Insights into iSAM AG

Technology for autonomous goods handling

by Bernd Mann, CEO of iSAM AG

Hamburg, 14 December 2021

Capital Markets Day 2021

HHLA GATEWAY TO THE FUTURE

01

Introduction of iSAM

DNA and history of iSAM

Delivering tailored, end-to-end solutions for industrial process automation based on a modular system architecture

1983
- Founding of iSAM (formerly: iSAM Hellmich GmbH) by a group of 4 students

1993
- Integrating industrial PCs for advanced controls and process models

2002
- Change of legal form to “small AG” (“pvt. Limited”) to enable further growth

2020
- iSAM becomes part of the HHLA Group

Start-up → **PLCs** → **IPCs** → **3D autonomy** → **AG** → **STS** → **HHLA** → **Container**

1983
- Implementing the first digital control systems for industrial applications

2000
- First truly autonomous bulk handling systems using GPS and 3D LiDAR

2012
- First autonomous GSUs

2021
- First truly autonomous container crane working jointly with personnel in the railyard

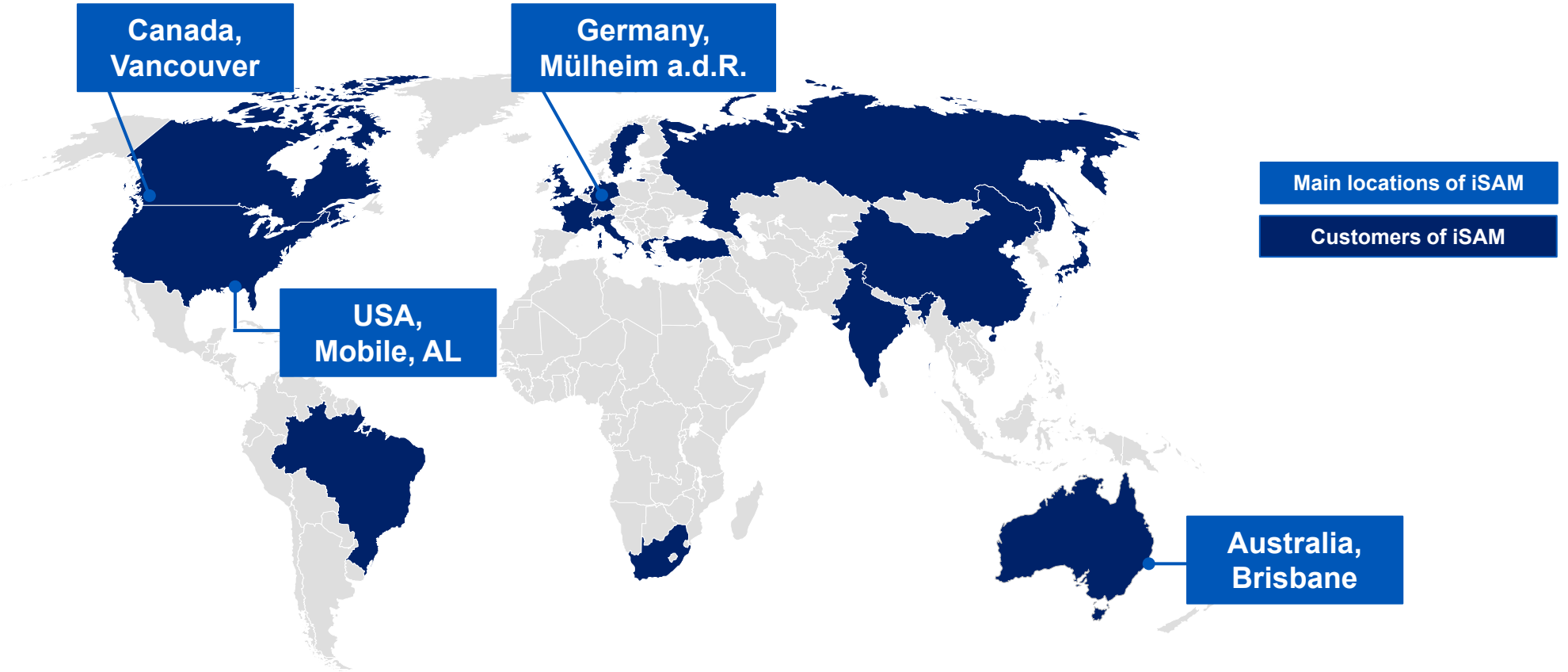
We continuously redefine what is possible in industrial automation by tackling previously unsolved problems and leveraging the latest technology for resilient, real-world applications.

Focus on automation for logistics, aviation and “old-school” industries

Companies all over the world benefiting from future-oriented solutions of iSAM automation technology

Interdisciplinary team of 60 employees
mostly

- Electrical engineers
- Software developers
- Project managers



Customers

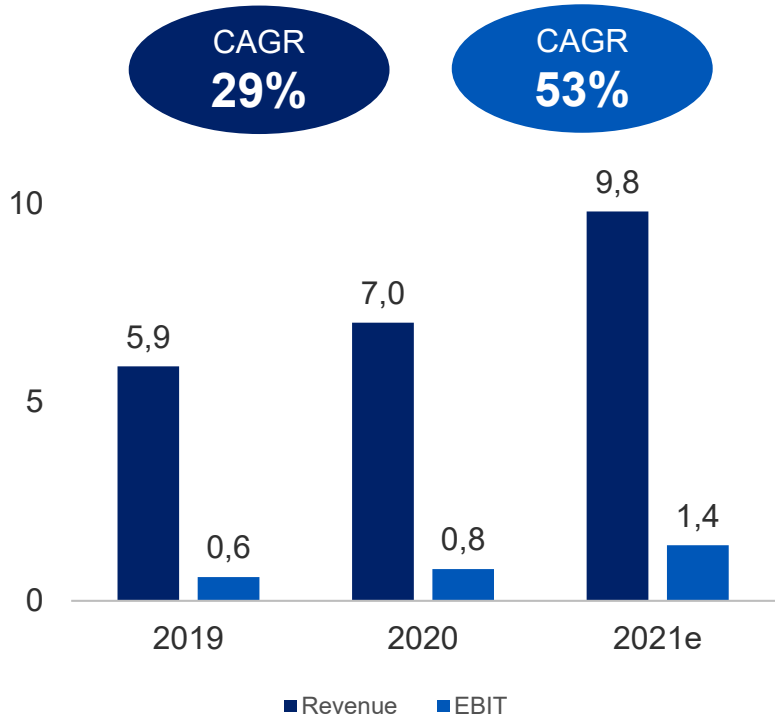
Ports and logistics	Mining	Heavy industry	Aerospace

Robust demand for remote and autonomous control systems despite COVID-19

Continuous growth of order intake, revenue and EBIT

Revenue and EBIT 2019 – 2021

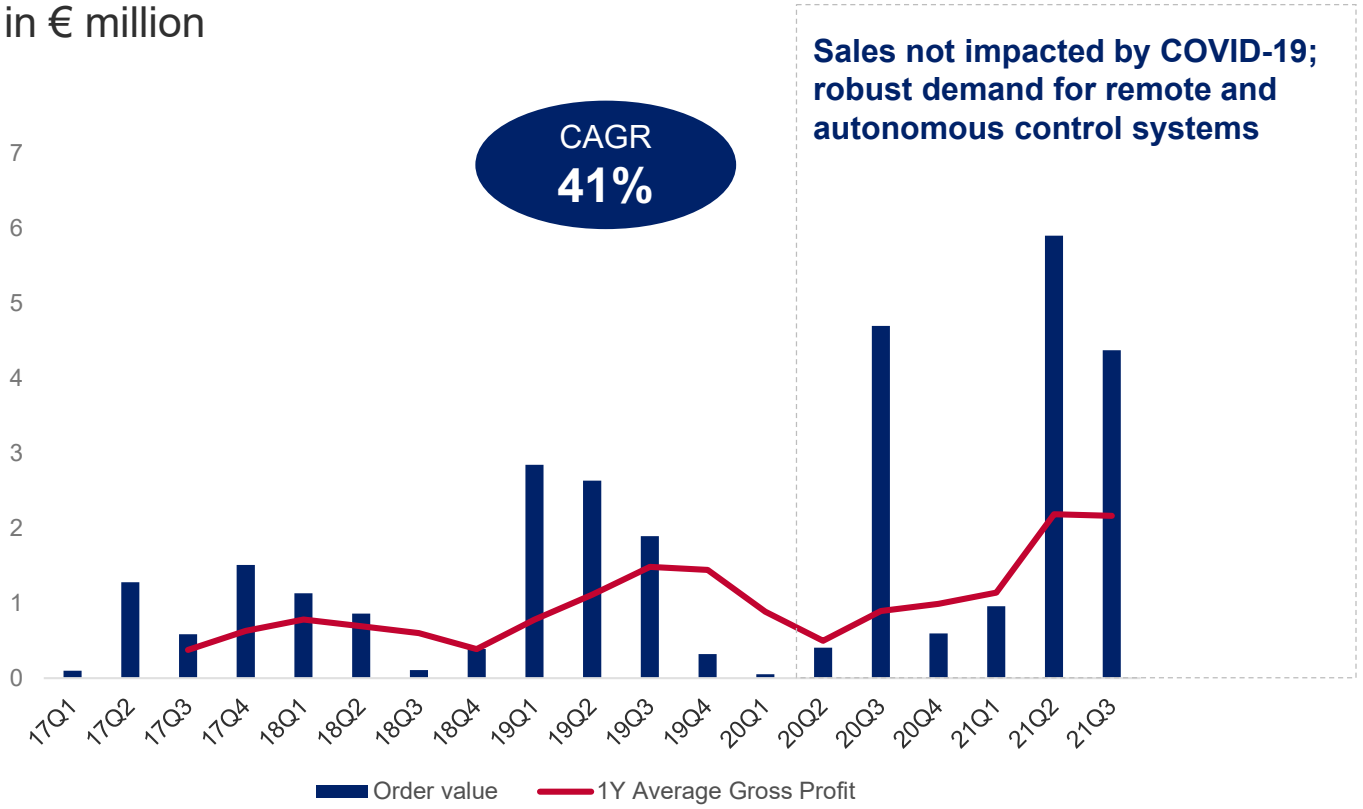
in € million



2019 – 2020: iSAM AG HGB balance sheet + GAAP EBIT of subsidiaries
2021: IFRS consolidated planning

Order intake Q1/2017 – Q3/2021

in € million



- Highly volatile order intake due to large project sizes and fixed-time budgeting processes of our customers
- Large-scale projects requiring 1-2 years from order intake to full revenue recognition

02

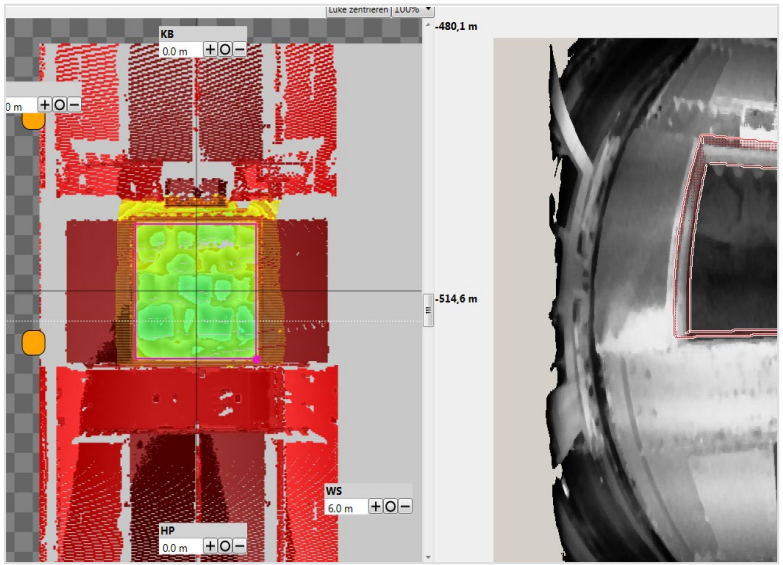
Bulk handling equipment – first truly autonomous controls

Optimising and increasing the efficiency of transport chains

Sensor systems based on user requirements

1

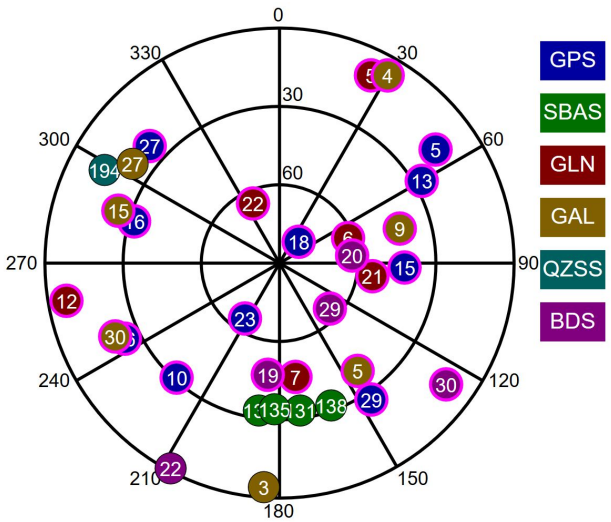
Requirements: What do we need?



- Accuracy 10 cm (S/R) ... 50 cm (GSU)
- Update 20 s (GSU) ... 2 min (S/R)
- Range 10 m (TL) ... 150 m (S/R)

2

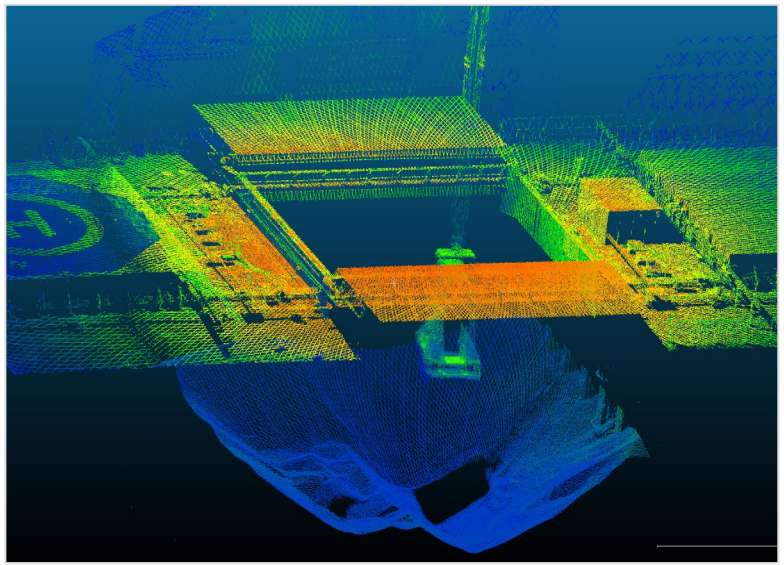
Positioning: Where is the machine?



- RTK GNSS multi-frequency, phase carrier, cm-level accuracy
- First use in 2000, GPS (US), 99.90% available (1 min/day)
- Currently GPS/GLONASS/Galileo/Beidou, 99.99% available (5 s/day)

3

Vision system: Where is the material?



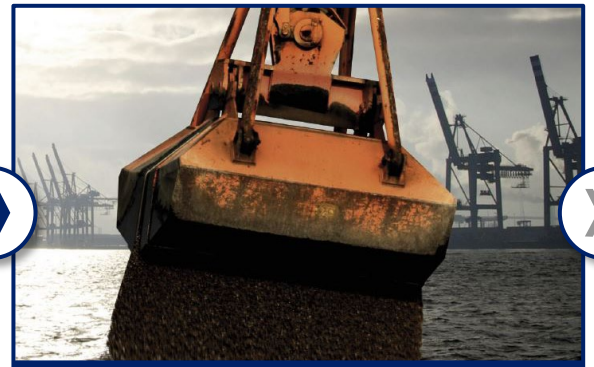
- 3D LiDAR
- First use in 2000, 28 kHz PRR, 200 m range, dm-level accuracy, 900 nm wavelength
- Currently up to 1.2 MHz PRR, 400 m range, cm-level accuracy, 1.500 nm wavelength

Increasing port productivity by more than 100% through advanced automation

Business case Hansaport (HHLA stake 49%) – local development and global roll-out

2001 – 2002: Train loader

2001 – 2005: Stockyard



2009 – 2012: Ship unloader

2015 – 2016: Ship loader

Innovation leadership

- First bulk terminal to automate the entire process chain for incoming and outgoing material
- Together with EMO (Rotterdam) still one of the most advanced bulk terminals globally
- Wide range of materials from light coking coal to heavy iron ore fines handled autonomously

Efficiency gains for Hansaport

120
employees
required to handle
8 million t
per annum

1999

112
employees
required to handle
15 million t
per annum

Plus: Reduced equipment wear, energy consumption and environmental footprint (dust etc.)

2019

Global roll-out by iSAM

- 60+ fully autonomous bulk handling systems in operation worldwide
- 12 autonomous S/Rs; 4 GSUs and 8 S/Ls under construction or in commissioning for customers in Japan, Malaysia, Australia and Canada
- 3 of the 4 leading mining companies globally use our technology (BHP, Rio Tinto, Vale)

03

Autonomous container handling – the next step

Container handling will benefit from autonomous car technology

LiDAR technology is enabling advanced automation

LiDAR as key component in autonomous car research

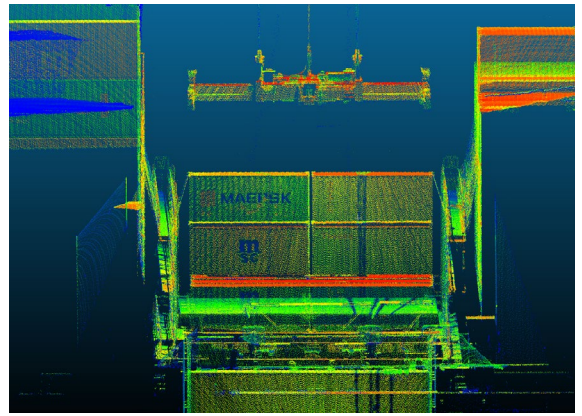
- High resolution (up to 256 parallel scan lines)
- 200 m range in low-visibility conditions
- Inherently safe sensor design (ASIL)
- Solid-state without moving parts

“Flipper accuracy" with stationary target

- Pick-up with mechanical guidance
- Set-down with mechanical guidance
- **~ 10 cm accuracy**
- **Stationary** target
- In operation at CTA from 2000

“Twist lock accuracy" with stationary target

- Pick-up and set-down without mechanical guidance
- **~ 2 cm accuracy**
- **Stationary** target
- Implemented at CTA in 2020



“Twist lock accuracy" with dynamic target

- Pick-up and set-down without mechanical guidance
- **~ 2 cm accuracy**
- **Dynamic** target (e.g. on a vessel)
- Target date 2025

CTA Rail Crane 4 – blueprint for autonomous intermodal handling

100% twist lock accuracy for all ISO container types

Truly autonomous operation

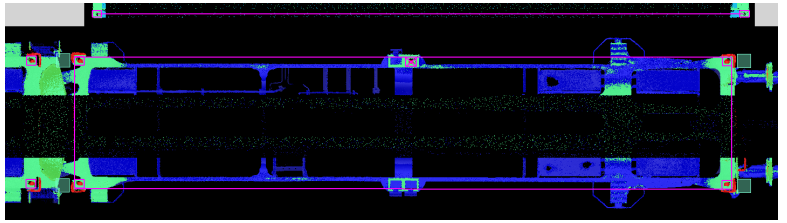
- First system to reliably position a container on a locking pin without any physical guidance for all types of rail cars
- Automatically detects incorrectly configured rail cars, wrong dimensions, etc.
- Fully autonomous handling of all ISO container types (including tank containers)
- Safe collaboration between the autonomous rail crane and personnel in the area

Benefits

- One operator can handle 4+ rail cranes including exception handling
- Repeatable, operator-independent performance with reduced equipment wear
- 24/7 operation without lost times due to shift changes and mandatory breaks

Status

- More than 2.500 containers moved without a single incident or need to reseat
- Safety certification in progress with DNV-GL



New technology enables significant productivity increases over the next years

Outlook – autonomous handling for intermodal and ship-to-shore applications (STS)

2022

- Full certification of autonomous rail crane

2023

- Roll-out of autonomous intermodal container cranes

2024 - 2025

- Remote control on the water side with augmented reality (AR) operator support
- Autonomous operation on the land side
- One remote operator can handle up to 2 STS cranes

2025 - 2026

- Remote control for water-side setdown
- Autonomous water-side pick-up
- Autonomous operation on the land side
- One remote operator can handle 2-3 STS cranes

2027 - 2028

- Fully autonomous operation
- Remote control only for exceptional handling and special loads
- One remote operator can handle up to 4 STS cranes

Prototype → **Intermodal** → **STS stage 1** → **STS stage 2** → **STS stage 3**

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