guidelines on the use of AI within the Federal Administration.<sup>17</sup> The guidelines lay out generic principles for the development and adoption of AI, including putting people first, ensuring optimal regulatory conditions, and laying down basic requirements for transparency and explainability (see Infobox). It also establishes strategic principles such as technological neutrality and a bottom-up approach to R&D from stakeholders in education, science, and business.

In 2022, the Federal Department of Foreign Affairs submitted a report to the Federal Council titled "Artificial Intelligence and international rules",<sup>18</sup> which examines the state of regulatory approaches to AI across the globe. The report recognises that while Switzerland has the freedom to set its own regulatory agenda, there is also a pragmatic need to align with any emerging global standards covering AI for the country to remain competitive. Recommendations focus heavily on increased international cooperation, such as with technical standards organisations, and via participation in negotiations for a Council of Europe AI instrument.

The 2023 Swiss Roadmap for Research Infrastructure, developed by SERI, provides an overview of Switzerland's participation in international research infrastructures.<sup>19</sup> NEST (Next Evolution in Sustainable Building Technologies), the modular research building operated by Empa and visited as part of the GEM, is included on the roadmap, with funding available until 2032.

<sup>16</sup> <https://www.bakom.admin.ch/bakom/en/homepage/ofcom/ofcom-s-information/press-releases-nsb.msg-id-72053.html>

<sup>17</sup> [https://www.sbf.admin.ch/dam/sbf/en/dokumente/2021/05/leitlinien-ki.pdf.download.pdf/leitlinien-ki\\_e.pdf](https://www.sbf.admin.ch/dam/sbf/en/dokumente/2021/05/leitlinien-ki.pdf.download.pdf/leitlinien-ki_e.pdf)

<sup>18</sup> <https://www.news.admin.ch/newsd/message/attachments/71099.pdf>

<sup>19</sup> <https://www.sbf.admin.ch/sbf/en/home/research-and-innovation/research-and-innovation-in-switzerland/swiss-roadmap-for-research-infrastructures.html#1506377639>



## What is explainability in AI?

Explainability describes the idea that an AI algorithm, and its outputs, can be explained in a way that is understandable to humans. Explainable AI aims to address the risk that AI decision-making becomes a "black box." One example could be the use of AI in detecting anomalies and defects in civil infrastructure, where it would be necessary to explain why particular issues have been flagged as defects that require further investigation or investment.



## International Cooperation

In November 2022, the UK and Swiss governments signed a Memorandum of Understanding,<sup>20</sup> deepening the relationship between the two countries' world-leading research and innovation communities. The memorandum encourages a particular focus on cooperation in 'deep science' and 'deep tech', as well as commercialisation through innovation and policy and diplomacy in science and innovation.

It also outlines the principles of the relationship, and specific forms of cooperation, including:

- Coordinated or joint initiatives, programmes, or projects.
- Meetings, workshops, conferences, or symposia.
- Exchange of information and documentation.
- Mobility, visits, and delegations.
- Strategy and coordination meetings.
- Plans for Ministers to convene a regular annual Anglo-Swiss Research Collaboration Council to oversee activities.

Further, in March 2023, Innovate UK and Innosuisse launched a £2 million investment fund<sup>21</sup> for bilateral research projects with innovative solutions. UK-registered organisations, in collaboration with at least one Swiss-registered business, could apply for a share of up to £2 million for research projects resulting in innovative solutions, while Swiss counterparts could apply via Innosuisse. Applications closed on 26th July 2023.

In June 2023, Switzerland Global Enterprise (S-GE) and the Department for Business and Trade (DBT) signed a Memorandum of Understanding<sup>22</sup> focusing on FinTech, cyber security, and quantum technologies, amongst other sectors. The signing of the MoU was timed to coincide with Swiss Business Hub UK & Ireland's twentieth anniversary.

<sup>20</sup> <https://www.gov.uk/government/news/uk-signs-major-science-co-operation-agreement-with-switzerland>

<sup>21</sup> <https://www.ukri.org/opportunity/uk-switzerland-bilateral-collaborative-research-and-development/>

<sup>22</sup> <https://www.techuk.org/resource/swiss-business-hub-uk-ireland-reaches-twentieth-anniversary-with-mou.html>



## In-country Stakeholders

Through the GEM, the team met with a wide range of stakeholders from the Swiss innovation landscape. These included representatives of government agencies, research institutions, innovation and business support programmes, large domestic construction providers, and startups.

### Government Agencies and Non-Governmental Organisations

The GEM team met with representatives of Switzerland's innovation agency, Innosuisse, together with representatives of the Secretariat for Education, Research, and Innovation and the Competence Network for AI (part of the Federal Statistics Office).

**The State Secretariat for Education, Research and Innovation** sits within the Federal Department of Economic Affairs, Education and Research. SERI is the federal government's specialised agency for national and international matters concerning education, research, and innovation policy.

**Innosuisse** is the Swiss Innovation Agency which serves to promote science-based innovation in the interest of the economy and society in Switzerland.

Innosuisse collaborates closely with SERI; however, it is a federal entity under public law with a separate legal personality. It provides support in accordance with the subsidiarity principle: it only supports projects if the innovation could not be implemented and market potential would not be tapped into without funding.

**The Competence Network for Artificial Intelligence (CNAI)** is part of the Federal Statistics Office (FSO). While CNAI does not play a role in funding, it governs AI projects within Switzerland and facilitates knowledge transfers for businesses, government, and research. The CNAI also contributes to informing the public and enabling transparency of ongoing AI projects both within and outside the Federal Administration.

For this meeting, the GEM team were also joined by representatives from the Science and Innovation Network from the British Embassy in Berne.

The GEM team were given a high-level introduction to the Swiss innovation and funding landscape, the current state of AI and, more specifically, R&D and innovation in the construction space. Discussions covered the pace of AI development and novel applications as key shared challenges, and the GEM team learned more about Switzerland's bottom-up approach to innovation, which is led by academia and business, with a focus on applications rather than individual technologies. As such, there is no top-down strategy or funding for industrial innovation.

## Federal Academic Institutions

### Swiss Federal Institute of Technology in Lausanne

The **Swiss Federal Institute of Technology (EPFL)** in Lausanne is one of two federal universities for engineering in Switzerland, consistently obtaining high rankings among global institutions and educating over 12,700 students and 350 professors.

The **Center for Intelligent Systems (CIS)** is part of EPFL, integrating AI, machine learning, and robotics for the development of intelligent systems, which perceive their environment and can learn from the data they collect to adapt to the changing world around them.

The CIS has over 650 researchers across 5 EPFL faculties, working at 84 laboratories. It encourages ambitious collaborative projects to build intelligent systems and dialogue with industry, society, and politics on the topic of AI.

Along with its academic and research activities, the CIS also supports industry engagement via affiliation programmes and events.

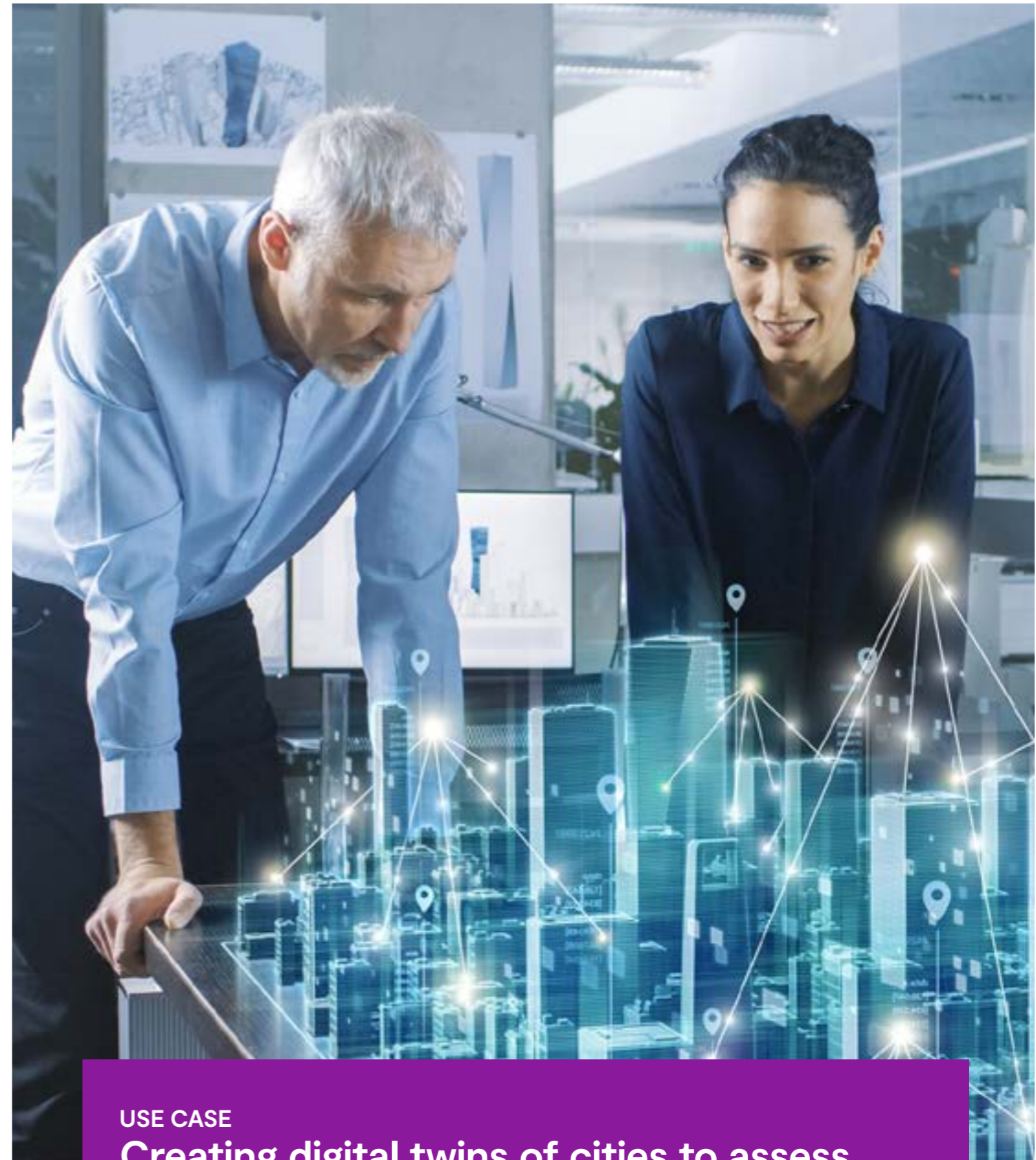
Following an introduction to the CIS, the GEM team had the opportunity to meet with leaders of research projects, along with a startup that was spun out of CIS research.



#### USE CASE

### Mechanised tunnel boring

EPFL researchers have developed a solution for mechanised construction using tunnel boring machines from the Intelligent Maintenance and Operations Systems Laboratory. Herrenknecht, a German tunnel boring company, has used this technology.



#### USE CASE

### Creating digital twins of cities to assess earthquake risks

The second presentation was from the Resilient Steel Structures Laboratory, where the research focuses on creating a digital twin of cities for earthquake risk using machine learning rather than big data, which overcomes the lack of big data in the built environment. However, this method leverages the presence of domain knowledge, which is more typically present in the construction sector, and that can be harvested for machine learning algorithms.

### Swiss Federal Institute of Technology

The **Swiss Federal Institute of Technology** is among the world's top-ranked institutions in science and engineering. Based in and around Zurich, ETH is considered a driving force behind Swiss innovation and industry. As of 2022, over 25,000 students are enrolled at ETH under the supervision of 567 professors.

Within ETH, there are two key centres for research and development in AI and construction.

The **ETH AI Center** brings together research on AI for the benefit of society. Its three key pillars focus on research, skills, and impact.

**Design++**, ETH's Center for Augmented Computational Design in Architecture, Engineering, and Construction, develops digitally augmented design tools, AI, and computational processes primarily for the design phase to simultaneously increase construction productivity, improve the quality of the built environment and substantially reduce the ecological impact within the Architecture, Engineering and Construction (AEC) sector.

The GEM team had the opportunity to meet with the ETH AI Center leadership and a researcher who works in the field of co-adaptive analytics. Co-adaptive analytics uses a combination of human and AI agents to solve data problems and streamline the analytical process.

The delegation also visited the Design++ Center at the ETH Hönggerberg campus. At around three years old, Design++ is a new research department at ETH, which sits between civil engineering and architecture, with a branch to computer science. It conducts research into applications such as structural ingenuity, innovative design, life cycle assessments, and acoustic quality using technologies such as AI, extended reality, and computational design. The centre works to drive collaborations and knowledge transfer with industry, as well as designing and building ETH's Immersive Design Lab.

The team had the opportunity to meet with the Design++ executive director and several researchers, where discussions focused on ongoing research projects. These included synthetic data generation to feed algorithms for the architectural, engineering, and construction space.

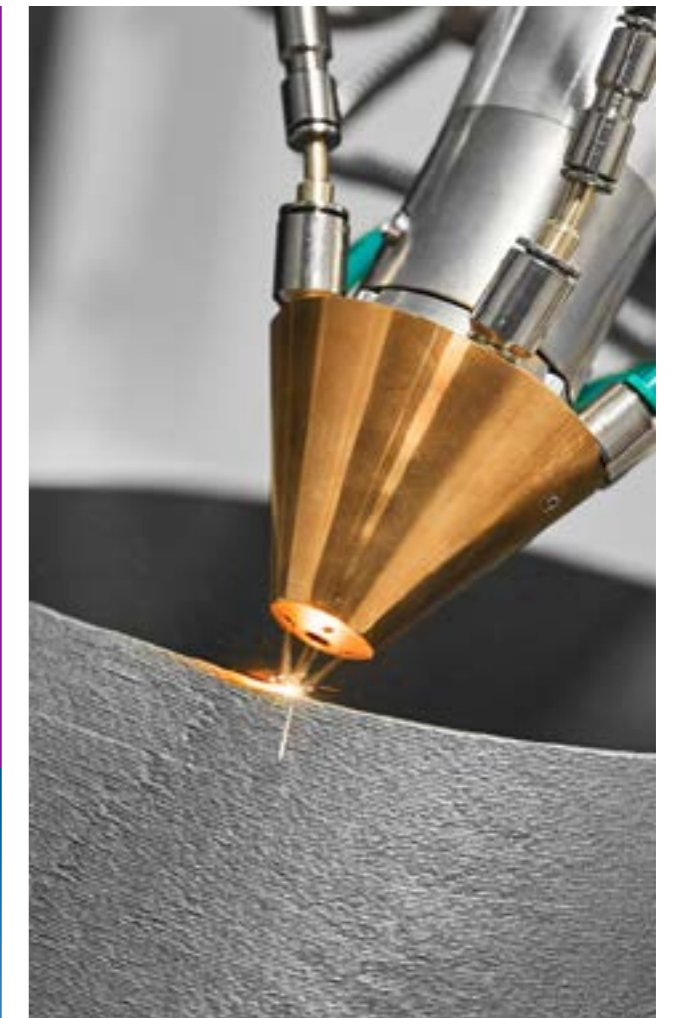
Also part of ETH, the **National Center for Competence in Research (NCCR)** Digital Fabrication is Switzerland's initiative to lead the development and integration of digital technologies within the fields of architecture and construction. Through combining digital technologies and physical building processes, over 100 researchers from six different academic disciplines collaborate for Switzerland to take a leading position within digital fabrication.

The NCCR visit also included a working demonstration of the software developed by incon.ai, an ETH spin-off, in practice in a construction setting.

### USE CASE

## Digital building technologies to create “add-on” living spaces for existing structures

ETH research utilises digital technology in designing rooftop units to attach to pre-existing apartment blocks, creating affordable solutions for new housing.



### EXPERIMENTAL USE CASE

## Impact printing

Impact printing is an experimental, high-speed, construction method using robotics and earth-based materials, which cuts CO<sub>2</sub> emissions in half compared to concrete walls.<sup>23</sup>

<sup>23</sup> <https://dfab.ch/news/impact-printing-wins-3d-pioneers-challenge>





## UK-Swiss Collaborative Research into Sustainability Robotics

In collaboration with Imperial College London, Empa's Sustainable Robotics team are developing drones that can be used in fields such as aerial additives manufacturing or under extreme conditions such as surveying active wildfires.

The research studies living organisms that can survive under extreme conditions to support drone development. The team is seeking to further expand the research with the establishment of a dedicated institute and further facility at NEST.

## Research Institutions

### NEST and Empa

**Empa** is a research institute for application-oriented materials science and technology. NEST is Empa's modular research and innovation building, where new technologies, materials and systems are researched, developed, and validated under real conditions.

The GEM team visited the NEST facility, a modular research and innovation building in Dübendorf, close to Zurich. NEST researches, develops, and validates technologies, materials, and systems under real conditions where humans live and work. Each modular unit operates as intended for several years, after which it can be removed and replaced with a new test unit for a different purpose. Close cooperation with partners from research, industry and the public sector ensures that innovative construction and energy technologies are put onto the market faster.

At NEST, the GEM team visited an apartment unit designed around sustainability and circularity, constructed from materials such as clay and agrifibres and where all waste, including water and sewage, are recycled. An office unit is constructed from two-thirds recyclable materials, including old library books and clay roof tiles, for various aesthetic and acoustic effects. A wellness unit which includes a gym, steam room, and sauna, reduces energy by up to six times compared to normal operations by continuously recycling waste heat from the facilities. An experimental unit called the Hilo has made use of an innovative construction technique involving spraying liquid concrete over a metal cable construction to achieve elaborate domed ceilings.

Following the tour of NEST, the GEM team met with Empa representatives to better understand the operation and impact of the research and technology transfer. Empa operates an extremely robust approach to knowledge and technology transfer and a variety of models for industry collaboration on research with over 350 Swiss industry partners.

## IDIAP

The GEM met representatives from IDIAP, an independent, non-profit research foundation partly funded by competitive research projects and public funds.

The **Dalle Molle Institute for Perceptive Artificial Intelligence (IDIAP)** is an independent, non-profit research foundation, partly funded by competitive research projects and public funds. IDIAP conducts fundamental research and technology transfer activities in the area of AI, both theoretical and applied. IDIAP has been involved with over 100 projects since 2008, many of which have gained national and international recognition.

IDIAP has deep and extensive involvement in AI research in Switzerland across a number of disciplines and sectors. The representative highlighted involvement in several initiatives at the convergence of AI and construction, including:

- The AI-based detection of asbestos fibres by classification of electron microscopy images for residue analysis.
- A simulation tool for District Heating Networks (DHN) based on AI to quickly assess and predict the performance of complex meshed networks.
- Leveraging user-centric intelligent daylight and electric lighting for energy saving.
- The use of robotics in construction and assembly.

## IDSIA

The **Dalle Molle Institute for the Study of Artificial Intelligence (IDSIA)** is a joint research institute of the Università della Svizzera and the University of Applied Sciences of Southern Switzerland. IDSIA focuses on various aspects of AI: algorithms and theory of AI and computer science, machine learning (deep neural networks, graph neural networks, reinforcement learning), intelligent control of networked systems, geometric and visual computing, information retrieval and natural language processing, and autonomous robotics.



## Innovation Support for Business

### KNOVA

On site at EPFL, KNOVA is an open innovation platform focused on building connections and strengthening networks between EPFL, Innovation Park partners, and startups.

**KNOVA** is a partnership programme that supports companies leveraging the EPFL research ecosystem to nurture their innovation. It also provides startups and researchers in the EPFL ecosystem with the chance to make a global impact with their technologies. KNOVA was established in 2022 and now has 16 industry members, including Siemens, Michelin, L'Oréal, and Swisspost.

The model onboards firms in three phases – an exploration week, a soft landing (1-6 months to test the value of innovation communities) and full membership. The GEM team was impressed to see the high level of interest from large firms (including SwissPost and Michelin, among others) and keen to consider how such a model could be imported to the UK.

### Switzerland Global Enterprise

The team also met with representatives from Switzerland Global Enterprise (S-GE) the official Swiss consultancy, promotion and platform organisation for export and investment promotion.

**Switzerland Global Enterprise (S-GE)** is the official Swiss consultancy, promotion and platform organisation for export and investment promotion operating in 30 countries. Together with partners at home and abroad, S-GE supports Swiss SMEs in their international business and helps innovative foreign companies with potential that are interested in settling in Switzerland.

There was a productive discussion regarding how it interacts with other stakeholder organisations and opportunities for importing UK business into Switzerland.



### Innovation Parks

There are six Innovation Parks at strategic locations close to academic, research, and industrial hubs across Switzerland. Notably for the GEM, the Innovation Park Network West EPFL is located close to the EPFL campus and hosts companies specialising in materials and manufacturing and energy, natural resources, and the environment.

**Switzerland Innovation**, the entity behind the Swiss Innovation Parks, facilitates collaborations for companies, startups, and universities. Together with its partners, Switzerland Innovation forms an ecosystem accelerating the transformation of research results into marketable products and services.



## Large Construction Stakeholders

### Swiss Federal Railways (SBB)

The GEM team met with Swiss Federal Railways (SBB) representatives to discuss the development of AI projects for the Swiss railway sector. SBB runs over 11,000 trains per day carrying 1.1 million passengers across 3,200km of track. The AI projects aim to improve the maintenance monitoring of rolling stock via two use cases: prediction of flat spots on wheel sets and maintenance planning thereof and wear prediction for pantograph carbon strips (used for collecting electrical current).

The discussion covered the key learnings and outcomes from the projects. One area of particular interest was in ensuring data quality and quantity and the challenges of data sharing. The latter issue is particularly relevant for the UK, where many entities are frequently involved in running a single transport network.

Discussions also covered change management within the workforce and the sharing of knowledge with the wider AI and transport sectors. SBB is part of Germany's Cross-Business Architectural Lab, which enables sharing with the EU railway networks, and it also works closely with domestic partners such as ETH for the development of mobility initiatives.

### Implenia

Implenia is Switzerland's largest construction and real estate service provider, undertaking most commercial and civil infrastructure projects in the country. The team met with a representative and had extensive discussions focusing on the Swiss construction landscape and challenges.

The company works with various partners – including research institutions such as the Fraunhofer Institute for Building Physics IBP, ETH Zurich and startups. The company has also worked with energy supply companies to optimise energy supply in neighbourhoods with ongoing construction or real estate activities.



### CASE STUDY

## Leveraging startup innovation

In 2021, Implenia worked with two startups – Imerso and Scaled Robotics – to develop a pilot creating new methods for quality and construction progress management using BIM, reality capture and AI.

## AI and Construction Startups

Throughout the GEM, the team met with several founders of startups at the convergence of AI and construction, many of which had been spun out of research institutions and programmes also encountered during the GEM.

**SwissInspect** is a startup spun out from research at EPFL's Earthquake Engineering and Structural Dynamics Laboratory. The research focused on the use of drones to automate damage inspection of structures such as buildings, bridges, dams, and tunnels. SwissInspect is now developing products that have use cases in inspecting building damage, façades, and road defects.

**Incon.ai** has developed an augmented reality app that uses a 3D overlay with instructions for building any given construction project, thus lowering the barrier to building. The key innovation is the highly effective "snap" feature, which "snaps" the construction blueprint over the phone's camera image so the builder can see what they have built versus how it is supposed to look, all on the same screen. The app has been used by an NGO to build social housing in the Philippines.

**Benetics** is an AI construction communication app which aggregates data from multiple sources for construction project management. For instance, it has a messaging function that can carry out smart issue tracking and offers real-time translation for sites where workers do not speak the same language.

**Gravis Robotics** automates the operation of construction machinery. Along with developing new robotic machinery, Gravis also offers a kit to automate existing machines retroactively, thus avoiding the costs of deprecating usable equipment and reducing the waste footprint.

The GEM team also met with founders of two startups spun out from Empa research. **Symphony** emerged from the Urban Energy Systems Lab as an AI tool that allows energy planners to develop a digital twin of a construction site in order to plan the most effective energy solutions and infrastructure based on available resources. **Twingtec** develops drones that are tethered to floating platforms for more efficient and sustainable harvesting of sea wind energy, including in deep water areas.

## Additional Stakeholders

In addition to the Swiss stakeholders, during the visit the GEM team attended the UK Swiss Life Sciences Innovation Forum, an event organised jointly by Innovate UK and Innosuisse, with the support of the British Embassy Science and Innovation Network in Berne. They had the opportunity to meet with the Rt. Hon. Sir Stephen Timm MP, who was attending the Forum in his capacity as the Prime Minister's Trade Envoy to Switzerland and Liechtenstein shared some of the experiences from the GEM.



## 06. Opportunities for Future Collaboration

The GEM team identified several opportunities for formal and informal bilateral collaborations between the UK and Switzerland at the government, industry, and startup levels.

### General networking and matchmaking for funding opportunities

Applied AI startups and growth companies could benefit significantly from networking opportunities and the chance to collaborate on funding initiatives such as the recent £2m investment fund for bilateral UK-Swiss research projects. During the GEM visits, there was significant support for matchmaking exercises to facilitate such connections from stakeholders such as Swiss Global Enterprise, IDIAP, and Empa.

### Leveraging the innovation platform model

The KNOVA innovation platform that acts as a bridge between industry and EPFL research was of particular interest during the GEM. KNOVA provides a formal framework for the establishment of networks and working partnerships between EPFL research teams and industrial partners, and has met with rapid success and adoption, including by household-name firms. There is an opportunity to replicate this model (or elements thereof) between UK industries and institutions with Digital Catapult acting as the KNOVA counterpart.

There is also an opportunity for a parallel partnership between KNOVA and Digital Catapult, which play complementary roles in many respects and could identify further avenues for collaboration.

### Potential for a joint accelerator

Delegates from the Center for Intelligent Systems at EPFL expressed specific interest in visiting the UK to assess capabilities and opportunities for potential funding for a joint accelerator focused on AI in construction. There may be an opportunity to run this via Digital Catapult, subject to readiness and availability checks.

Such an accelerator would allow UK businesses to access the extensive AI innovation network and research capabilities in EPFL and the wider Swiss academic landscape.

### Low-hanging fruit in compliance and safety use cases

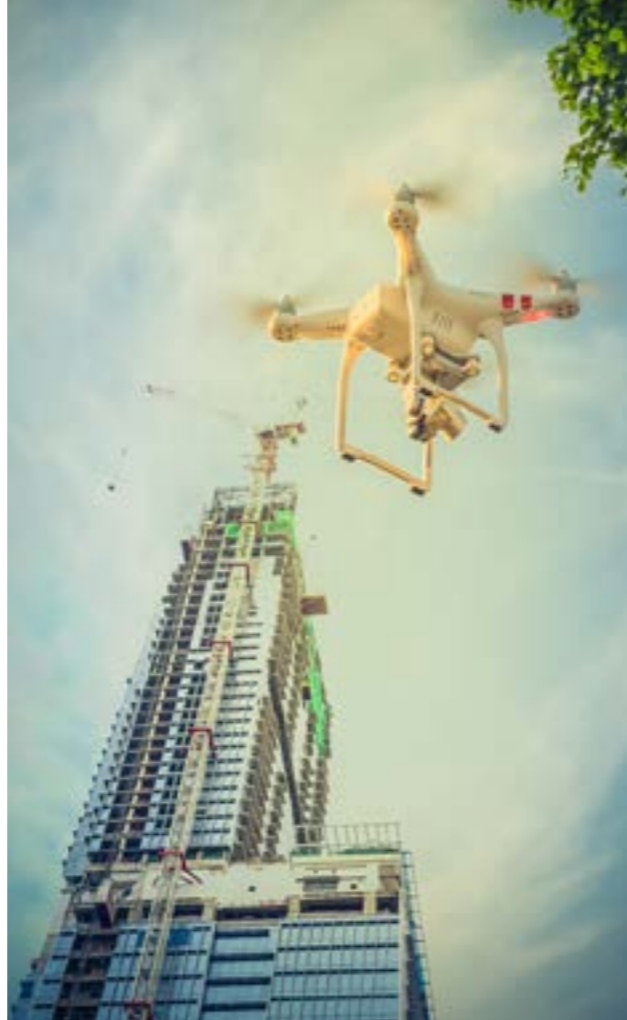
During the visit, several use cases for AI in the areas of safety and compliance were showcased (see Infobox.) Several of these use cases represent low-hanging fruit for AI development since they do not depend on the use of personal or human-generated data but could deliver significant benefits. The GEM team believes there is an opportunity for UK research and development to explore this gap.

### Investment gaps in Swiss institutional funding models

Swiss federal institutions are not directly involved in equity funding for startups spun out from their research. There is an opportunity for UK venture investors to fill these gaps where Swiss startups are developing solutions without UK equivalents that could be used in industrial applications in the UK.

### Connecting Swiss startups to UK industrial initiatives

There were several Swiss startups and research initiatives with solutions that could be of benefit to specific UK industrial initiatives. One example is incon.ai and potential use cases in UK construction. Another is the potential for collaboration between Digital Catapult and Dr. Mirko Kovac, who leads the Sustainability Robotics Lab at Empa/Imperial College. Both parties have already been separately involved in the RACE nuclear decommissioning effort.



### EXAMPLE USE CASE Building assessments using drones

Assessing damage to buildings and structures through wear and tear, or following incidents such as earthquakes, can be risky and expensive using human inspectors. However, projects such as SwissInspect use drones to observe inaccessible areas of structures such as dams, bridges, tunnels, or façades and capture large volumes of imaging data that can be assessed by AI algorithms. Such a use case can dramatically reduce the human risks associated with damage assessments, while improving the accuracy. Furthermore, it requires only data comprising images of safe and defective buildings and structures, not of any human-sensitive nature.



### Collaboration on specific AI research initiatives

Collaboration with research initiatives offer high potential to share and build technical areas of expertise, the GEM team identified IDIAP as an institute with multiple areas of collaboration opportunities. These include:

- Spiking neurons for energy-efficient AI.
- Simulations for district heating networks.
- Computer vision used for fault detection.
- NASA University leadership seeking transfer opportunities for some of their aviation techniques.
- Global optimisation to plan assembly tasks.
- IDIAP Create Challenge 16-24 Aug 2023 – 9 day hackathon.

### Establish joint effort on EU regulatory policy

EU regulatory policy regarding the development of AI is potentially one of the biggest external influences on the adoption of the technology for both the UK and Switzerland. In June 2023, the European Parliament passed a draft version of the AI Act,<sup>24</sup> imposing restrictions on certain use cases such as facial recognition and introducing transparency requirements. The final version of the law is subject to negotiation with the branches of the EU, and is expected to be agreed upon by the end of 2023.

Both the UK and Switzerland have legislative freedom to write their own regulatory frameworks independent of the EU AI Act; however, there is recognition of a need to align regulation to promote competition and innovation in AI. Therefore, there is an opportunity to collaborate and establish a joint effort on policy responses and domestic implementation.

### Expand NEST “test and deploy” capabilities to UK

The NEST facility has an outstanding capability for rapidly deploying and testing new technologies. Thanks to the modularity of its research building, NEST can research, develop, and validate technologies, materials, and systems under real conditions for several years at a time, treating each module as a discrete project which can be replaced relatively easily once completed.

There is an opportunity to expand these capabilities into the UK research landscape and vice versa if there are already similar shared testbed initiatives or facilities in UK. UK stakeholders with an interest in such opportunities should connect via Innovate UK Edge to explore further.



<sup>24</sup> <https://www.europarl.europa.eu/news/en/headlines/society/20230601ST093804/eu-ai-act-first-regulation-on-artificial-intelligence>



## 07. Potential Barriers to Collaboration

### Lack of aligned technology readiness

The Swiss federal institutions in the scope of the GEM focus on early-stage research at the lower levels of technology readiness, which may limit opportunities for collaboration with UK industry.

Furthermore, many UK institutions tend to also focus on higher technology readiness levels, which may act as a barrier to collaborative research efforts. However, there may be more scope for collaboration with institutions such as IDiAP or Empa where technology readiness is more aligned.

### Lack of industry readiness

The complexity and fragmentation of the construction industry, combined with a high level of psychological resistance and capability gaps at various stages of the construction process, means that technological change is notoriously slow to implement. This will likely make it challenging to test or operationalise new innovations in both countries.

### Risks of excessive regulation

There is a risk that lawmakers choose to regulate AI technology on a general level, which will run the risk of stifling use cases at the industry or application level. This is a particular risk in the construction sector, given the substantial opportunities to leverage non-personal and non-human data in AI construction applications.

The Swiss approach, which focuses on sector-led regulation rather than technology-led regulation, allows for a more pragmatic balance of innovation against legislation.

### Data sharing and commercial sensitivities

There may be challenges in data sharing due to the limitations of the GDPR. While neither the UK nor Switzerland are mandated to implement the full scope of the GDPR, both countries are broadly aligned.

There may also be limitations on data sharing imposed for commercial confidentiality reasons.

### Lack of data quality and standards

A lack of data quality and standardisation is a general issue when developing AI-based solutions and was a recurring challenge raised throughout the GEM. Any collaboration between the UK and Switzerland may be held back by this lack of standardisation and data quality, as even attempting to resolve the issue on a per-project basis consumes significant time and resources.

However, the absence of universally recognised standards and the use of ad-hoc systems and nomenclature also creates the risk of AI development happening in silos.

### Pace of technology development

There is currently a mismatch between the pace of AI development and the ability of the industry to implement solutions at speed and scale. The key challenge is being able to implement solutions that can deliver results without being outpaced by new developments that mean the UK cannot remain competitive on the global stage.

### Different sizes, different approaches

UK networks between institutions and industry are larger and more fragmented than their Swiss equivalents. This makes it comparatively more difficult to discover and establish innovation partnerships and thus more difficult for the UK to implement similar networking models with the same success.

Switzerland's bottom-up approach to innovation and technological development, led by startups, industry, and academia, tends to differ from the top-down approach of the UK, which direct investment according to industrial policy. While the different methods are partly reflective of differences in size, scale, and overall approaches to national governance, they create barriers to the discoverability of partnership opportunities.

## 08. Conclusions

The GEM found an appetite for collaboration between the UK and Switzerland to tackle shared barriers and develop knowledge transfers within the construction sector. In particular, there is a broad scope for the application of AI, from design and planning through to building construction and maintenance, with the opportunity to improve building and workplace safety, enhance energy efficiency, and increase productivity.

Furthermore, the sector faces challenges such as ageing infrastructure and workforce, skills shortages, and consistent quality control, that AI can help to mitigate.

The UK and Switzerland are in comparable positions in several respects – most notably, a shared regulatory and legislative freedom tempered by the need to maintain trade and innovation routes with the European Union. These commonalities provided the backdrop for a productive GEM that focused on overcoming shared challenges and leveraging the opportunity to build innovation-focused collaborations.

Two particular initiatives highlight the opportunities that should be further explored for their potential to accelerate UK innovation. The KNOVA innovation platform model offers broad sector-agnostic potential to help improve the discoverability of innovation partnerships and strengthen the connections between academia and industry. The NEST facility offers a more specific opportunity to leverage existing research into construction innovation and replicate or extend similar research and test capabilities to the UK – through new facilities or existing locations with research efforts underway.

Overall, the key recommendation is to build on the initial success of the GEM with the development of further programmes to explore more specific opportunities to connect businesses and academic research initiatives, with a view to establishing bilateral innovation and trade partnerships. In light of the pace of development in AI and the chance to coordinate policy, standards, and best practices, a timely follow-up would be most effective to capitalise on the opportunities discovered.

## 09. Annex 1 – List of UK Participants

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### Electronic Media Services Ltd.

[www.ems-uk.com](http://www.ems-uk.com)

EMS develops cloud-managed 5G SD-WAN and Edge AI Computing appliances. Its OptiBond® SD-WAN software combines multiple data connections to provide a secure, reliable data connection at remote or temporary locations. Its OptiEdge.AI™ platform provides ultra-low latency for real-time digital twins, IoT, smart city and construction applications, ensuring real-time actionable insights, especially where the data connection from the edge to the cloud is slow or unreliable.

The company's solutions are used in the construction, events, transport and logistics, outside broadcast and retail sectors, local government, and emergency services. Customers in the UK include DHL, CRH Tarmac, Warwickshire Council and Humberside Police.

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### Department for Business & Trade

[www.gov.uk/government/organisations/department-for-business-and-trade](http://www.gov.uk/government/organisations/department-for-business-and-trade)

The Department for Business & Trade is the Department responsible for the UK's trade policy and supporting international trade and investment links, as well as the productivity and international competitiveness of business sectors, including construction. In relation to the infrastructure and construction sectors, in 2018 the Department works to support the adoption of digital and offsite manufacturing technologies, including AI applications, as well as strengthening the system that supports skills development in the industry and reforming payment practices.

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### KOPE

[www.kope.ai](http://www.kope.ai)

We are KOPE and we are dedicated to revolutionising how we design and construct the built environment. Technology has the power to transform the way we create our world in a more equitable, more effective, and more environmentally sound way. Combining deep knowledge of industry practices with new technologies, we are revolutionising the way people work in Offsite Construction.

Our key focus is KOPE Construct, our Product Application Platform enabling offsite construction through the instant exploration and integration of prefabricated products and systems directly within construction projects.

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### Digital Catapult

[www.digicatapult.org.uk](http://www.digicatapult.org.uk)

Digital Catapult is a partially-government-funded not-for-profit company whose mission is to accelerate the adoption of advanced digital technologies in the UK, for its benefit. It is a leading UK authority on such technologies, and is working with a range of businesses, from hundreds of startups to the largest UK firms. It is a part of the UK's Catapult Network, a government-established group of nine companies covering a range of advanced technology areas.

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Innovation Lead – Bridge AI

Innovate UK drives productivity and economic growth by supporting businesses to develop and realise the potential of new ideas.

We connect businesses to the partners, customers and investors that can help them turn ideas into commercially successful products and services and business growth.

We fund business and research collaborations to accelerate innovation and drive business investment into R&D. Our support is available to businesses across all economic sectors, value chains and UK regions.

Innovate UK is part of UK Research and Innovation.

**For more information visit [ukri.org/councils/innovate-uk/](https://ukri.org/councils/innovate-uk/)**

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