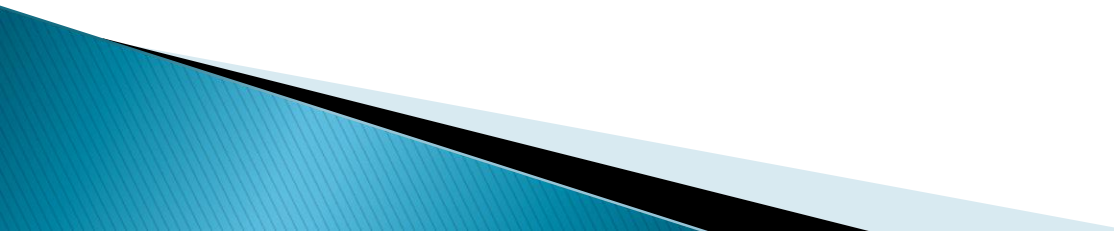


Reviewing the concept of Scientific and Technological Activities (STA)

Meeting of the RICYT Technical Committee
Buenos Aires, 28–29 October 2014
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Overview

- ▶ Introduction and brief recap of previous work
 - ▶ Main elements of current definition and links to related concepts and frameworks
 - ▶ Implementation
 - ▶ Identifying problematic areas
 - ▶ Guiding principles for a revision
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Background

- ▶ UNESCO *Recommendation* from 1978 (Standardization of Statistics on Science & Technology) and current definition from 1984 *Manual for Statistics on STA*
- ▶ Includes 3 components: R&D, S&T services (STS) and S&T Education and Training (STET)
- ▶ Growing concern that concepts need to be reviewed:
 - Not well implemented → data availability and comparability
 - Significant changes in S&T and innovation systems
 - Related frameworks have continued to evolve (e.g. R&D, innovation)
 - Increasing policy demand to better measure impacts of public support to S&T as well as broader socio-economic impacts

Previous UIS work

- ▶ First results from consultation presented at 2011 and 2013 meetings, further replies after that
- ▶ Responses from Argentina, Brazil, Colombia, Cuba, Costa Rica, El Salvador, Paraguay, Uruguay + China
- ▶ Main messages:
 - Strong interest in maintaining the concept, but need to revise and possibly refocus
 - Differences in implementation: sometimes narrower (excluding some STS or STET), sometimes broader (including innovation and/or administrative and support activities), sectoral coverage also varies

Earlier UIS proposal

- ▶ Broaden definition to STIA (including innovation)
- ▶ Redefine sub-components:
 - R&D → unchanged
 - Human capital → linked to STET
 - S&T infrastructure → linked to STS
 - Innovation → new, linked to Oslo/Bogota concept
 - Diffusion and transfer of knowledge and technology → new, systemic dimension focusing on flows, linkages
- ▶ Concerns that approach may be too broad and difficult to implement
- ▶ Current work: examining other options

Key elements from current definition

- ▶ For statistical purposes, scientific and technological activities (STA) can be defined as all systematic activities which are closely concerned with the generation, advancement, dissemination and application of scientific and technical knowledge in all fields of science and technology, that is the natural sciences, engineering and technology, the medical and the agricultural sciences (NS), as well as the social sciences and humanities (SSH). (UNESCO, 1984)

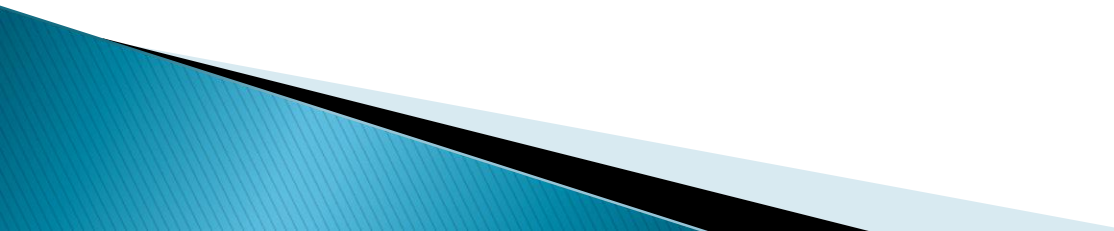
Sub-components of STA

Research and Experimental Development: R&D defined as per *Frascati Manual* (currently being revised)

Scientific and technological education and training at broadly the third level (STET) can be defined as all activities comprising specialized non-university higher education and training, higher education and training leading to a university degree, post-graduate and further training and organized lifelong training for scientists and engineers.

Scientific and technological services (STS) can be defined as any activities concerned with scientific research and experimental development and contributing to the generation, dissemination and application of scientific and technical knowledge.

STET

- ▶ Very broad concept that includes widely different types of activities, combining formal (tertiary) education with training
 - ▶ Potential boundary issues with *R&D* even if Frascati delineates what is inside
 - ▶ Potential boundary issues with *education* since the scope of S&T may be unclear (all fields of science?)
 - ▶ Little detail on what types of activities / programmes should be included
 - ▶ → currently not well-suited for measurement
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STS

- ▶ For practical reasons, list-based definition was developed identifying 9 “key” services
- ▶ Implicit link with R&D
- ▶ Includes:
 - Activities of organizations whose main domain is S&T (e.g. museums, zoos)
 - “S&T services” (not clearly defined) provided by organizations involved in information collection and dissemination + translation/editing of S&T books and periodicals
 - Routine S&T support activities which do not qualify as R&D (data collection, surveying, testing/standardization)
 - Activities relating to Intellectual property (IP) protection

Some history (1)

- ▶ Godin (2001) traces emergence of current STA concept to UNESCO work in 1970s and how these were originally linked to R&D (Bochet, 1974)
- ▶ Scientific and technological activities comprise those:
 - 1. Activities which, whilst not being actually innovative in character, form the infrastructure necessary for the effectiveness of R&D
 - 2. Activities which, within the framework of science and technology, maintain the continuity of the routine competence necessary for R&D activity, although not playing a direct part in it;
 - 3. Activities which, whilst not being innovatory in character, have, in varying degrees, connections with R&D activities, created according to circumstances, either internally or externally to R&D.

Some history (2)

- ▶ 1978 UNESCO Recommendation outlines a step-wise approach regarding measurement
 - a first stage focusing on "R&D activities in all sectors of performance, together with the stock of SET [scientists, engineers and technicians] and/or the economically active SET"
 - a second stage "once a sufficiently large number of [countries] are in a position, on the basis of international experience and their own work to extend statistical observation" to STS and STET
- ▶ Coverage of STS/STET: originally only for institutions in which R&D is performed, progressively expanded → implications for data collection (e.g. surveys vs. budgetary information)

Link with R&D (1)

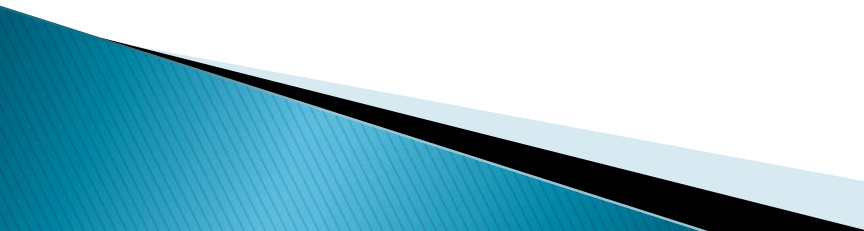
- ▶ Co-evolution as Frascati R&D definition evolved since 1960s
- ▶ Originally R&D explicitly excluded:
 - legal and admin work for patents
 - routine testing and analysis
 - other technical services
- ▶ Latest FM (2002) clarifies boundary excluding:
 - education and training [→ which includes STET]
 - other related scientific and technological activities which include:
 - scientific and technical information services
 - general purpose data collection
 - testing and standardisation
 - feasibility studies
 - specialised health care
 - patent and license work
 - policy-related studies
 - routine software development

→ Many would be currently be in scope of STS

Link with R&D (2)

- ▶ Other exclusions:
 - other industrial activities: (i) other innovation activities [see also *Oslo Manual* 2005]; (ii) production and related technical activities
 - administration and other supporting activities: (i) purely R&D-financing activities; (ii) indirect supporting activities
- ▶ R&D → more closely linked to the production of (scientific) knowledge. STS/STET closer to its transfer and use.
- ▶ FM clarifies boundary of R&D, but categories mentioned outside may be overlapping and go beyond the boundary of STS+STET

Link with innovation

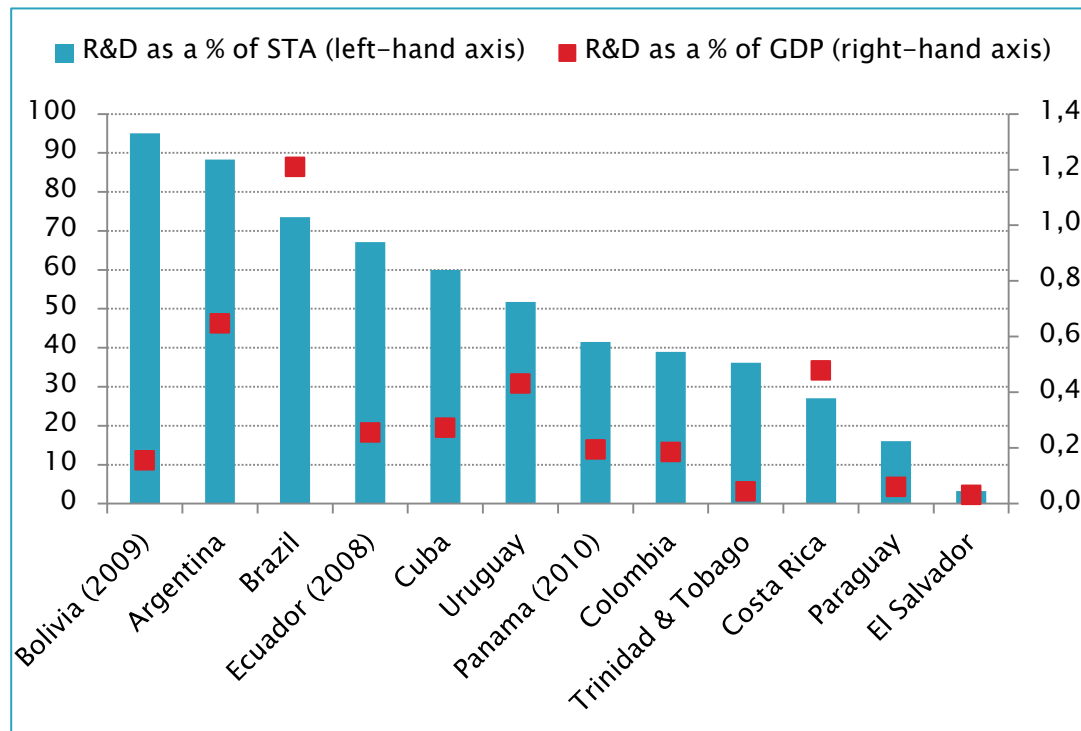
- ▶ More problematic since concept was built on a different logic, even if there is some modularity for measurement purposes (R&D listed as an innovation activity)
 - ▶ S&T (and R&D) characterized by method for acquiring/producing new knowledge
 - ▶ Innovation centered around concept of novelty and more closely linked to implementing something new (or significantly improved) either introducing it into a market, or within an organization
 - ▶ So innovation may or may not require R&D and may or may not involve (other) S&T activities
 - ▶ Problematic to add it as a 4th (additive) component of STA → many boundary problems, in addition to practical issues regarding data collection (until now innovation has been mainly considered as a business phenomenon)
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STA: practical implementation

- ▶ RICYT data shows great variability, confirmed by UIS consultation (metadata) → different methods/scope

R&D and STA in selected LAC countries

2011 or latest available year



Source: RICYT, September 2014

STA: scope of data collection

	R&D	STS	STET	Additional activities
Argentina	Y	Y	P	
Brazil	Y	P	N	
Colombia	Y	Y	Y	Innovation, Administration and support
Costa Rica	Y	Y	Y	
Cuba	Y	P	N	
El Salvador	Y	Y	Y	
Paraguay	Y	Y	Y	
Uruguay	Y	Y	Y	Administration and support

Source: replies to UIS consultation, October 2014.

Examples of data collection in other countries and regions

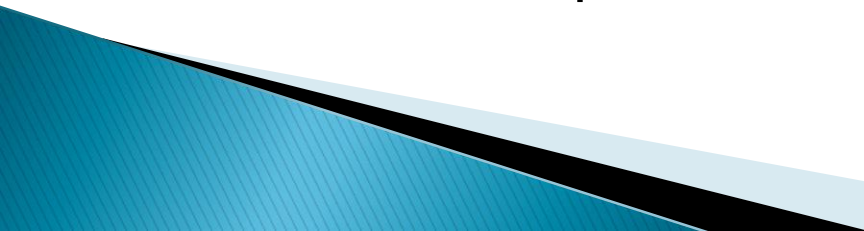
- ▶ Mexico collects data on Federal expenditure on S&T also including (technological) innovation and also estimates total STA
- ▶ China collects data on R&D and STS but not STET
- ▶ South Africa collects data on Government funding for STA which used to include innovation and now only R&D+STS+STET
- ▶ Canada collects data on Federal expenditure on S&T activities which includes R&D and Related Scientific Activities (RSA) → narrower scope, mainly some STS
- ▶ US collects information on Federal Science & Engineering (S&E) support but focusing on academic institutions and consortia and only limited set of activities (e.g. support for S&T conferences, fellowships/traineeships/training grants, etc.)

Identifying problematic areas – overall concept


▶ Strengths

- Broad, so of relevance to larger group of countries compared to R&D, focuses not only on knowledge creation, but also diffusion, adoption
- Currently defined in modular way, so can build on other frameworks for collecting data (notably Frascati)
- Link to concept of HRST which is of high policy interest

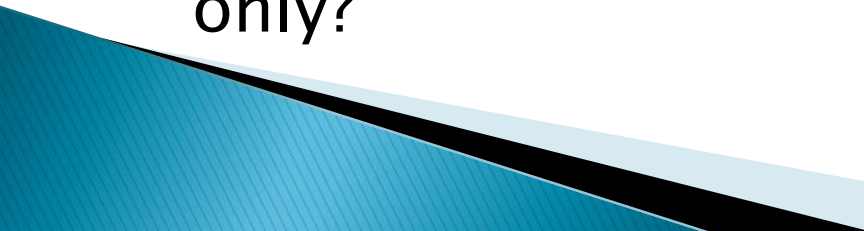
▶ Weaknesses

- Too broad? Difficult to interpret and implement (particularly STET)
 - Boundary issues, mainly with R&D but also innovation and education
 - STS uses list-based definition: can be outdated, not exhaustive
 - Focus on expenditure → little on outputs/impacts
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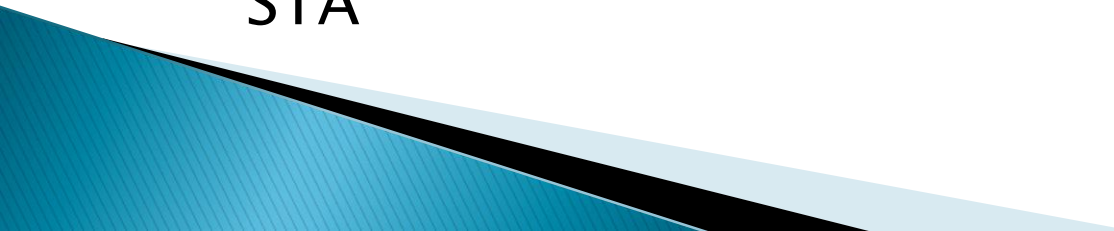
Examining STS

- ▶ Current list combines 2 perspectives: based on the *nature of the activities* vs the *type of organization*
 - ▶ Some could potentially be excluded for both conceptual and practical reasons → Should we consider a sub-set of ‘key’ services that would be prioritized for measurement purposes?
 - ▶ Some should be narrowed: e.g. data collection, activities of S&T-related institutions
 - ▶ Some scope for consolidation: e.g. administrative /support services?
 - ▶ Need to explicitly recognize key role of ICT/Internet services. Separate category? Or within others?
 - ▶ Need to consider to what extent these are required to be linked to R&D
 - ▶ Need to consider practical issues for measurement: target population? Which would already be covered by R&D/innovation/other S&T surveys?
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Examining STET

- ▶ Concerns about scope (too broad?) and boundary (with education)
 - ▶ Combines formal teaching in HE institutions and training programmes for S&T personnel
 - ▶ Unclear whether there is a strong demand to maintain this, or at least to consider it in a modular way with the others → expenditure may not be only (or main) variable of interest (e.g. mobility, career paths, skills)
 - ▶ Need to consider to what extent other surveys/sources can better meet policy demands
 - ▶ If it is maintained, may be preferable to focus on a narrower concept, possibly begin with HES only?
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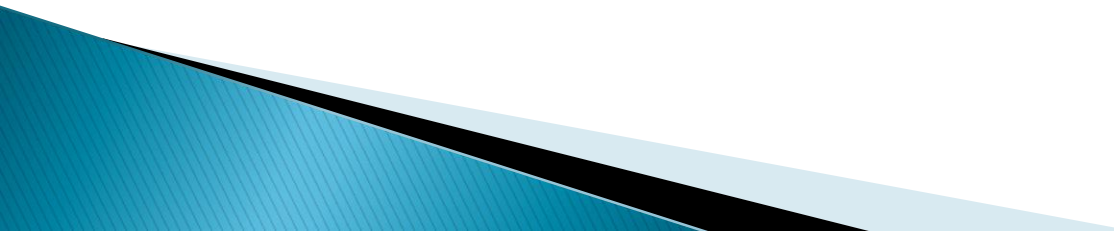
Guiding principles for a revision

- ▶ Need further information from data collectors and input from policymakers and other users
 - ▶ → changes should be clearly justified and feasible to implement
 - ▶ Need to cover both conceptual and practical issues
 - ▶ Can consider various approaches:
 - Marginal refinements to current definitions
 - More significant changes, focusing on modifying the sub-components
 - Longer-term considerations and looking beyond STA
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Maintaining and refining current concepts (i)

- ▶ Aligning with forthcoming *Frascati* for R&D (2015) and reviewing the additional sub-categories (STS and STET)
- ▶ For STS:
 - Discuss whether to continue with list-based definition → another option is to keep only a generic one, and then have examples
 - If a list is preferred, for each one decide whether to keep/drop/adjust (including regrouping)
 - Consider possible additions (e.g. ICT/Internet?)
 - Consider how to treat administrative and other support activities (separate group? Linked with IP protection?)

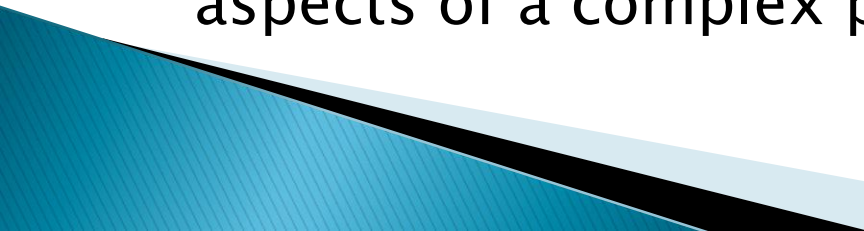
Maintaining and refining current concepts (ii)

- ▶ For STET: if maintained as a related component, possibly narrow focus to HES?
 - ▶ Consider whether for measurement purposes, the scope of STA (or possibly only STS?) should be narrowed to include the Government sector only → in line with practical implementation in some countries which focus on (Federal) Government-funded S&T activities
 - ▶ Should we explicitly consider funding vs. performance? (“GBAOST”?)
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Modifying the definition and boundaries

- ▶ Seems to be little demand for a broader concept of STIA built in a modular way → innovation will still appear as a transversal concept, revised text could focus on explaining links and differences
- ▶ Could also envisage building another additive system starting with R&D: $STA = R\&D + R\&D$ support activities (similar to RSA but focusing only on R&D) + other S&T activities (to be defined, would include some STS) → may be more compatible with what some countries currently include in STA, but would be narrower and (too?) closely linked to R&D

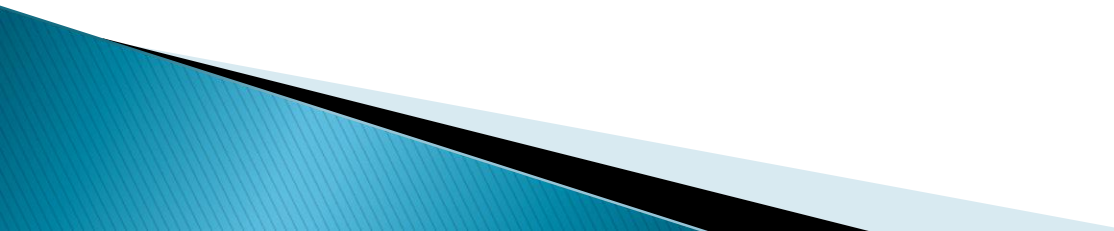
Looking beyond STA

- ▶ Earlier work highlighted the need for S&T metrics to address questions of policy interest to many developing countries regarding the broader role of S&T and its socio-economic impacts
 - ▶ In addition to revising STA, this could be done by making these more explicit within existing frameworks (e.g. Frascati Annex being mainstreamed, ICT/innovation surveys) as well as identifying possible modifications to indicators from other fields (notably education, but also occupational data) to address these issues
 - ▶ Countries with less developed S&T statistical systems will have to prioritize (R&D? basic indicators? Exploit existing surveys and other data sources)
 - ▶ Unrealistic to expect a single figure to capture many aspects of a complex phenomenon
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Conclusions and next steps

- ▶ Feedback on approach, main messages → priorities for a revision?
 - ▶ Interest in contributing to next phase of discussions (e.g. sharing analysis, information on user needs, methodologies)
 - ▶ Would welcome written comments and other material by mid-November if possible
 - ▶ Next steps (Nov.–Dec.): collect additional information, develop initial proposals for circulation to wider group (other regions), further work on personnel (HRST), consider forthcoming Frascati drafts
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Questions for discussion (i) – main priorities

- ▶ Overall conceptual framework? How to consider innovation?
 - ▶ Theory vs. practical implications: conceptual framework may be broad but need to prioritize for measurement purposes
 - ▶ Focus first on reviewing STS?
 - ▶ STET?
 - ▶ User needs, i.e. what do policy-makers want to know?
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Questions for discussion (ii) – STS

- ▶ Should we continue to use a general + list-based definition?
 - ▶ Should there be an explicit/implicit link to R&D?
 - ▶ Should we continue to combine 2 perspectives: based on the *nature of the activities* and the *type of organization*?
 - ▶ Which services among those currently included could be:
 - dropped from the list?
 - consolidated with others?
 - redefined (e.g. narrower scope)?
 - ▶ Which key services are missing or should be more clearly delineated? (e.g. ICT/Internet? Admin/support? Others?)
 - ▶ To what extent should practical issues linked to measurement: be considered, for example regarding the target population?
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Questions for discussion (iii) – STET

- ▶ Is there a strong demand to maintain this as a modular component for the purposes of measurement?
 - ▶ Is there a need to develop a further breakdown to facilitate data collection?
 - ▶ Is there a need to narrow the scope (e.g. focusing mainly on HES?)
 - ▶ Should the focus be instead on exploiting other data sources?
- 