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Existing infrastructure and future requirements for dynamic force traceability in materials testing

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ComTraForce Public Stakeholder Workshop
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Work Package 1 Objectives

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- Equipment
  - Review and evaluate performance of existing force measurement equipment and instrumentation
  - Review existing force calibration facilities
  - Review existing material testing machine facilities
  - Evaluate material testing facilities not supported by force calibration infrastructure
- Documents
  - Review force calibration standards
  - Review relevant non-force calibration standards
  - Evaluate test machine capabilities not supported by documented calibration procedures

Work Package 1 Objectives

- Technology roadmap to include:
  - Future requirements for improved force transfer standards
  - Future requirements for calibration methods for testing machines
- Report to take into account:
  - Realistic uncertainties
  - Results from equipment and document studies
  - Input from stakeholder committee and workshops
- Conclusions of work will result in:
  - Scope of procedures to be developed
  - Design criteria for improved transfer standards

Equipment

- Review of available transducers and instrumentation
  - Strain gauge and piezoelectric force transducers
    - Repeatability
    - Reproducibility
    - Reversibility
    - Creep
    - Zero shift
    - Long-term drift
  - AC and DC ratio meters, digitising units, charge amplifiers
- Review of available calibration facilities
  - Generally only static capabilities

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Existing Force Standards

	Static Force		Continuous Force	Dynamic Force
Transducer Calibration	ABNT NBR 8197 ASTM E74 BS 8422 CEM ME-002	DIN 51308 DKD-R 3-3 ISO 376 VDI/VDE 2624-2.1	DKD-R 3-9	DKD-R 3-10(2)
Machine Calibration	ASTM E4 DIN 51302-2 EN 12390-4 ISO 7500-1 ISO 7500-2	ISO 4545-2 ISO 6506-2 ISO 6507-2 ISO 6508-2 ISO 14566 - Charpy		ASTM E467 DKD-R 3-10(3) ISO 4965-1 MIL-STD-1312B NASM 1312
General	DKD-R 3-10(1) EURAMET cg-4			

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Existing Non-Force Standards

	Static Force	Continuous Force	Dynamic Force
Acceleration			ISO 16063-1
Alignment	ASTM E1012 EN 12390-4 ISO 23788	ASTM E1012 ISO 23788	ASTM E1012 ISO 23788
Displacement / Speed	ASTM E2309 / ASTM E2658		
Extensometry	ASTM E83 ISO 9513		
Temperature			ISO/TS 21913
Voltage	ASTM E74 ISO 376		ASTM E1942 DKD-R 3-2 ISO 4965-2

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Stakeholder Input

Three user groups:

- High quality labs – very competent, accredited, but dynamic not in scope
- Material testing labs – modernised machines, many resonance ones
- Secondary applications – rely on calibration service providers

Criticisms are that:

- ISO 4965 / ASTM E467 contain no traceability / uncertainty
- Verification procedures not clearly defined, open to interpretation, particularly related to strain gauging and alignment
- For low frequency structural testing, DKD-R 3-10 summarises methods but gives no explicit procedures / uncertainty model
- No specifications relating to adaptors / clamping affecting sinusoidal form
- Temperature not properly considered in dynamic standards

Main ranges: 20 kN – 100 kN, 1 Hz – 200 Hz

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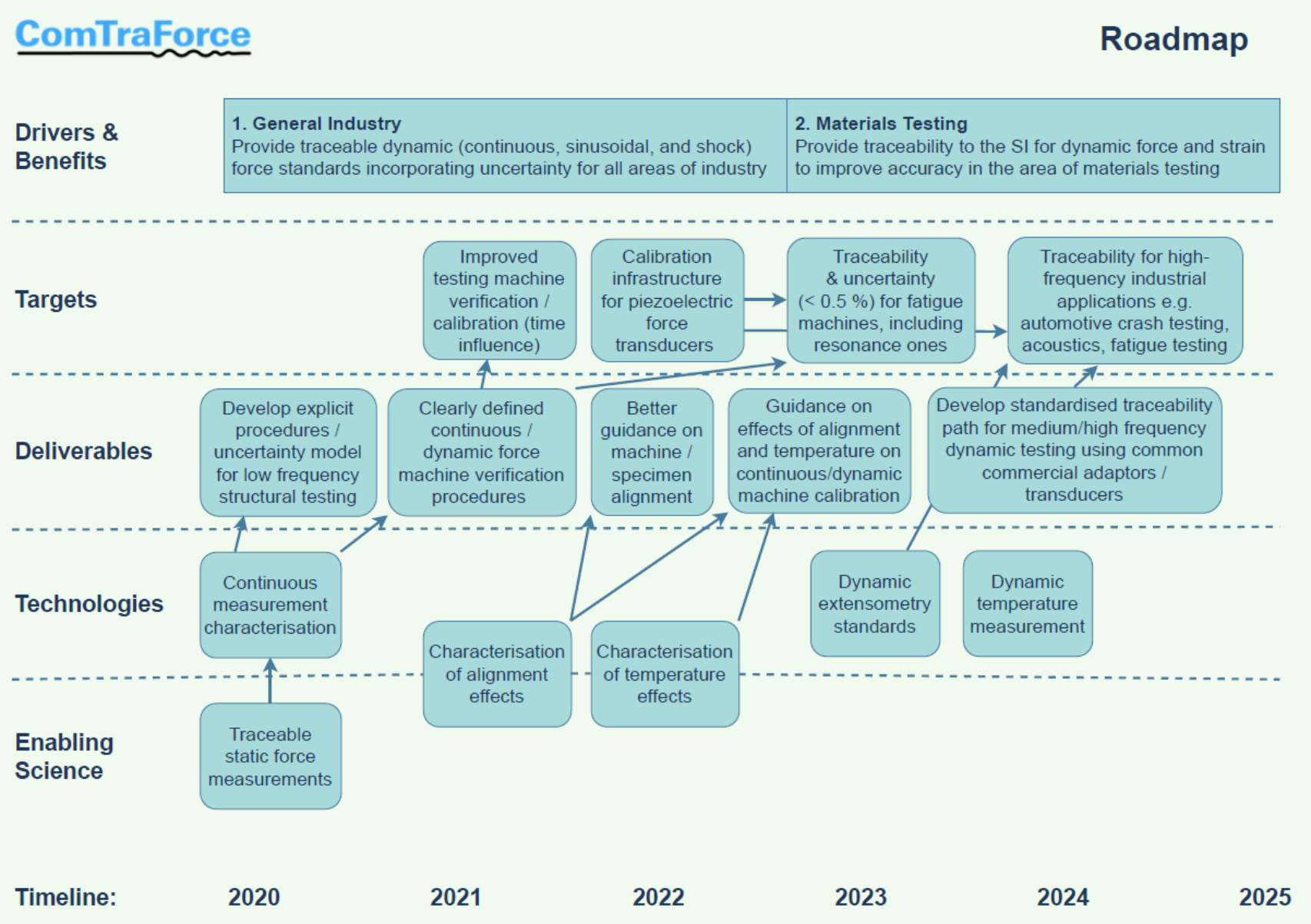
Stakeholder Input

- The standards have no uncertainty budget and no dynamic traceability
- The standards are not precise enough and enable interpretations
- It would be good to use flexible transfer standards with traceable, comparable commercial transducers inside - agreed with the principle of mass- and stiffness-adapters developed within WP 2 and 4
- ISO 23788 concerning alignment problems does not meet the needs of end-users
- The adaptation of the test specimen within the testing facility and its influence on the test results is not investigated enough or described in any standard
- Traceable calibration or verification possibilities for special applications are necessary for single transducers realised in dynamic force reference machines
- The idea of digitisation and the advantages of digital twins could enable future possibilities in the use of material testing facilities
- Temperature influences should be investigated in more detail
- Calibration procedure for piezoelectric transducers

Draft Roadmap



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