FIG WORKING WEEK 2023
28 May - 1 June 2023 Orlando Florida USA
Protecting Our World, Conquering New Frontiers

Possible ways to FIG Standards for Surveying by Drones

David Martin
ESRF, Chair FIG Standards Network

ESRF European Synchrotron Radiation Facility

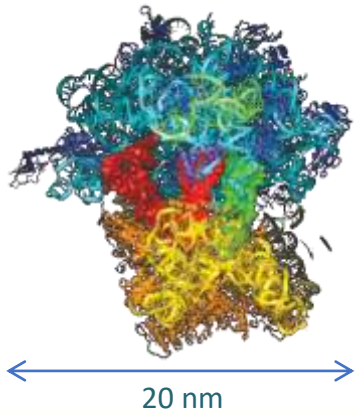
Organized By NSPS FIG INTERNATIONAL FEDERATION OF SURVEYORS

Diamond Sponsors esri THE SCIENCE OF WHERE Trimble

David Martin, Chair Commission 5.1 and the FIG Standards Network
Head of the Survey and Alignment Group at the
European Synchrotron Radiation Facility (ESRF)

What is the ESRF?

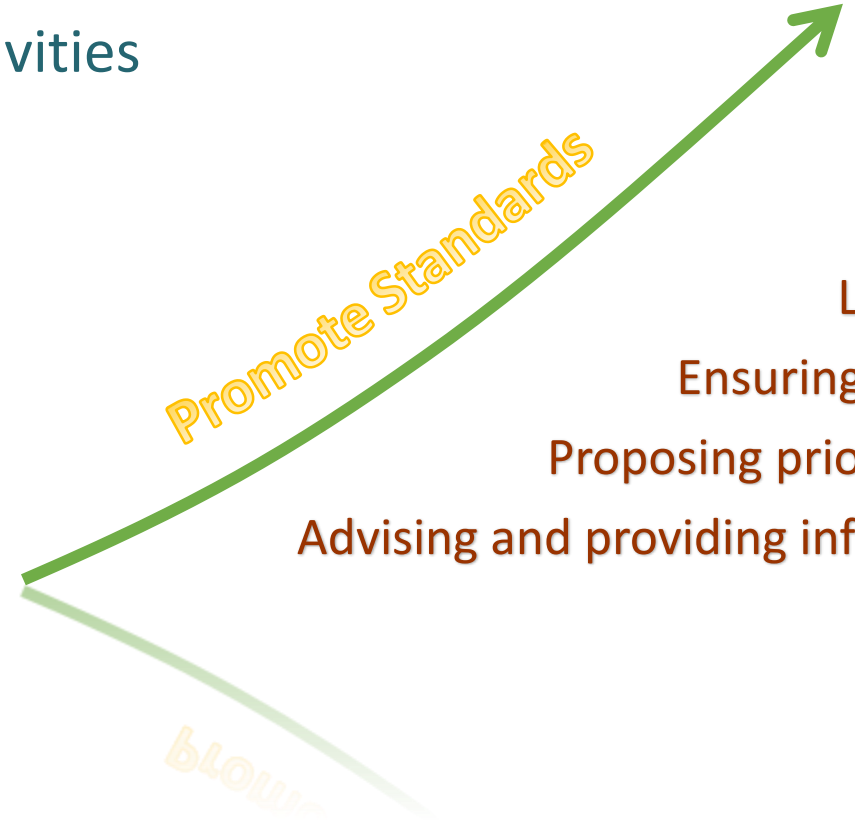
- The ESRF is the world's brightest X-ray source. We do research into in condensed and living matter science
- The ESRF Survey and Alignment Group ensure the installation, the control and the high precision alignment of the accelerators and experiments.
- The alignment tolerances are generally less than one millimetre but often in the order of a tens of micrometres.



Interest in standards

From 2001 until 2012 the ESRF Alignment and Geodesy group ran an internationally recognized COFRAC ISO-17025 accredited suite of standards for calibrating robotic total stations and laser trackers.

Standards Network responsibilities and activities



Liaison with standards bodies and NGOs

Ensuring lead contacts to Technical Committees

Proposing priorities on FIG's standardisation activities

Advising and providing information on standards to FIG members

What will we talk about…

- Quality
- Traceability
- Possible approaches to a standard
- What already exists
- Next steps

Important concepts

Quality management → *Best practice is a feature of accredited management standards such as ISO 9000**

- The core purpose of Quality management is to prevent mistakes and defects in both manufactured products and delivered services.
- Quality management ensures a product is:
  - *fit for purpose, and*
  - *has no errors.*

Measurement traceability and uncertainty:

- Traceability ensures a measurement is an accurate representation of what it is trying to measure.
- Traceability ensures an unbroken chain of comparisons that ends at a national metrology institute (NMI).
- Uncertainty is a non-negative parameter characterizing the dispersion of values being measured.

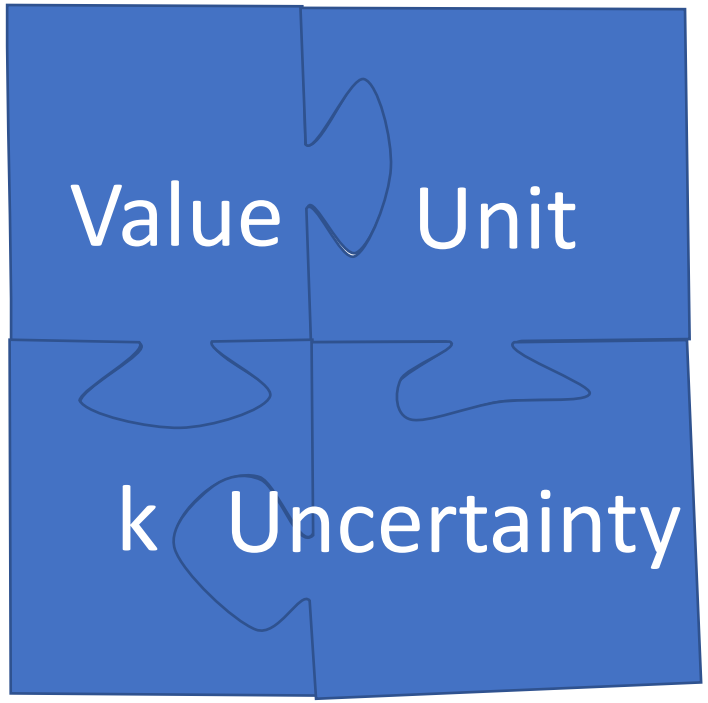
**Wikipedia → Nash, Jennifer; Ehrenfeld, John (2010). "Code Green: Business Adopts Voluntary Environmental Standards". Environment: Science and Policy for Sustainable Development. 38: 16–45. doi:10.1080/00139157.1996.9930973.*

The seven ISO 9001 quality management principles

- **Customer focus** makes the customer the center of the business.
- **Leadership** creates an environment that focuses on customers and involves all employees.
- **Engagement of people** ensures everyone with a vested interest is committed to success.
- **Process approach** focuses on the big picture and shows issues and concerns during product development.
- **Improvement** to make things better.
- **Evidence-based decision making** makes data-driven decisions for comparison and building confidence in results.
- **Relationship management** is actively managing relationships with all stakeholders.

Ref: https://www.iso.org/files/live/sites/isoorg/files/store/en/PUB100080.pdf

A measurement has four parts

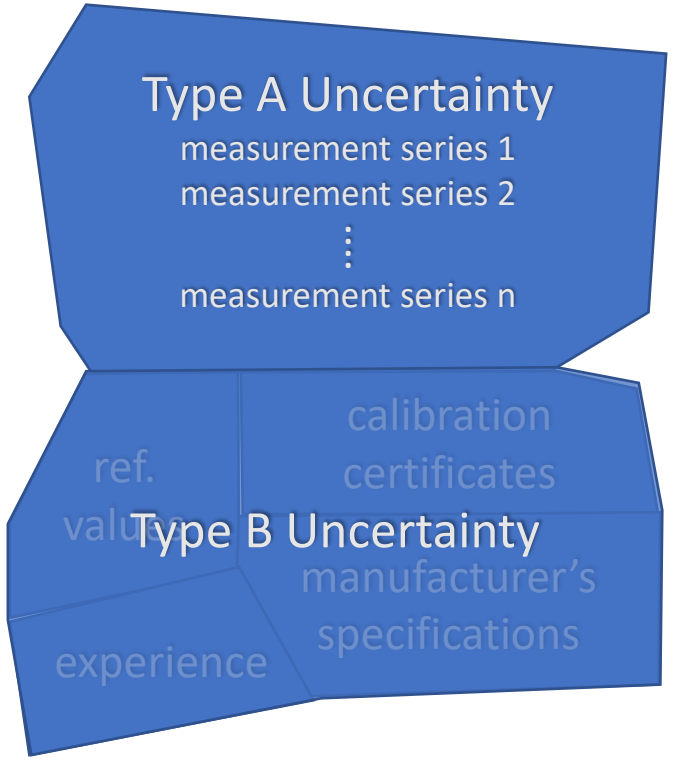


So, for example we might have a distance:

D = 1.02345 m; $U(D)$=0.0005 m; k=2

VIM and GUM

Measurement Uncertainty

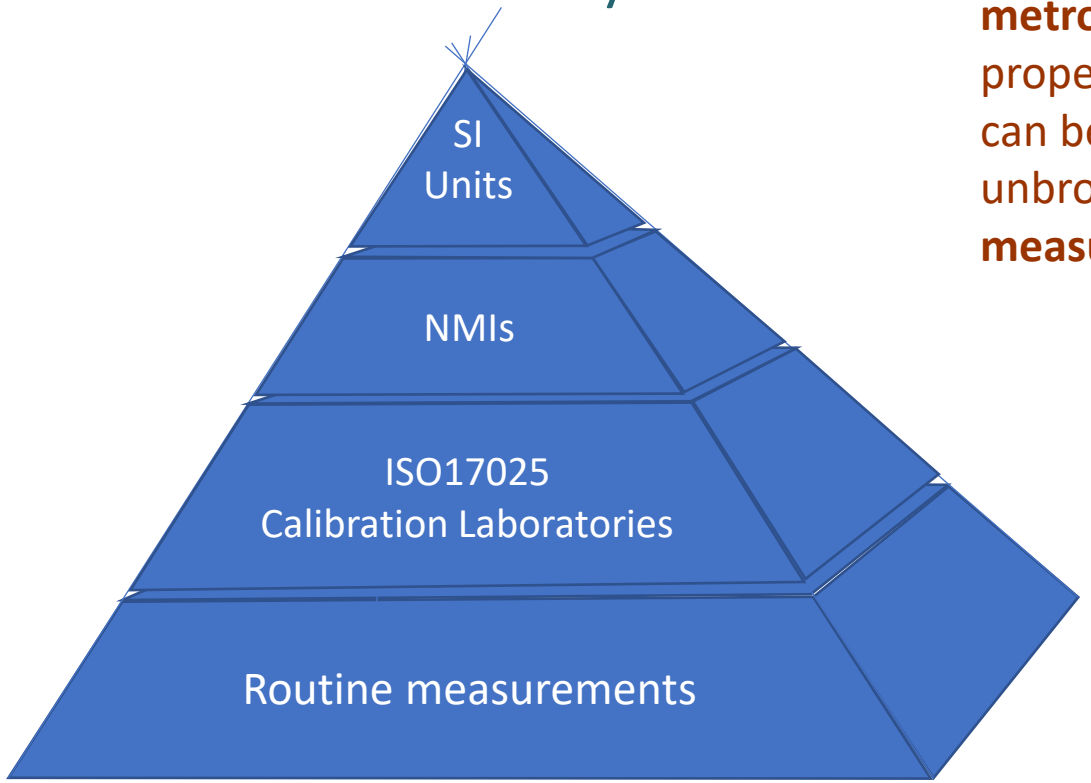


measurement uncertainty
non-negative parameter characterizing the dispersion of the **quantity values** being attributed to a **measurand**, based on the information used

$$U = \sqrt{(\text{Type A})^2 + (\text{Type B})^2}$$

VIM and GUM

Measurement Traceability



metrological traceability
property of a **measurement result** whereby the result can be related to a reference through a documented unbroken chain of **calibrations**, each contributing to the **measurement uncertainty.**

SI Units

- **length (metre)**,
- mass (kilogram),
- **time (second)**,
- electric current (ampere),
- thermodynamic temperature (kelvin),
- amount of substance (mole),
- luminous intensity (candela).

BIPM, VIM and GUM

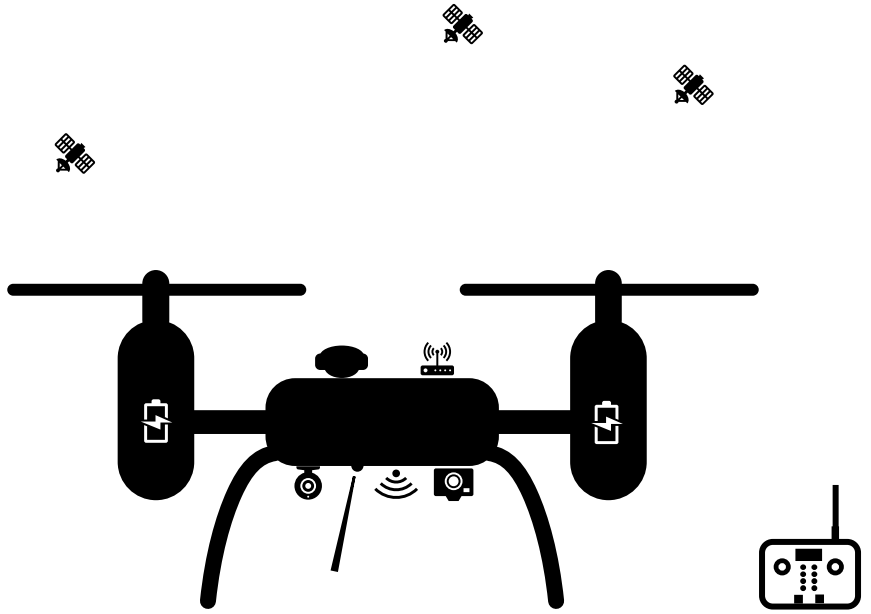
Drone surveying and mapping standards scope[1]…

Technical Details for Surveying by Drones including:

- Site Planning
- Mission Planning
- Data Acquisition
- Data Processing
- Map Production
- …

Operational Best Practices for Surveying by Drones including:

- Payload Sensor Choice for Different Applications
- Georeferencing Method for Imaging Sensors
- Data Processing Best Practices
- Map Production Best Practices
- …



[1] *e-mail Mohamed Mostafa*

Why might you want/need to have a standard for surveying by drones?

Generally, a standard is created to **fulfil a need**. For example:

- - assure safety of products,
- - ensure that products and materials are fit for their purpose,
- - promote and ensure the interoperability of products and services,
- - facilitate trade by removing trade barriers,
- - promote a common understanding of a product or service.

A standard will succeed when it satisfies the needs, requirements and expectations of its **stakeholders**.

Who/what are stakeholders?

Stakeholders are entities that have freedom to provide or withdraw something from an enterprise.

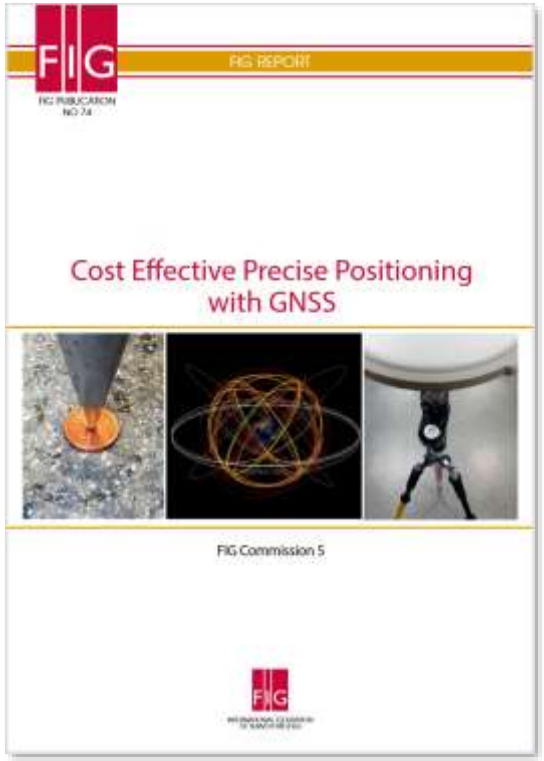
The customer is a special stakeholder. They receive the product or service. They also pay for it!

Customers require **quality** products and services that satisfy their needs, requirements and expectations.

Ultimately, the customer is the only one who can decide if products or services are satisfactory ...

Three possible approaches to a standard for surveying by drones…

A FIG publication



An ad-hoc/industry standard

An ISO standard

A FIG publication

What is it

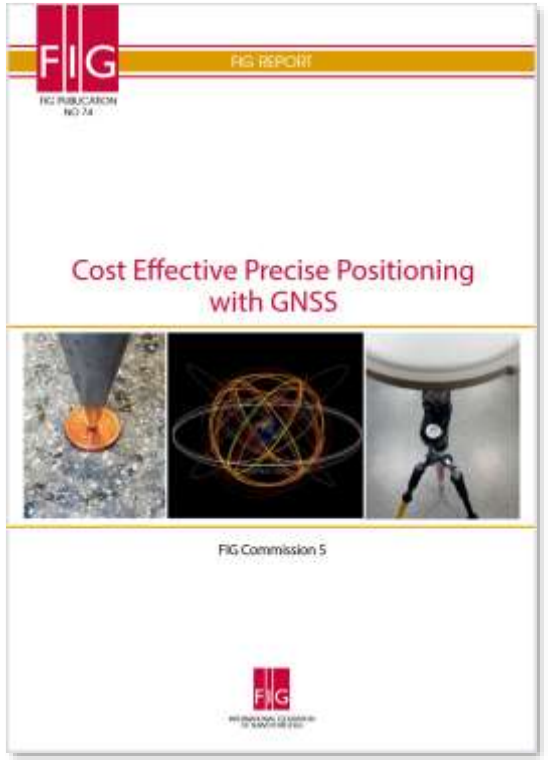
FIG publications (https://www.fig.net/resources/publications/figpub/) cover a number of topics of interest to surveyors. They can deliver official statements; provide information, general guidance or best practice; discuss policy etc.

Pros

These documents are relatively straightforward to create, and are entirely controlled by FIG. FIG publications can be distributed free of charge.

Cons

Possibly limited acceptance and audience; short lifetime and possible obsolesce if not kept up to date.



Ad-Hoc or industry standard

What is it

These become standard because the practice is commonly accepted and used. Generally, these type of standards determined by marketplace consensus before being accredited e.g. by ISO. They must have the backing of a broad majority of stakeholders to be accepted and be effective.

Pros

This type of standard is relatively straightforward to create because it is managed by, and has broad agreement from experts and stakeholders across industry. Generally, because they are designed to meet a specific industry need, they are free of charge.

Cons

If a general consensus is not met i.e. all actors and stakeholders, there can be limited industry acceptance.

An ISO standard

What is it

ISO standards are internationally agreed best way of doing something. They represent the distilled wisdom of people with expertise in their subject matter and who know the needs of the organizations they represent – people such as manufacturers, sellers, buyers, customers, trade associations, users or regulators[1].

Pros

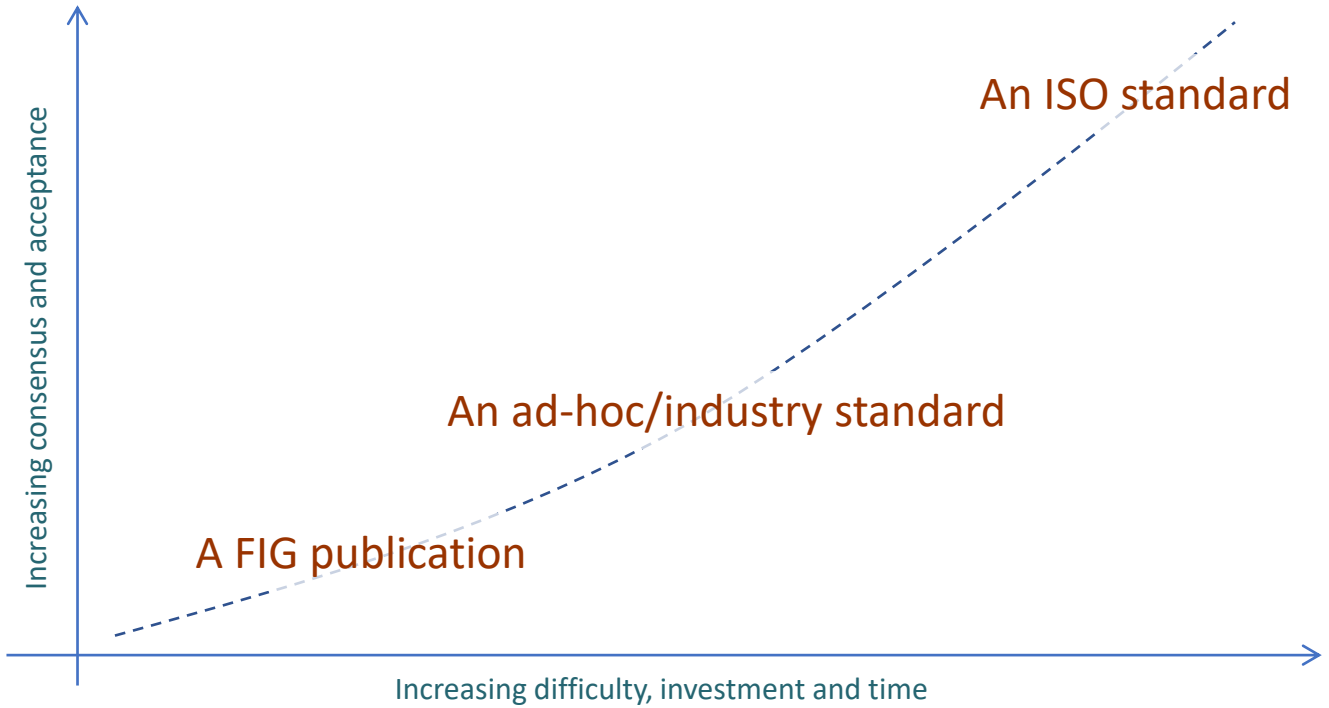
Once created it has universal stakeholder acceptance e.g. throughout industry and government!

Cons

This type of standard is difficult to create because it requires international agreement from stakeholders across industry. Generally, because of this universal acceptance thy can take a long time to make. ISO standards generally cost in the order of $100 to $200 each.

1) https://www.iso.org/standards.html

Relative difficulty



The main difference between the three approaches would be in the time, the degree of prescription and the consensus required.
There are *virtually* no rules for a FIG publication or an industry standard, so it is difficult to define how they could be established or what they might look like.
However, the path to ISO standards is very clearly defined.

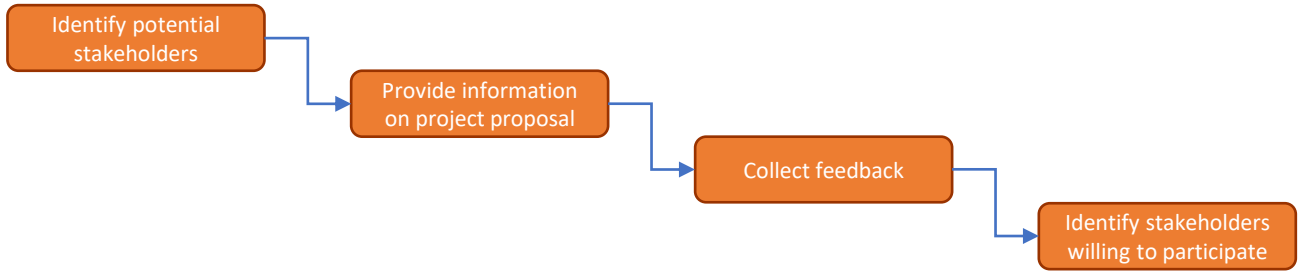
Market relevance and **stakeholder engagement** are two key principles common to all new work in ISO

Every standard responds to the needs of the end user and solves a problem faced by the market. Important questions about market relevance are:

- why does the market need the standard - what are its aims?
- whose interests will be affected - who are the stakeholders?

Engage stakeholders and determine the market relevance of the proposal. Will the standard be beneficial and why…

- What value will it bring the end user?
- What problem does the standard solve?



Ref: Guidance on new work, ISO 2019
https://www.iso.org/publication/PUB100438.html

What exists

- Academic and industry documentation,
- Manufacturer's user manuals, guidance and specifications,
- Standards by ISO TC211 Geographic information/Geomatics
  - Geographic information, coordinate reference systems, metadata
  - *ISO 19130 Imagery sensor models for geopositioning:*
    - *Part 1 Fundamentals, and*
    - *Part 2: SAR, InSAR, lidar and sonar,*
- Standards by ISO/TC 172/SC 6 Geodetic and surveying instruments
  - *ISO/NP 17123-10 Optics and optical instruments -- Field procedures for testing geodetic and surveying instruments -- Part 10: UAV photogrammetry systems* (?)*
- Standards by ISO/TC 20/SC 16 Unmanned aircraft systems,
- OGC e.g. sensor web enablement standards, wide area motion imagery ...
- JCGM Publications: Guides in Metrology
  - *Guide to the expression of uncertainty in measurement (GUM) and supplements,*
  - *International vocabulary of metrology (VIM),*
- ISO 9001 Quality management systems,
- ...

** https://standardsdevelopment.bsigroup.com/projects/9021-05680#/section*

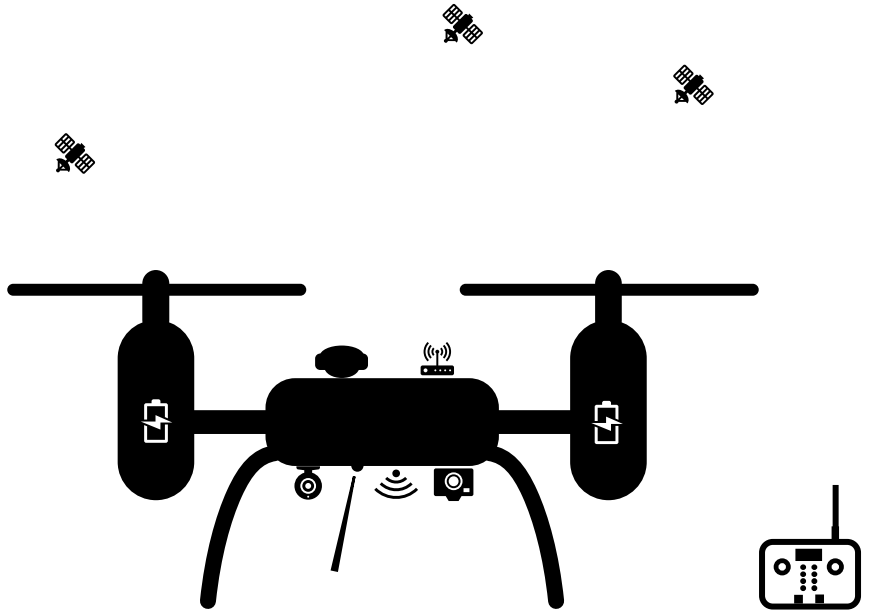
Next steps?

Formulate Terms of Reference* for Standards for Surveying by Drones:

- vision, objectives, scope and deliverables (i.e. what has to be achieved)
- stakeholders, roles and responsibilities (i.e. who will take part in it)
- resource, financial and quality plans (i.e. how it will be achieved)
- work breakdown structure and schedule (i.e. when it will be achieved)

Reflect-on/decide on the best approach:

- FIG document,
- Ad-hoc or industry standard,
- ISO standard – new working item proposal.



*ref: https://en.wikipedia.org/wiki/Terms_of_reference


Global Challenges
Standards Network
clarity
ISO
Consensus
Purpose
People
Governance
Planet
CHALLENGES
Courage
Serving
Society
Planet
People
Society
Standards
GLOBAL
Partnership
Communication
Action