We are Visual Sweden

The importance of visualization and image analysis in a changing world.

This is an impact report on the technology areas visualization and image analysis in Sweden. This report is assembled by the organization **Visual Sweden.**

For all of Sweden, with all of Sweden

Sweden's strengths in visualization and image analysis come from a combination of a strong academic foundation, innovative companies, extensive support from the government and a climate that promotes research and entrepreneurship. These factors work together to place Sweden in a leading position globally in these technological areas. Applications for the techniques are found throughout society.

About the report
This report is divided into two parts. The first part provides a broad overview of the technological fields of visualization and image analysis across Sweden. In the second part, you will be introduced to the organization Visual Sweden and learn about our efforts to drive innovation and promote development.

Societal Challenges

Visualization and image analysis play a crucial role in addressing societal challenges by providing clear insights and enabling data-driven decisions for complex issues.

Strong Innovation Ecosystem

The Swedish innovation ecosystem in visualization and image analysis is renowned for its cutting-edge technologies, fostering a dynamic environment that drives advancements in diverse fields such as healthcare, security, and urban planning.

Possibilities for all of society

Solutions within visualization and image analysis are game changers within organizations like the police, education and health care.

Groundbreaking Companies

Many of the global companies driving innovation worldwide started right here in Sweden. For example:

tobii · K. · metria · AXIS COMMUNICATIONS · ContextVision

World changing innovations

Sweden is home to groundbreaking innovations like Sectra's medical imaging systems, Volvo's driver assistance technology, CellaVision's AI blood analysis, Autoliv's night vision for vehicles, and NVIDIA's advancements in 3D rendering.

The Visual Everyday Life

Visualization and image analysis are technologies we encounter daily, often without even realizing it. Try and considered what life would be like without them, quite different right?

06:30
The alarm goes off and you unlock your phone with face ID.

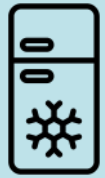
06:40
After some snoozing you use voice recognition to ask Alexa for some uplifting music.

07:45
Drive the fastest route to work using the car's GPS.

08:30
At work, you code side by side with your colleague via video calls.

11.45
You track the lunchtime walk in your health app and can see the number of steps and your heart rate on the screen.

16:30
When you pick up the kids from school, you play a game of VR headset.



18:00
Your smart fridge gives you a suggestion for dinner based on the ingredients inside

20.30
You are relaxing on the couch in front of the latest Netflix hit.

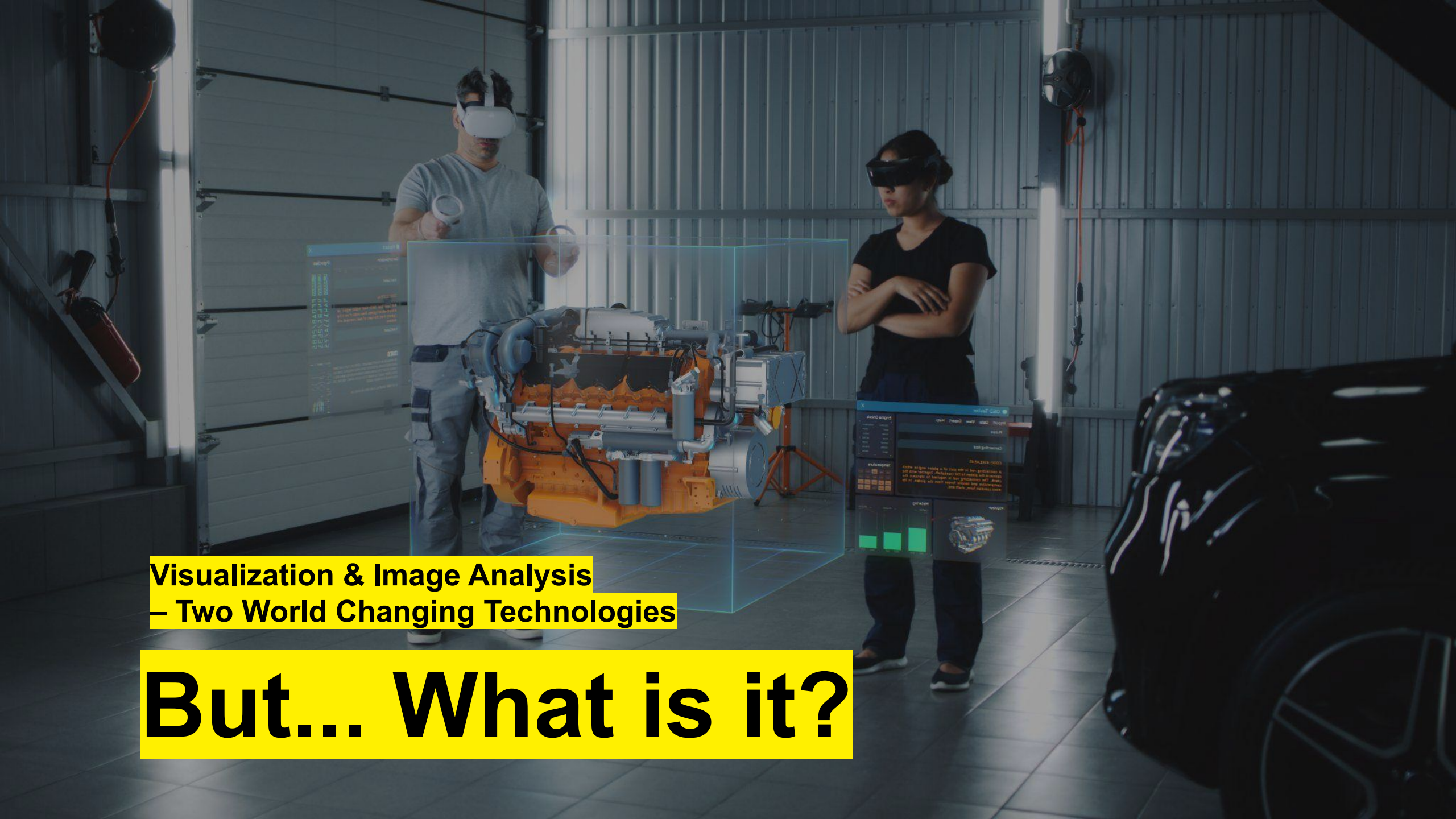
00:42
The home alarm sends a notification that something has been seen in the camera outside the house.

But luckily, it was only a fox.

“Linköping University has been a leading player in the field of image and video compression since the 1980s. This includes digital coding of X-ray images as well as the early steps towards the MPEG standards for digital TV. The knowledge leveraged from these applications has spurred the development of dedicated vision chips, fast algorithms, and user-friendly medical applications, which are at the core of several of our spin-off companies.”

Sweden needs to keep investing in visualization and image analysis!

Robert Forchheimer
Professor of Image Coding at Linköping University in Sweden. Co-founder of Sectra.



Visualization & Image Analysis
– Two World Changing Technologies

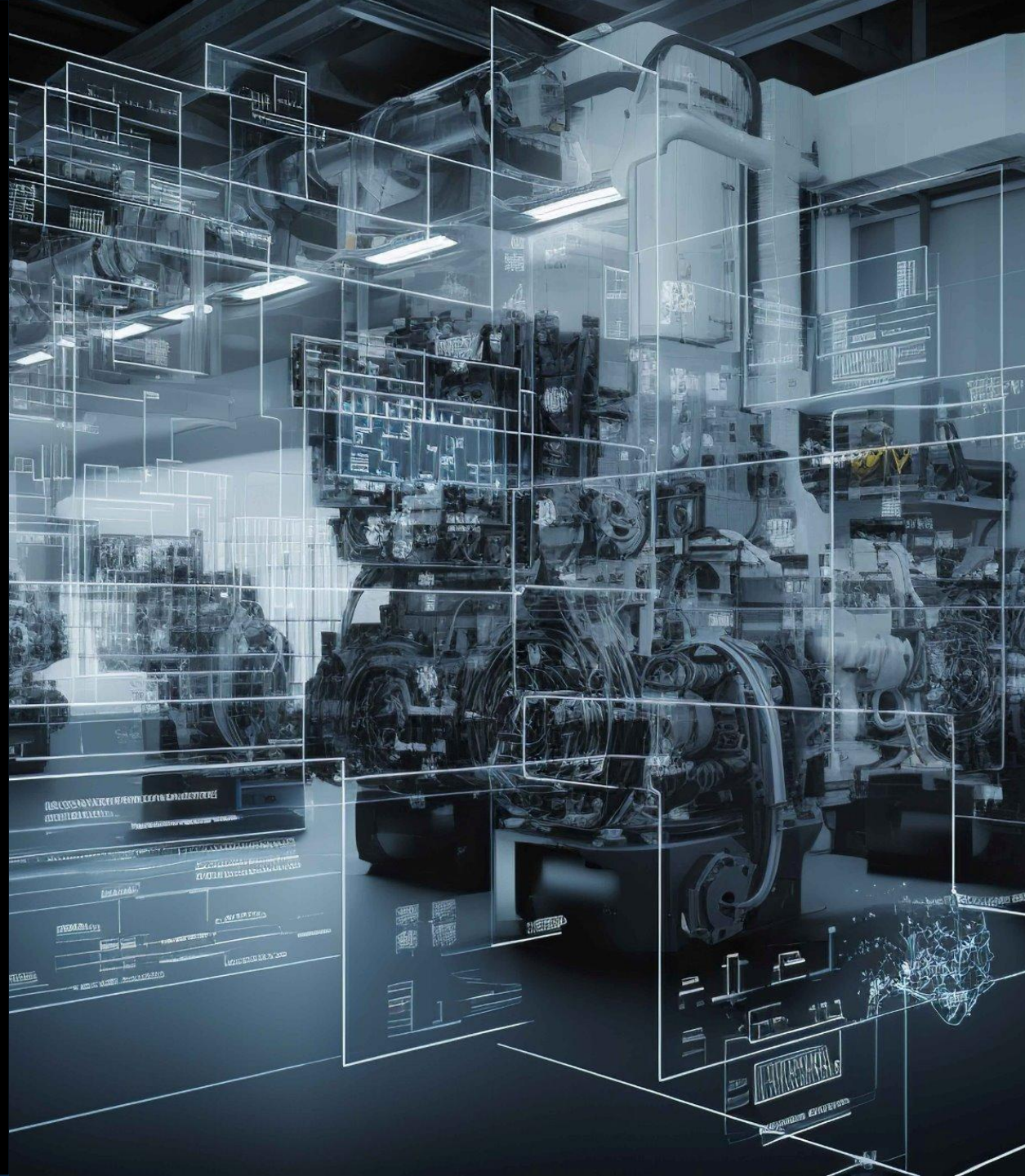
But... What is it?

...Visualization...

...is the process of representing data or information in a visual format, such as charts, graphs, maps, or infographics, to make it easier to understand, analyze, and communicate insights. By translating complex data into a visual form, it becomes more accessible and interpretable, allowing for quicker decision-making and better comprehension.

Common applications:

- Business Intelligence - Visualizing KPIs and financial data for strategic decision-making.
- Healthcare - Displaying patient data, trends, and epidemiological information to improve outcomes.
- Scientific Research - Visualizing experimental data to uncover patterns, correlations, and insights in various fields like physics, biology, and environmental studie



...Image Analysis...

is the process of examining and interpreting images to extract meaningful information and insights. This involves techniques such as pattern recognition, object detection, and image segmentation, which help in understanding and quantifying visual data. By analyzing images, it is possible to automate tasks, identify trends, and make informed decisions based on visual inputs.

Common applications:

- Medical Imaging - Analyzing X-rays, MRIs, and CT scans to detect abnormalities, diagnose diseases, and guide treatment plans.
- Surveillance and Security - Monitoring and analyzing video footage to detect suspicious activities, identify individuals, and enhance security measures.
- Remote Sensing - Interpreting satellite and aerial images for environmental monitoring, urban planning, and disaster management.

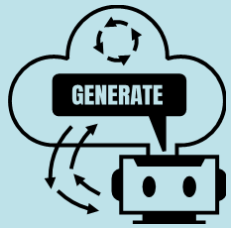
A Highway to the Future!

Visualization and Image Analysis are important keys to the development and understanding of other technological areas.

AI driven workflows

Distributed systems and connectivity

Human in the Loop technologies



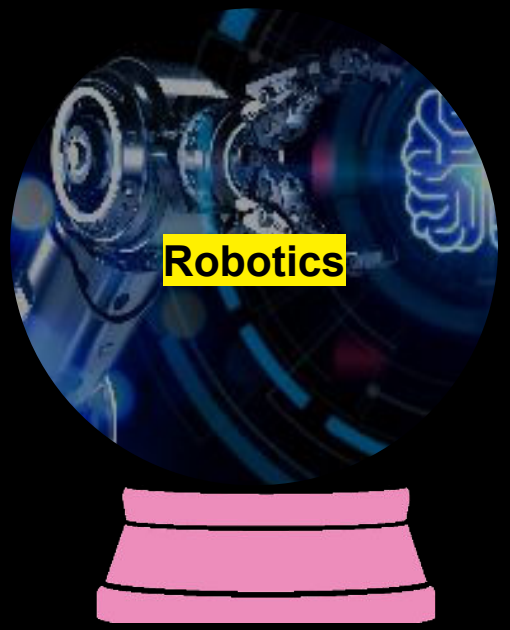
Generative AI

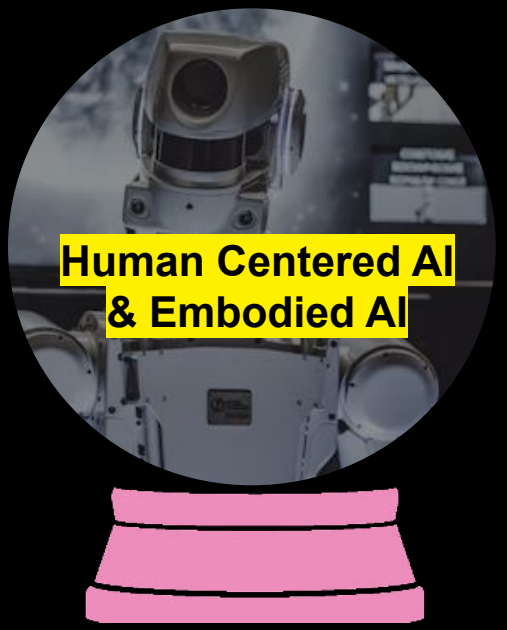
Data

Sensors

Looking into the Future

Visualization and image analysis are also crucial for other technological fields.
Here are some key areas where we anticipate their growing significance.





“We see that people are increasingly working with processes instead of inside processes”

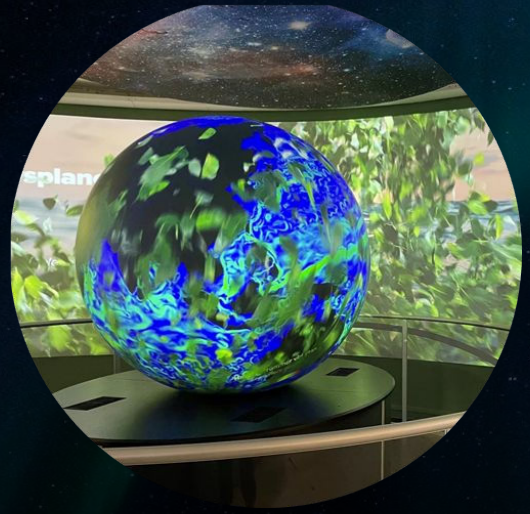
Kristofer Skyttner
CEO & Founder at SkyMaker

”The role of paid work is rapidly changing. We see that people are increasingly working with processes instead of inside processes. Performing repetitive or rule driven tasks are handled by technology in the modern workforce. And the level of complexity that technology can solve is improving fast.

Since we still need people to build and manage these processes we constantly need to improve our tools so we can monitor, analyze and control the world around us. That's why visualization and advanced analytical methods of our surroundings are critical to ensure that we can tackle the ever increasing complexity of the world.”

The Challenges of our time

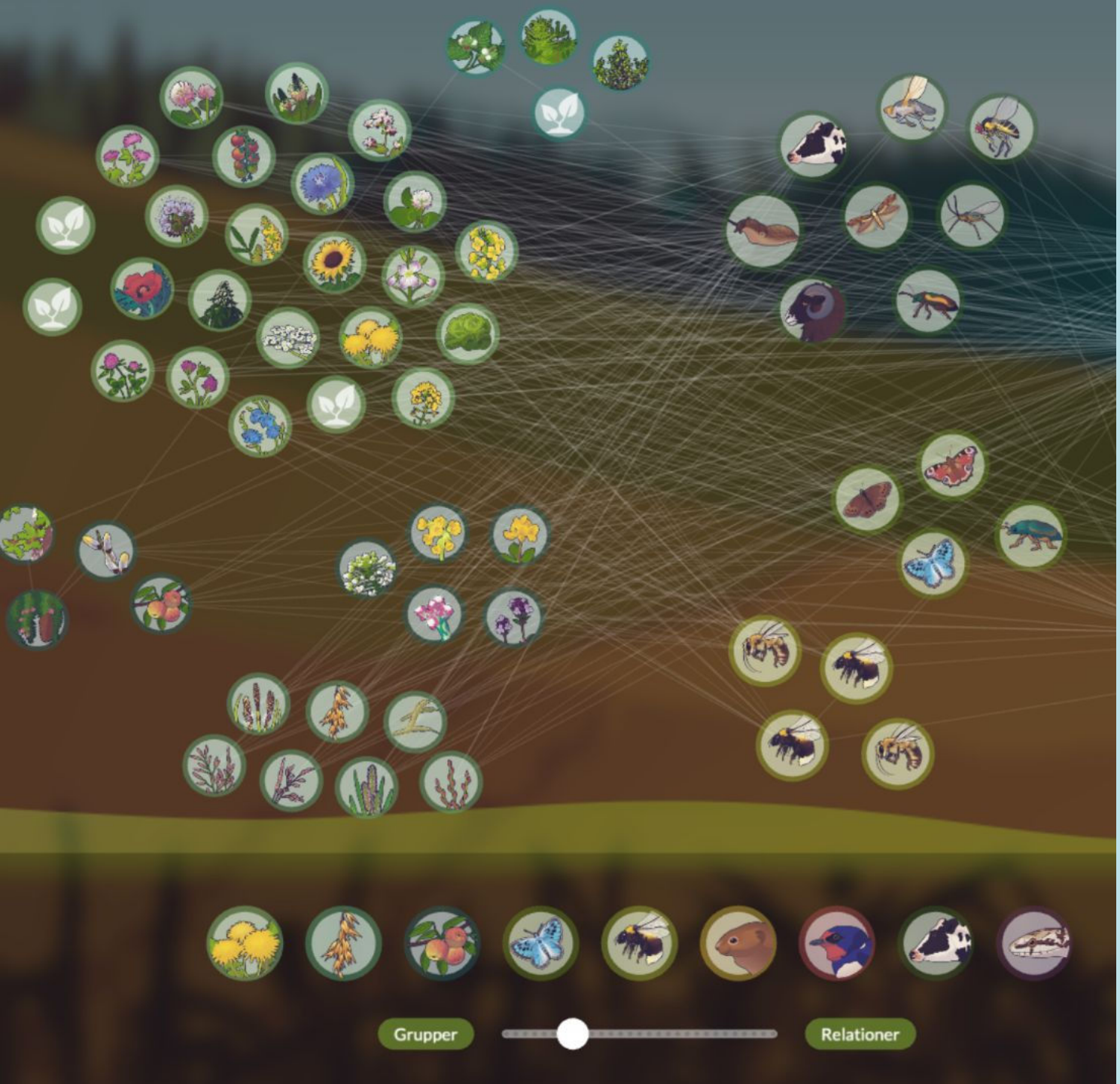
Solutions in visualization and image analysis have the potential to make a significant impact on sustainability challenges such as climate change, social vulnerability, and security issues.



Interactive Visualization of Biodiversity
Biodiversity visualized in an easy-to-understand way using an interactive globe at Skansen.

Smart Forest through Digital Twins
Smart twins for forest environments help forest owners with decision making.

Social Inclusion and Children's health
Interactive Playground with the ability to play remote from the hospital.



Visualization for Sustainability

”Interactive visualizations are powerful tools for sparking engaging discussions on societal challenges such as biodiversity loss.”

Anna Eklöf
Professor in Theoretical Biology at Linköping University & creator of EcoWeb, a game that teaches kids about biodiversity.


Three Perspectives on Why Sweden Needs to Invest in Visualization and Image Analysis – Now.

"Visualization of scientific data is a tool for explaining the world, but also a tool for changing it. “

Monica Billger
Professor in Architecure and Visualization
Chalmers University of Technology

"Visualization of scientific data is a tool for explaining the world, but also a tool for changing it. Through data visualization, inspiration for research, innovation, collaboration, and sustainable development in Sweden is created. Increased resources for visualization in Sweden are needed to make complex research results accessible to different audiences and to enhance understanding of both the challenges and opportunities we face."

“Sweden is playing a fundamental role in the development of advanced digital technologies and solutions that will underpin digital innovation and ongoing transformation of industries and society at large. Advanced technologies including AI, visualization, image analysis and other emerging technologies are all playing a role in designing solutions and opportunities that meet future social and business challenges. These technologies are taking the world into unchartered waters with digitalization and infrastructure transformation shaping industry and society and the way people live and work.”

Alexander Morrone
Program Manager Digital Technologies – AI & Data Analytics at Business Sweden

More accurate diagnoses and treatment decisions

Mattias Bergbom
Vice President of Products & Services,
Sectra Orthopaedics AB

”Continued investment in visualization and image analysis gives us an opportunity to “industrialize” healthcare disciplines reliant on medical imaging, by automating repetitive tasks as well as helping uncover important patterns in the data, leading to more accurate diagnoses and treatment decisions. Ultimately this will help doctors treat more patients at lower cost, which will be crucial as the population ages.”

From Vision to Reality

Technological progress is fast,
but achieving greatness takes time. Let’s look at some examples.

CMIV: A Decade of Expansion and Innovation

An example of how the area of visualisation and image analysis has grown in the Norrköping-Linköping region is the Center for Medical Image Science and Visualization. It is a research center at Linköping University in Sweden, focused on medical imaging and visualization. Established in 2002, CMIV serves as an interdisciplinary platform where researchers from medicine, engineering, and computer science collaborate.

Revenue, Researchers and Doctoral students from 2013-2023

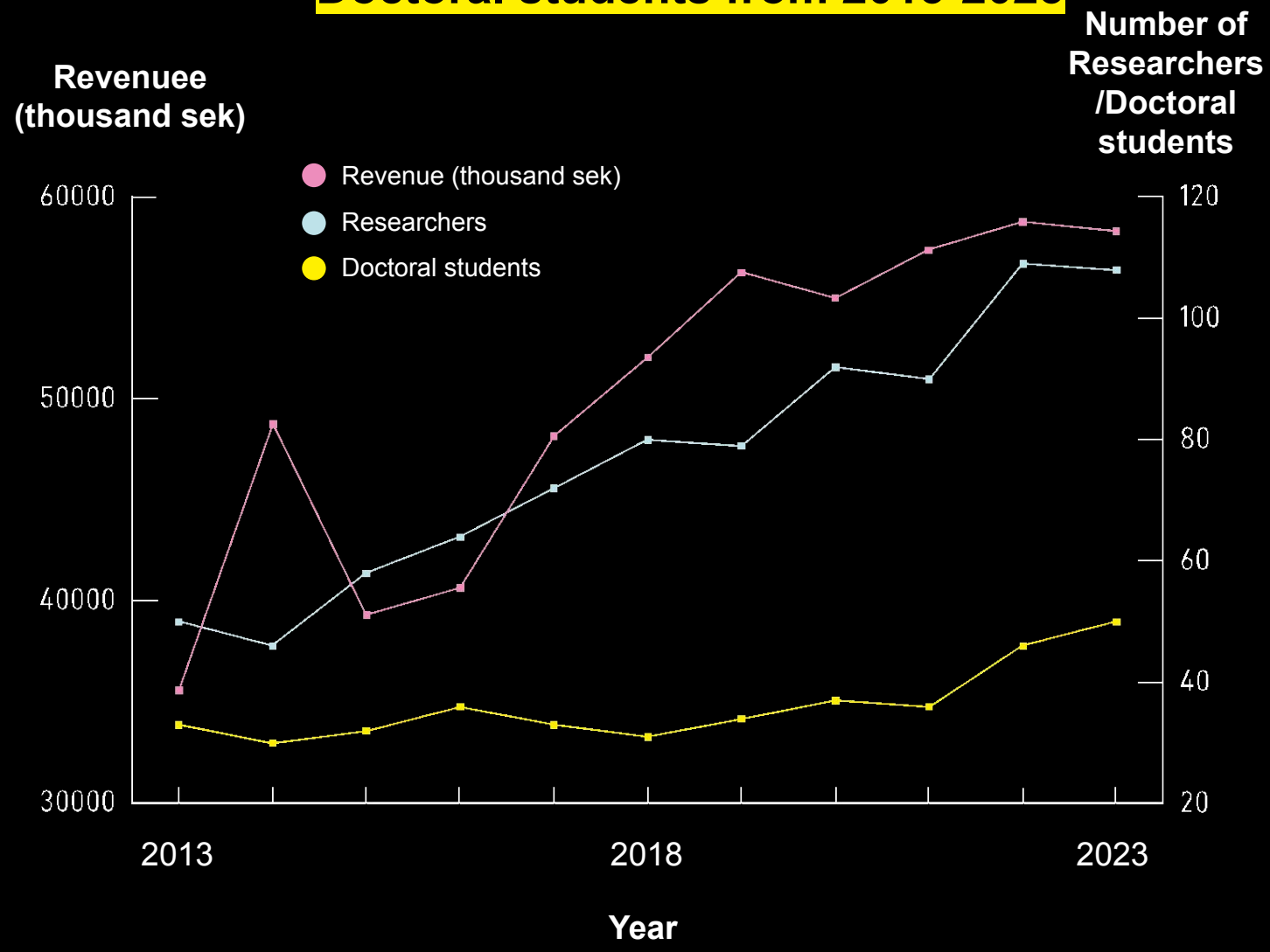


Image Analysis: Past, Present, and Future...

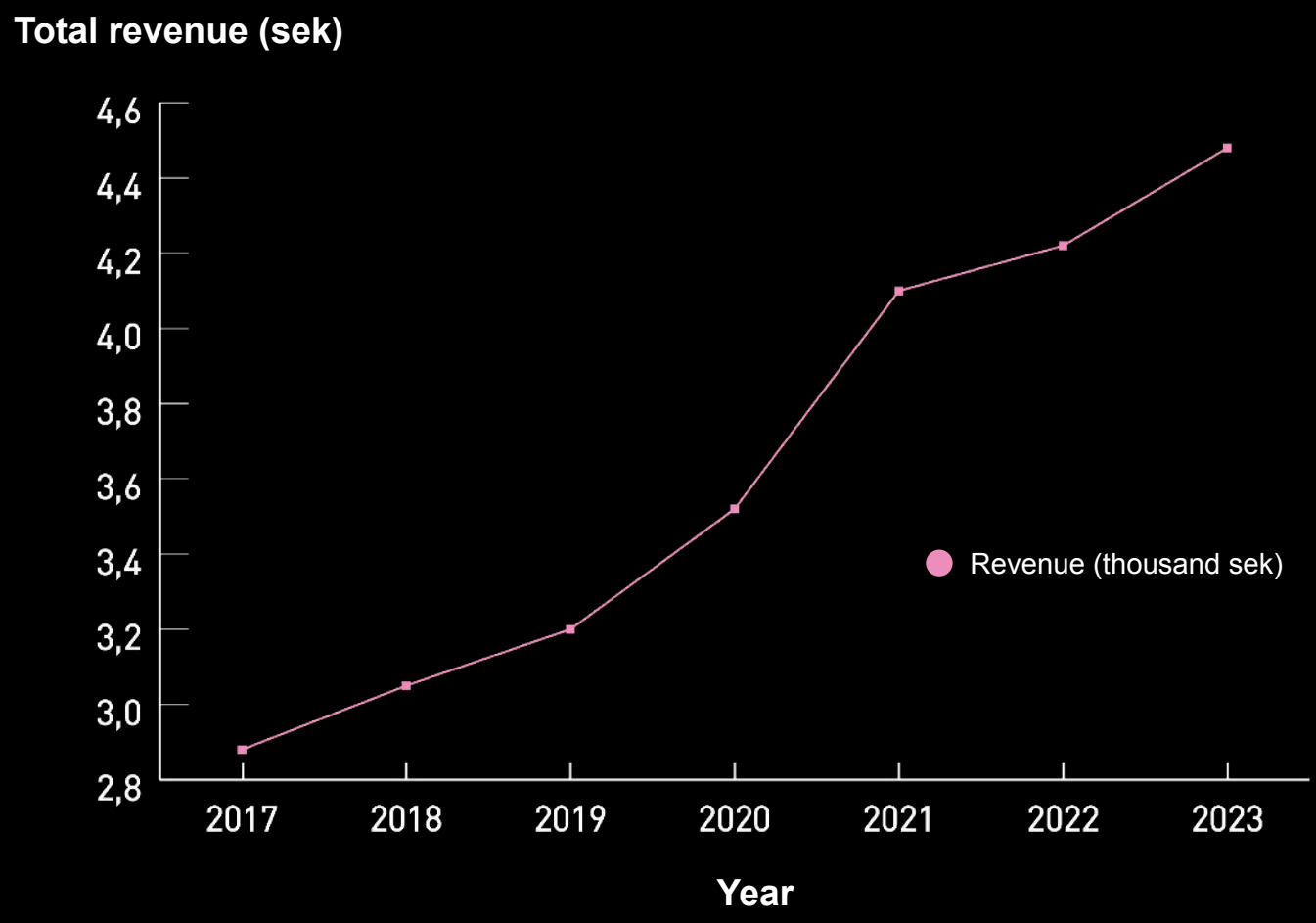
The increasing number of companies within Image Analysis in the Linköping/Norrköping region

Revenue Development

for MIT and Computer Vision at Linköping University

The **Computer Vision Laboratory (CVL)** at Linköping University focuses on artificial vision systems, including object detection, tracking, and 3D vision, often applied in AI and robotics. The **Media and Information Technology (MIT)** division emphasizes visualization and human-computer interaction, collaborating with the Norrköping Visualization Center C on cutting-edge visualization research.

Revenue Development from 2017 to 2023



Visible Business

Swedish companies make Sweden a force to be reckoned with - all over the world

Extended Reality (XR) is the interface to a new digital reality, driven by AI, connected via 5G/6G, and made interactive with IoT and robotics. The Games Industry has led XR's development, driving technical progress and creating interactive metaverse environments. Now, XR is expanding into industry 4.0, where VR, AR, and digital twins will enhance worker capabilities. Meta, formerly Facebook, is investing heavily in the metaverse, with VR and AR expected to become key tools for accessing virtual worlds, building connections, conducting commerce, and enabling decentralized business and smart contracts.

Traditionally Sweden has been prominent in the analysis of image content, yet with the growth of the games industry, Sweden has also become very strong in the process of generating image content. In the past 20-30 years Sweden has risen to be one of the world leaders in visualization, with the cluster in Linköping-Norrköping announced as Europe’s most attractive innovation environment for visualization and image analysis. Norrköping hosts the dome theater Visualization Centre C,the most technically advanced in Northern Europe.

Making Sweden visible through XR

Source: Business Sweden

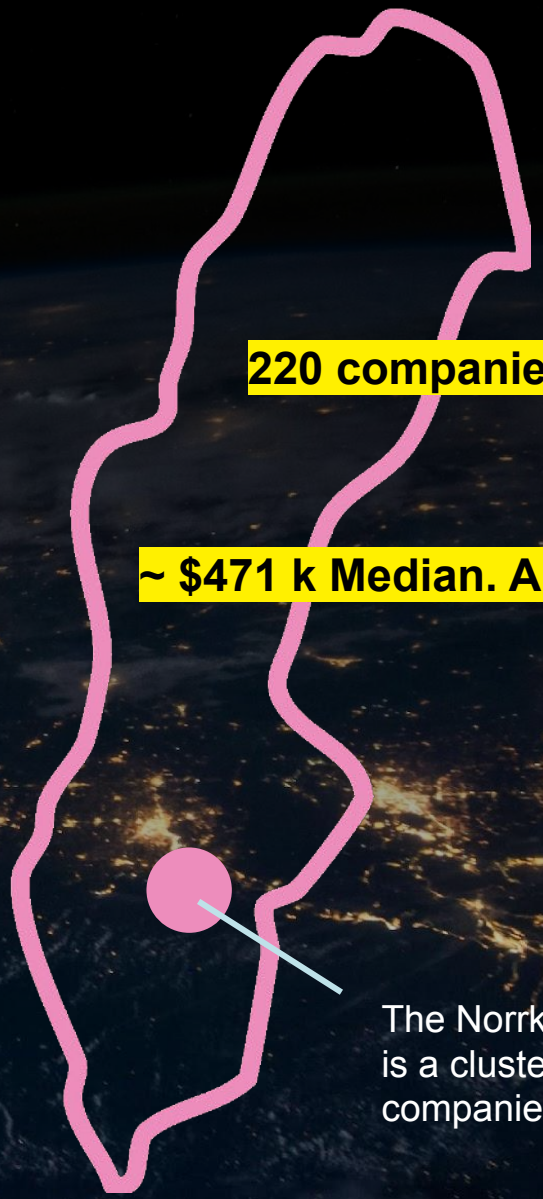
XR in Sweden

220 companies active in XR technology, supported by +30 Science Parks and Incubators.

Outside of gaming and entertainment, the most beneficial use cases of XR technology are seen as; healthcare, education, manufacturing and marketing.

9 out 10 XR-companies are planning to recruit within the next 18 months, with 65% actively searching for talent outside of Sweden.

The Swedish games industry is reaching new heights at EUR 3.3 billion in turnover. This is on par with national wood export levels.



220 companies in Sweden

~ $471 k Median. Annual turnover

The Norrköping-Linköping area is a cluster for research and companies within the area.

Leif Haglund
Strategic Advisor at MAXAR

“The region around Visual Sweden is one of the top places in the world to be situated in for our company.”

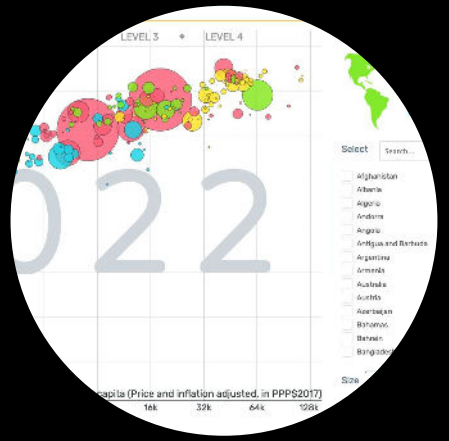
“The competences in computer vision, image processing and visualization is major factors for the success of Maxar International Sweden AB. The collaboration with the university, with respect both to the engineering education and the world leading research are major factors for the continuous company development, which the US management also understands and appreciates. In principal the region around Visual Sweden is one of the top places in the world to be situated in for our company.”

Made in Sweden

Sweden has a very strong culture of innovation, particularly in the fields of visualization and image analysis. The innovations span many areas, and examples of these can be found here.

In Linköping, the world's most widely used digital algorithm for moving images, **MPEG**, has been developed and perfected. The algorithm is used today by digital TV, streaming TV, video conferences, mobile phones, and other applications.

The world’s first **virtual autopsy table** is one of the many research results from Linköping University. While a tradition of autopsy can take several days, the virtual equivalent takes only 20 seconds and serves as an excellent complement.



Gapminder was founded in Stockholm by Ola Rosling, Anna Rosling Rönnlund, and Hans Rosliing. In 2006, Hans gave his first TED talk, called, ”The best statistics you’ve ever seen”. It became one of the most watched TED talks ever. Since it’s founding, Gapminder has developed several innovative data visualizations.

The home of groundbreaking research

At the forefront of research

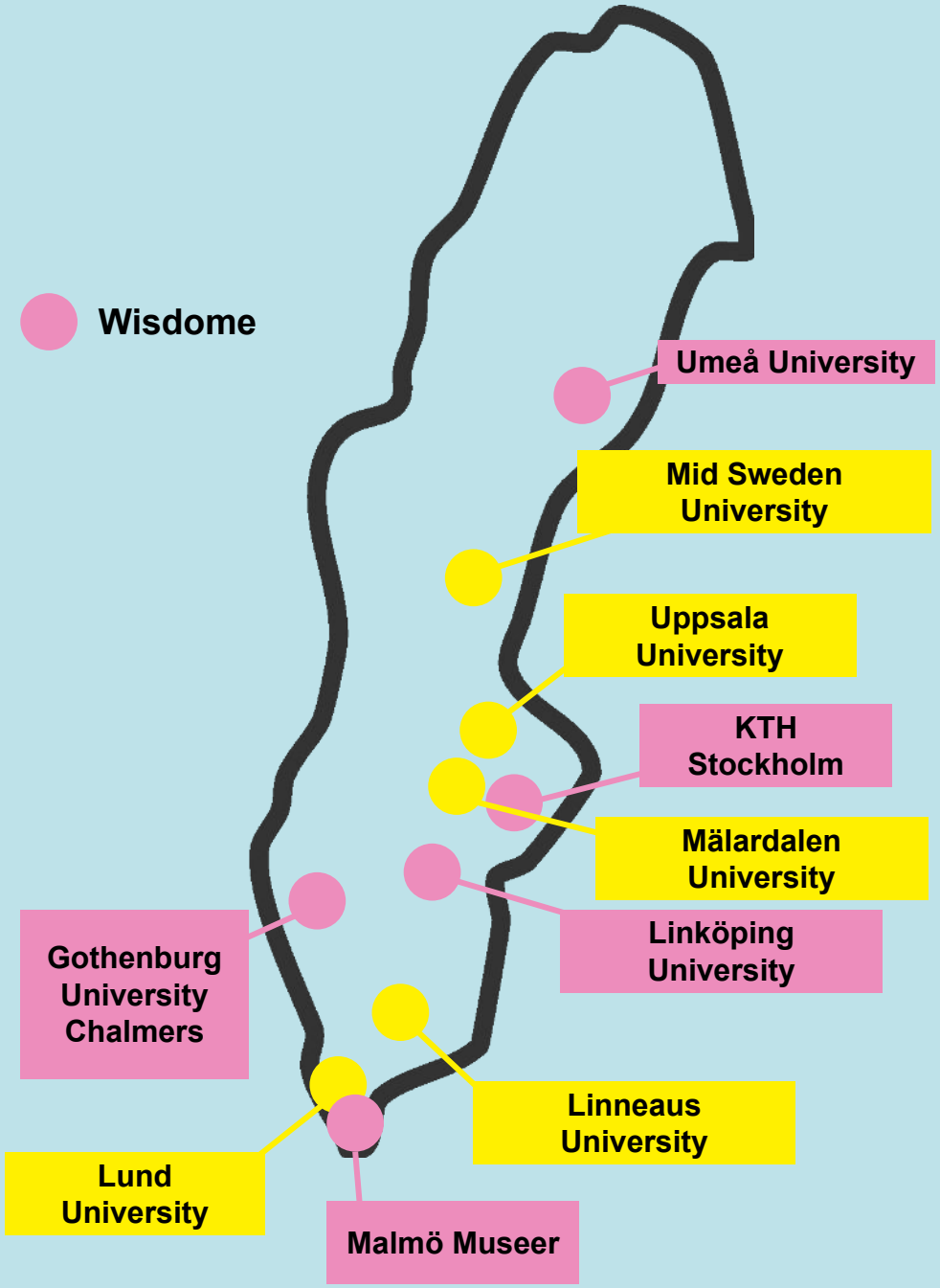
Research on visualization and image analysis in Sweden is extensive and diverse, conducted at several leading universities and research institutes. Meet some of the key actors:

KTH has several research groups that are leaders in visualization and image analysis, particularly in medical imaging, computer vision, and interactive visualization. Their focus includes applications in medicine, industry, and autonomous systems.

LiU hosts strong research environments in medical image analysis and visualization, particularly at their Center for Medical Image Science and Visualization (CMIV). They are known for their work in advanced image analysis and volume visualization.

Research here focuses on applications in medicine and biology, including microscopy and medical image analysis.

Sweden has several national research programs and initiatives that support research in visualization and image analysis, such as WASP (Wallenberg AI, Autonomous Systems and Software Program), which is one of Europe's largest research programs in AI and autonomous systems.



And there are more

Sweden hosts world-class research sites for visualization and image analysis, including Visualiseringscenter C in Norrköping and Linköping University. These facilities drive innovation in fields such as medical imaging, virtual environments, and scientific visualization.

Wisdome began in 2017 with support from the Knut and Alice Wallenberg Foundation to inspire young Swedes in technology and science. Wisdome connects five science centers.

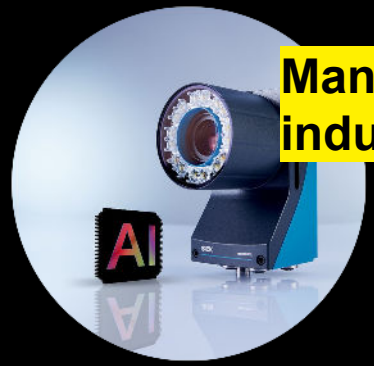
Some of the largest areas within swedish visualization and image analysis research:

Medicine

Farming

Education

Forest



Manufacturing industry

Smart City

The People Driving Innovation Forward:

Four Perspectives from the Research Community

Johanna Björklund
Associate professor at the Department for Computer Science, Umeå University, Founder of Adlede

Better support in complex decision making

“By integrating neural methods with graph-based computation, we aim to develop data-driven approaches to media processing that combines the strengths of machine learning with the transparency of rule-based systems. If successful, this effort will enhance the planning and reasoning capabilities of AI systems, allowing them to better support humans in complex decision making.”

Pushing the boundaries of what is possible

"Visual computing lies at the intersection of computer graphics, vision and visualization. Building new models of and computational methods for the visual world plays a key role the development of photo-realistic image synthesis, sensor simulation for visual AI and machine learning, image analysis, and data visualization, pushing the boundaries of what is possible."

Jonas Unger
Professor within Media and Information Technology, Linköping University

Promote transparancy and strengthen democracy!

Miriah Meyer
Professor in the Department of Science & Technology at Linköping University

”My research is about understanding and developing the process to visualizing data. This is crucial for Sweden as it enables insights that can enhance societal decisions and policies. By presenting data in a fair and clear manner, we can identify and address inequalities, promote transparency, and strengthen democracy. Equal data visualization ensures that all societal groups have a voice and that decisions are based on an accurate and inclusive picture of reality. We need to be aware of how we work with data in everything from collection, to interpretation, and visualization. This contributes to a more just and sustainable society where everyone can benefit from progress and development.”

Sweden is playing a leading role

“Our research on Trustworthy AI, including leading the European Network of Research Excellence TAILOR and the EU project TrustLLM developing trustworthy and factual language models, shows the competence at LiU and the trust placed in us by others. This means that Sweden is playing a leading role in developing the technical foundations for achieving the European vision of human-centered trustworthy AI.”

Fredrik Heintz
Professor in the Department of Computer and Information Science (IDA) at Linköping University

Re-shaping the Public Sector

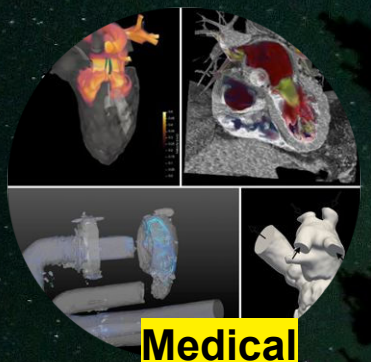
A Visual Sweden for All of Sweden

Visualization and image analysis are on the verge of revolutionizing the public sector in Sweden.

In medicine, advanced image analysis enables the early detection of diseases and more precise treatments, improving the quality of care. In the justice system, the technology is used not only to analyze evidence and monitor security but also to spark curiosity and educate children and young people. Additionally, autonomous air transport is becoming a reality, where image analysis plays a crucial role in navigation and safety. Moving forward, these technologies will be even more integrated, creating a smarter, more sustainable, and secure public sector.

Solving murders with game engines

Autonomous assistant in traffic planning



Medical Digital Twin

The Swedish National Police Authority benefits greatly from visualization in its work to solve crimes. Lena Klasén, Research Director at the Swedish National Police Authority and Adjunct Professor, Digital Forensics, LiU, says that, for example, they have introduced technology for 3D measurement of crime scenes for documentation, analysis, and visualization of large and complex crime scenes, of which it may be difficult to get a clear overview for various reasons.

”3D models also make it possible to recreate and visualize the course of events. We’ve also participated in several projects for biometric identification and automated searches for persons, objects, or vehicles in large data volumes, tested virtual witness visits to crime scenes, and tested hyperspectral sensors for detection of different types of traces at crime scenes.”

Lena Klasén
Research Director at The Office of the Police Comissioner, Swedish Police Authority &
Adjunct Professor at Linköping University

“Visualization and image analysis are critical in medicine for diagnosing, monitoring, and treating diseases.”

Tino Ebbers
Professor of Physiological Measurement Technology at Linköping University

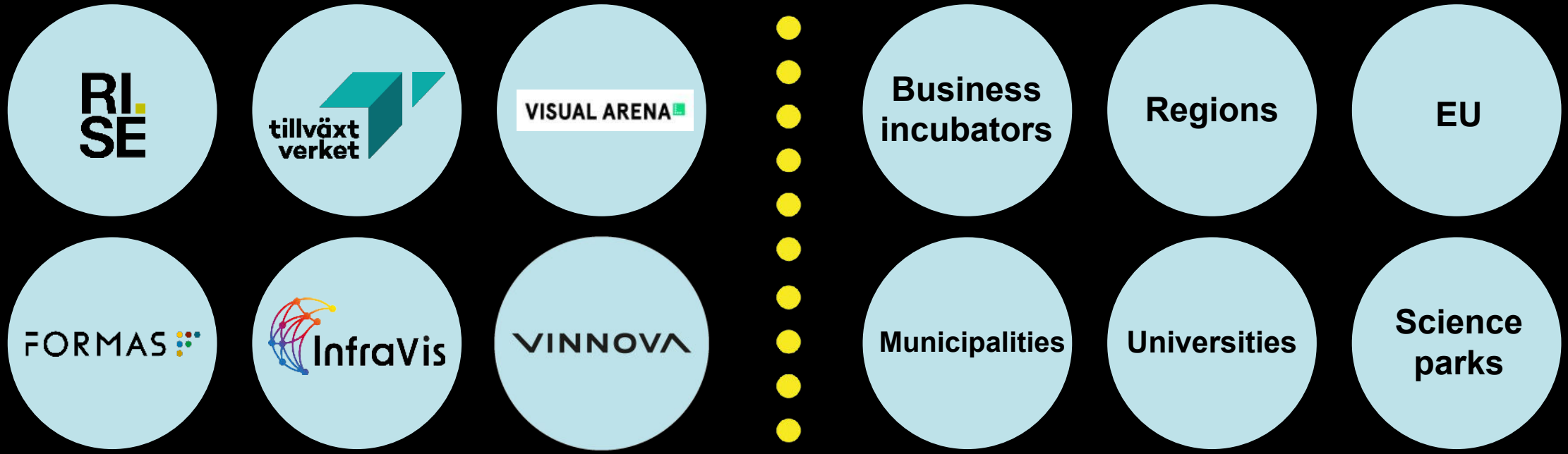
“Medical imaging technologies provide detailed information about the anatomy and functioning of the human body, revealing abnormalities such as tumors, fractures, or reduced functionality that physical exams cannot detect. Advances like digital twins and artificial intelligence enhance the quantification and interpretation of complex data, increasing the power of medical images.

These visual tools are crucial for early disease detection, improving the chances of successful treatment and better patient outcomes. They also enable monitoring and, combined with digital twins, prediction of disease progression or treatment response over time, offering critical insights for optimization of medical strategies. In surgery, these techniques aid in planning and guiding procedures, making them more effective. Visualization and image analysis are therefore indispensable for providing high-quality, precise, and efficient healthcare in the future.”

The Swedish Innovation Ecosystem

A unique Eco System

Sweden's innovation ecosystem excels in visualization and image analysis, driven by collaboration between academia, industry, and public institutions. Key hubs like KTH and Linköping University lead advancements in medical imaging, AI-driven analysis, and real-time data visualization. This focus on interdisciplinary cooperation and sustainability positions Sweden as a global leader in visual tech innovation.



Anna Bird
CEO Mälardalen Industrial Technology Center

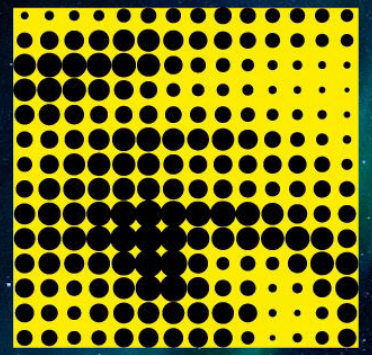
”Visualization and simulation are important tools for both large and small manufacturing companies. They offer opportunities for efficiency, savings, and sustainability. Our collaboration with Visual Sweden has given us a real boost in our simulation work!”

Transforming the workforce

”Visualization and image analysis transform workforce skills, requiring expertise in data visualization, AI, real-time processing, ethics, and continuous learning. But these technologies also simplify new employee onboarding. I am therefore looking forward of seeing how the workforce will transform and hopefully include a wider range of experience and competences in the future.”

Elin von der Lancken
Deputy CEO & Business Area Manager at Skill

Now you know a lot about the importance of Visualization and Image Analysis and their importance for all of Sweden. At the organization Visual Sweden we work to push and drive the development forward. And this is how. →



VISUAL SWEDEN

Europe’s most attractive innovation environment
for visualization and image analysis

How does Visual Sweden work?

Innovation Consultation

A network of 100+ Swedish expert companies

Top academic expertise

A broad network of public authorities and demand owners

Neutral Arena

Connection to students

Part of international networks

Spreading knowledge

Community Activities

VISUAL SWEDEN

Our offer

Assemble

Connects the industry and builds knowledge around visualization, simulation and image analysis

Share and spread

Make projects, results and affiliated organizations visible.

Collaborate

Collaborates with students, research, companies and public activities, regionally, nationally and internationally.

Stimulate

Arranges and supports events and other initiatives. Monitors and captures technology and market trends.

Strengthen

Monitors and captures opportunities for new projects, including international ones. Formalizes applications and builds consortia.

Support

Supports projects by bringing actors together and we contributing with funding.

Co-Act

We encourage initiatives in the field of visualization and image analysis. Stakeholders are encouraged to use the Visual Sweden brand.

VISUAL SWEDEN

10 years of Visual Sweden

Over the past 10 years, Visual Sweden has built a strong innovation environment through collaborations, projects, and events that have engaged companies and individuals to drive real change.

138
branch companies as our members

115
projects

160
newsletters

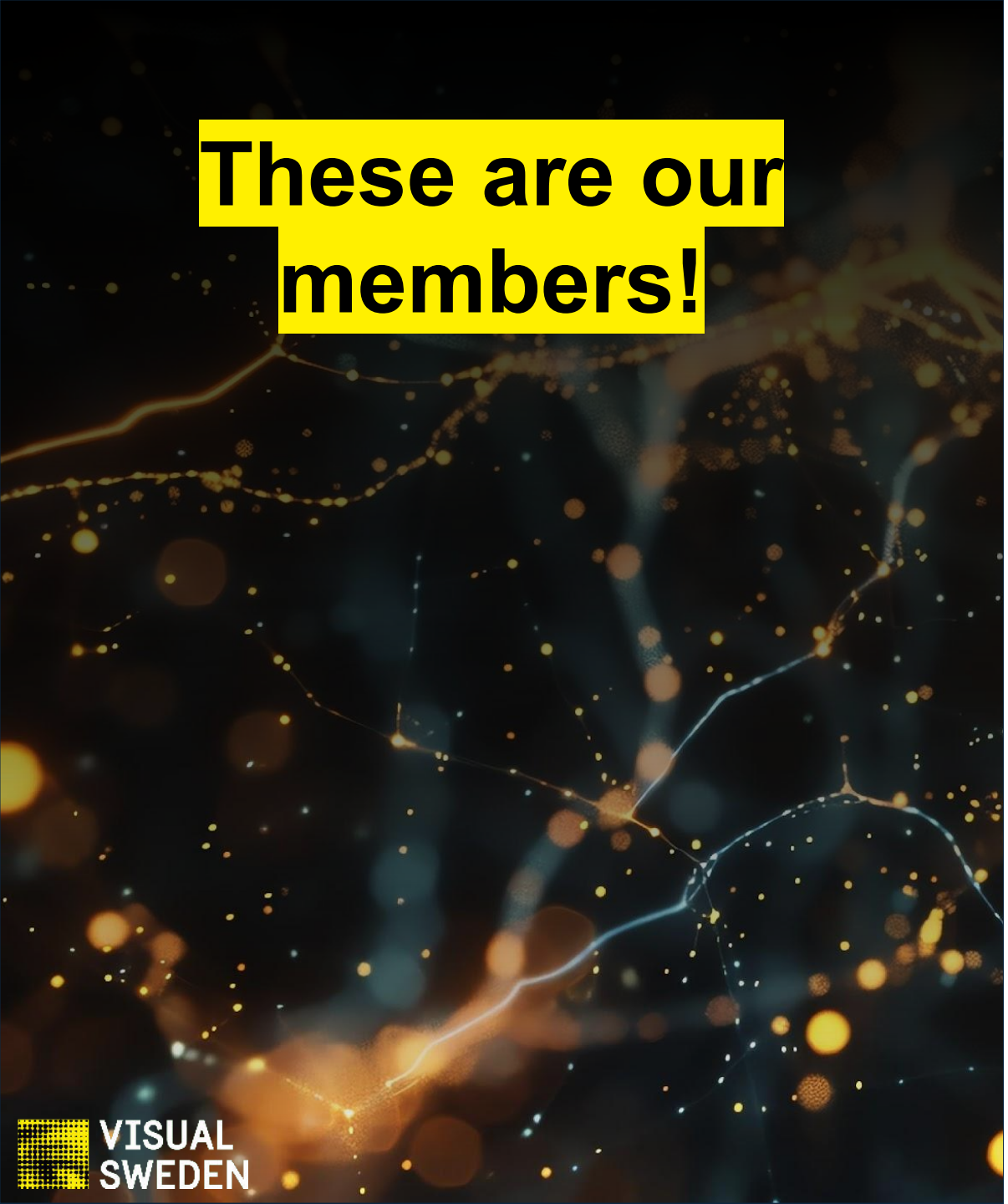
+1000
companies engaged

18 000h
participant hours

46
MSEK 2023 in project financing

VISUAL SWEDEN

These are our members!



VISUAL SWEDEN

Interspectral
DEVANT
FlatFrog
PRODELOX
AMRA
VISIARC
Flowtropolis
ContextVision
SECTRA
SICK
Sensor Intelligence.
Etteplan
Dyno Robotics
termisk
MAXAR
UNIVRSES
SkyMaker
Visage Technologies
AXIS COMMUNICATIONS

...and a hundred more

Visual Sweden board
led by Dan Jangblad

Process Management
led by Peter Westerdahl

Project partners

Växjö Linnæus Science Park
Örebro University
MITC
Norrköping Science Park
Linköping Science Park
Linköping University
Automation Region

Financiers

Region Östergötland
Co-funded by the European Union
VINNOVA
Linköping
Norrköping

The Visual Sweden organization

VISUAL SWEDEN

None of what we do would be possible without you. Together, we shape the future of innovation through collaboration between innovators, entrepreneurs, researchers, students, and the public sector.

Thank you for being part of our network, our drive, and our vision. And remember:

YOU are Visual Sweden

VISUAL SWEDEN