Geospatial Data &Geographic Information Systems and Smart Manufacturing

This questionnaire is intended to evaluate the usage of Geographic Information Systems (GIS) in conjunction with Smart Manufacturing Systems. In particular, we are interested in the usage of Standards in that area. The results of this questionnaire will be published with the participants' consent.

Privacy statement: We treat your personal information as confidential, and will erase any personal data from the filled questionnaire by you. We will keep your identity confidential at all times!

There are 85 questions in this survey.

Demographics

Select the discipline that best describes your background (please only one answer) *

Choose one of the following answers

Please choose **only one** of the following:

- ◯ Biomedical Engineering
- ◯ Cartography
- ◯ Chemical Engineering
- ◯ Civil Engineering
- ◯ Computer Engineering
- ◯ Electrical Engineering
- ◯ Engineering Design
- ◯ Engineering Technology
- ◯ Geography
- ◯ Geospatial Science
- ◯ Industrial Design
- ◯ Industrial Engineering
- ◯ Mathematics
- ◯ Mechanical Engineering
- ◯ Medicine
- ◯ Other [ ]

Select the job title that best describes your current role:

Choose one of the following answers
Please choose **only one** of the following:

- ◯ Business Executive
- ◯ Cartographer
- ◯ Biomedical Engineer
- ◯ Civil Engineer
- ◯ Computer Programmer
- ◯ Construction Manager
- ◯ Geospatial Scientist
- ◯ Industrial Engineer
- ◯ Maintainer
- ◯ Manufacturing Engineer
- ◯ Mechanical Engineer
- ◯ Operations Manager
- ◯ Operations Researcher
- ◯ Research Manager
- ◯ Research Scientist
- ◯ Software Architect
- ◯ Other [ ]

Select your highest earned degree. If not listed, please select the closet equivalent level:

Choose one of the following answers
Please choose **only one** of the following:

- ◯ Secondary school degree (i.e. High School)
- ◯ Associate's degree / Tradeschool diploma
- ◯ Bachelor's degree
- ◯ Master's degree / Diploma thesis
- ◯ Doctorate / PhD / MD /JD

Fill in the demographic information. Your age:

Only numbers may be entered in this field.
Please write your answer here:

[ ]
years

Fill in the demographic information. Your gender:

Please choose **only one** of the following:

- ◯ Female
- ◯ Male

Fill in the demographic information. Your country of residence:

Please write your answer here:

[ ]

Fill in the demographic information. Your years of Professional Experience:

Only numbers may be entered in this field.
Please write your answer here:

Geospatial and Manufacturing Data

What is the current state of data collection and curation in your organization?

At what level, does your organization collect and store data from your manufacturing environment?(Select all that apply)

Check all that apply
Please choose **all** that apply:

- [ ] ISA-95 Level 1: I/O Link, DeviceNet, Sensors
- [ ] ISA-95 Level 2: PLC, DCS, Motion, Robot, CNC, HMI, SCADA, Batch
- [ ] ISA-95 Level 3: MES, LIMS, WMS, CMMS, QMS
- [ ] ISA-95 Level 4: ERP, APO, Logistics
- [ ] Other:

ISA-95 Level 1: I/O Link, DeviceNet, Sensors

Please choose **all** that apply:

ISA-95 Level 2: PLC, DCS, Motion, Robot, CNC, HMI, SCADA, Batch

Please choose **all** that apply:

ISA-95 Level 3: MES, LIMS, WMS, CMMS, QMS

Please choose **all** that apply:

ISA-95 Level 4: ERP, APO, Logistics

Please choose **all** that apply:

How would you rate the quality of the data collected? (poor [1 star] - ideal [5 stars])

Please choose **only one** of the following:

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5

poor

Please choose **only one** of the following:

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5

ideal

Please choose **only one** of the following:

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5

Does your organization store/update a Computer-Aided Design (CAD) representation of the manufacturing facility itself? Select the description below that best fits your organization’s practice.

❗ Choose one of the following answers
Please choose **only one** of the following:

- ◯ No formal CAD data stored
- ◯ Construction CAD data without additional attributes
- ◯ Construction CAD data with additional attributes
- ◯ Construction CAD data and indoor objects as CAD geometries
- ◯ GIS data of indoor space with indoor objects (devices, shelves, tables, ...)
- ◯ GIS data of indoor space with detailed geometry of indoor objects and their attributes

How often does your organization update the CAD models of the facility?

Choose one of the following answers
Please choose **only one** of the following:

- ◯ Never (i.e. only original drawings stored)
- ◯ Annualy
- ◯ Monthly
- ◯ Daily
- ◯ Hourly
- ◯ Continuously
- ◯ does not apply

How do you integrate Geospatial data and manufacturing data?

Choose one of the following answers
Please choose **only one** of the following:

- ◯ Using an exact position (i.e., XYZ coordinates) as an anchor
- ◯ Using implicit device names (and the positions of the devices) as a basis
- ◯ Using location names in the facility as anchor
- ◯ Using temporal markers (e.g., timestamps)
- ◯ Using camera feeds and approximately relating data to it
- ◯ Other [ ]

Industry 4.0 / Smart Manufacturing technologies in your organization.

Definitions of Terms

- *Industry/Industrie 4.0* is the ongoing transformation of traditional manufacturing and industrial practises combined with the latest smart technology.

- *Smart Manufacturing* combines advanced manufacturing capabilities and digital technologies throughout the product lifecycle.

For the purpose of this questionnaire, consider these two terms as synonyms.

If Industry 4.0/Smart Manufacturing technologies are implemented in your organization, do the technologies meet your expectations, give reasons why?

Choose one of the following answers

Please choose **only one** of the following:

◯ Yes, why:

◯ No, why:

Make a comment on your choice here:

Are Industry 4.0/Smart Manufacturing technologies implemented in your organization?

Please choose **only one** of the following:

◯ Yes

◯ No

What was the primary reason you chose to or would implement these technologies? (Select one)

Choose one of the following answers
Please choose **only one** of the following:

- ◯ faster maintenance
- ◯ better monitoring of manufacturing processes
- ◯ more optimal transportation processes
- ◯ cost savings
- ◯ efficient production processes
- ◯ Other

Do you use Industry 4.0 technologies in conjunction with Geographic Information Systems? Please indicate the purpose for which you use Industry 4.0 technologies with GIS. (Select all that apply)

Check all that apply
Please choose **all** that apply:

- ☐ does not apply
- ☐ Asset localization and mapping
- ☐ Support asset transportation planning
- ☐ Mapping of physical movement of production assets
- ☐ Localization of sensors
- ☐ Optimization of production layout
- ☐ Dashboard (production performance monitoring)
- ☐ Augmented or Virtual Reality applications (any kind)
- ☐ Smart maintenance (e.g. with AR)
- ☐ Incident analysis
- ☐ Other:

does not apply

Please choose **all** that apply:

Asset localization and mapping

Please choose **all** that apply:

Support asset transportation planning

Please choose **all** that apply:

Mapping of physical movement of production assets

Please choose **all** that apply:

Localization of sensors

Please choose **all** that apply:

Optimization of production layout

Please choose **all** that apply:

Dashboard (production performance monitoring)

Please choose **all** that apply:

Augmented or Virtual Reality applications (any kind)

Please choose **all** that apply:

Smart maintenance (e.g. with AR)

Please choose **all** that apply:

Incident analysis

Please choose **all** that apply:

Standards deployed in your organization

Which Smart Manufacturing standards are used in your organization? (Select all that apply)

Comment only when you choose an answer.
Please choose all that apply and provide a comment:

- [ ] Not applicable

- [ ] ISO TC184 SC4, e.g. STEP, purpose:

- [ ] OPC Unified Architecture, purpose:

- [ ] Open Applications Group (OAG)

- [ ] Object Management Group (OMG), e.g. SysML

- [ ] MTConnect, purpose:

- [ ] ASTM F45 Methods for AGV's

- [ ] ASTM F48

- [ ] ASTM E60

- [ ] ASME MBE, e.g. Y14, purpose:

- [ ] other #1 and purpose:

- [ ] other #2 and purpose:

☐ other #3 and purpose:

☐ other #4 and purpose:

Not applicable

Please choose all that apply and provide a comment:

ISO TC184 SC4, e.g. STEP, purpose:

Please choose all that apply and provide a comment:

OPC Unified Architecture, purpose:

Please choose all that apply and provide a comment:

Open Applications Group (OAG)

Please choose all that apply and provide a comment:

Object Management Group (OMG), e.g. SysML

Please choose all that apply and provide a comment:

MTConnect, purpose:

Please choose all that apply and provide a comment:

ASTM F45 Methods for AGV's

Please choose all that apply and provide a comment:

ASTM F48

Please choose all that apply and provide a comment:

ASTM E60

Please choose all that apply and provide a comment:

ASME MBE, e.g. Y14, purpose:

Please choose all that apply and provide a comment:

Which Geographic Information Systems standards are used in your organization and for which purpose (why)? Select all that apply. If you do not know how to answer this question, please click on "not applicable"!

Comment only when you choose an answer.
Please choose all that apply and provide a comment:

- [ ] not applicable

- [ ] WPS, purpose:

- [ ] WMS, purpose:

- [ ] WFS, purpose:

- [ ] SensorThings API, purpose:

- [ ] Sensor Observation Service (SOS), purpose:

- [ ] Point Cloud formats (like FLS, PCD, LAS), purpose:

- [ ] IndoorGML, purpose:

- [ ] GML, purpose:

- [ ] CSW, purpose:

- [ ] CityGML, purpose:

Other:

not applicable

Please choose all that apply and provide a comment:

WPS, purpose:

Please choose all that apply and provide a comment:

WMS, purpose:

Please choose all that apply and provide a comment:

WFS, purpose:

Please choose all that apply and provide a comment:

SensorThings API, purpose:

Please choose all that apply and provide a comment:

Sensor Observation Service (SOS), purpose:

Please choose all that apply and provide a comment:

Point Cloud formats (like FLS, PCD, LAS), purpose:

Please choose all that apply and provide a comment:

IndoorGML, purpose:

Please choose all that apply and provide a comment:

GML, purpose:

Please choose all that apply and provide a comment:

CSW, purpose:

Please choose all that apply and provide a comment:

CityGML, purpose:

Please choose all that apply and provide a comment:

Name three standards in the field of smart manufacturing and/or Geographic Information Systems that are widely used and explain why.

Standard #1

Standard #2

Standard #3

Name three standards in the field of smart manufacturing and/or Geographic Information Systems that are NOT used and explain why?

Standard #1

Standard #2

Standard #3

Why do you avoid using standards?

Choose one of the following answers
Please choose **only one** of the following:

- ◯ does not apply
- ◯ too complex
- ◯ too heavy to implement
- ◯ do not serve the intended purpose
- ◯ do not represent the practical needs of our company
- ◯ not supported by software
- ◯ Other

other #1 and purpose:

Please choose all that apply and provide a comment:

other #2 and purpose:

Please choose all that apply and provide a comment:

other #3 and purpose:

Please choose all that apply and provide a comment:

other #4 and purpose:

Please choose all that apply and provide a comment:

Future perspectives

What use case does your organization consider to implement in future?

Check all that apply

Please choose **all** that apply:

- [ ] asset localization (indoor)
- [ ] asset transportation (indoor)
- [ ] incident management
- [ ] warehouse picking
- [ ] maintenance
- [ ] production performance monitoring
- [ ] Other:

asset localization (indoor)

Please choose **all** that apply:

asset transportation (indoor)

Please choose **all** that apply:

incident management

Please choose **all** that apply:

warehouse picking

Please choose **all** that apply:

maintenance

Please choose **all** that apply:

production performance monitoring

Please choose **all** that apply:

What are primary barriers (organizational/social/behavioral, technological, or ...) for transitioning from the current situation to the envisaged future state - with integrated Smart Manufacturing and Geographical Information Systems? (select all that apply)

Check all that apply

Please choose **all** that apply:

- [ ] does not apply
- [ ] Data Interoperabiltiy
- [ ] System Interoperability
- [ ] Data storage capacity
- [ ] Latency
- [ ] Availability of Indoor Positioning Systems
- [ ] Accuracy of Indoor Positioning Systems
- [ ] Costs of Indoor Positioning Systems
- [ ] Lack of technical experienced staff (esp. computer science, GIS, ...)
- [ ] Other:

does not apply

Please choose **all** that apply:

Data Interoperabiltiy

Please choose **all** that apply:

System Interoperability

Please choose **all** that apply:

Data storage capacity

Please choose **all** that apply:

Latency

Please choose **all** that apply:

Availability of Indoor Positioning Systems

Please choose **all** that apply:

Accuracy of Indoor Positioning Systems

Please choose **all** that apply:

Costs of Indoor Positioning Systems

Please choose **all** that apply:

Lack of technical experienced staff (esp. computer science, GIS, ...)

Please choose **all** that apply:

Thanks for participating in this survey!

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Submit your survey.
Thank you for completing this survey.