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**EUROPEAN COMMISSION
STATISTICAL OFFICE OF THE EUROPEAN
UNION (EUROSTAT)**

**ORGANISATION FOR ECONOMIC COOPERATION
AND DEVELOPMENT (OECD)
STATISTICS DIRECTORATE**

Meeting on the Management of Statistical Information Systems (MSIS 2010)
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Topic (i): Developing common high-level architectures

**A Collaborative Development Approach to Agile Statistical Processing
Architecture –
Australian Bureau of Statistics (ABS) Experience and Aspirations**

Invited/Supporting Paper

Prepared by Brian Studman, Australian Bureau of Statistics

I. Introduction

1. The Australian Bureau of Statistics (ABS) has conducted two major change programs in the last decade, improving business and social statistical processing, and data capture and dissemination services. These programs have positioned ABS to begin a strategic information management transformation program (IMTP), including a new approach to ABS business, applications, information and technology architectures. Importantly, our experience locally and internationally is that statistical institutions cannot afford to act in isolation in the development and enhancement of the next generation of our information management systems. The ABS has committed to using DDI¹ and SDMX² metadata standards in the context of the statistical value chain. The ABS has also committed to using the Generic Statistical Business Processing Model (GSBPM)³ as a process reference model. Added to these choices, is the maturity of service-oriented architecture (SOA)⁴ and the enabling technologies fuelled by internet and Web innovations. These themes of metadata, process, architecture and collaboration operate throughout this paper as their deliberate confluence, dominate ABS business and architecture strategy of the new IMTP initiative. More specifically, this paper expands on the architecture theme.

2. ABS is seeking to create a collaborative development approach (beyond sharing) that delivers practical outputs and mutually supports existing international efforts and furthering of standards which directly support our statistical information industry.

¹ <http://www.ddialliance.org/>

² <http://sdmx.org/>

³ <http://www1.unece.org/stat/platform/display/metis/The+Generic+Statistical+Business+Process+Model>

⁴ http://en.wikipedia.org/wiki/Service-oriented_architecture

II. ABS Revised Architectural Approach and Collaboration

A. Architecture Lessons and the New Approach

3. The concepts of re-usable design, metadata and software in business systems have existed at the ABS from at least the 1960s onwards (the first mainframe era). Formal architecture practice and theory did not begin until the late 1990s. Over the subsequent years, the theory (which was also evolving) was examined and employed. FEAF, DoDAF, Zachmann⁵ and other approaches, and later TOGAF all passed through thought processes, with some inclusion in architectural efforts but making limited impact.

4. The use of “Posters” (arranged diagrams and content on an A3 sheet) for architecture became a central method for production of architectural content in the late 1990s. While successful in some facets, notably at a conceptual level, these were largely user-views at mostly higher levels of content and left many key aspects of architecture unanswered with staff. The associated architectural governance processes lost traction without a richer set of content and a commitment to process. The “Poster” Architecture approach fulfilled some higher order business value in communication change, but gradually eroded.

5. In beginning a new approach, several architecture lessons were evident from our previous experiences:

- the lack of structured architectural content, particularly at lower levels of detail allowed projects to make good local choices but of lower strategic value as the more complete guidance was not in place;
- when the original architecture content was sound, it became dated when communicated in ‘posters’;
- whilst some business ownership and engagement was initially created, this did not persist and mechanisms for business input and ultimately business architecture governance did not occur;
- the architecture governance model did not have architecture input early enough in project development; and
- the translation of architecture into high-level design was not facilitated and subsequent detailed design did not necessarily align with architectural directions.

6. The new ABS architectural governance approach addresses several lessons to create continuous business engagement in both the Architecture Working Group and Architecture Board, and through the ‘solution designer’ role employed to influence projects in their early stages:

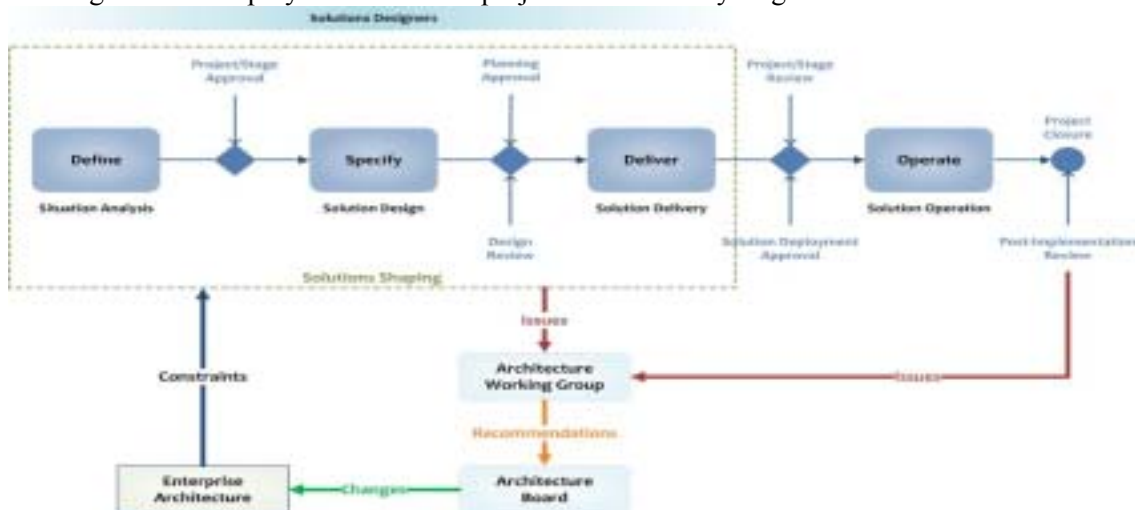


Diagram 1: Where the ‘Solution Designer’ Translates Architecture to Design

⁵ Other enterprise architecture frameworks

7. Architecture governance does not exist in isolation of other business governance and planning processes. The adoption of formal standards frameworks are shown in an IT management context below to integrate architecture processes⁶:

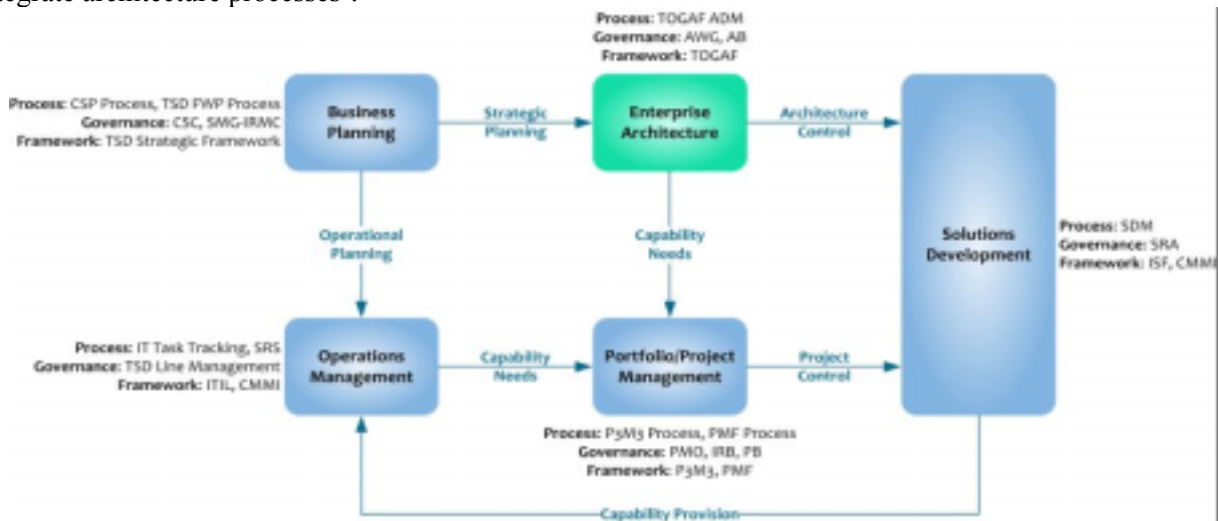


Diagram 2: Relationship Between Frameworks Relative to Architecture at ABS

B. What Type of Architecture Enables Collaboration?

8. In creating a revised architecture initiative within ABS, a central factor was to adopt an approach that would support:

- ABS business objectives,
- the Australian National Statistical System (NSS) objectives, and
- improved (statistical) international collaboration and sharing.

9. Collaborative projects which create outputs of use to all three levels above, produce the most compelling investments and greatest business value. The ABS and other organisations' experience, has demonstrated that collaboration requires mutual adoption (and usually further development) of standards. Identifying, agreeing and developing statistical industry standards relevant across architectural domain enables sharing and collaboration at heightened levels.



Diagram 3: Standards Across the Architecture Domain⁷

10. Like many governments in the world, Australia has adopted formal architectural approaches, primarily based on improved interoperability and efficiency between government agencies. In Australia, this is known as the Australian Government Architecture (AGA)⁸ which was initially adapted from the US Government's FEAF. The ABS has also adopted The Open Group Architecture Framework (TOGAF)⁹ as a mature (business and technically) architectural framework, providing both content and a process advice. TOGAF is easily synthesised with the AGA, but as an open standard for architecture, is accessible

⁶ A number of ABS organisational acronyms and IT framework acronyms are used in this diagram. The intent is to show overall governance integration.

⁷ From TOGAF Version 9.

⁸ <http://www.finance.gov.au/e-government/strategy-and-governance/australian-government-architecture.html>

⁹ <http://www.opengroup.org/togaf/>

internationally. In developing high-level shared architecture, a TOGAF concept, the Architecture Continuum, can be used to target the areas of common value. Using an 'open' architectural framework provides a common language for communication of architectural and design artifacts:

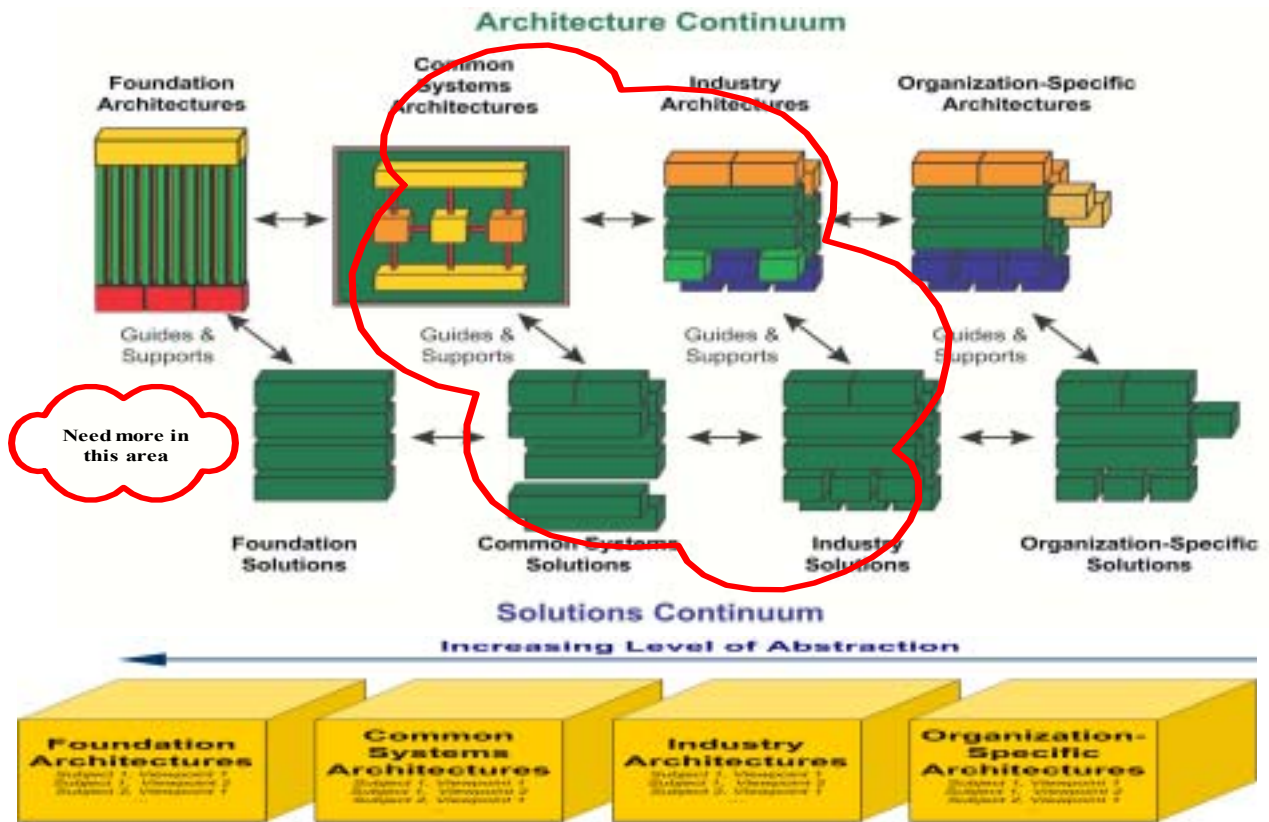


Diagram 3: Targeting Highest Value Architecture for All National Statistical Institutes (NSIs)

11. The current ABS architecture activities are summarised below, heavily influenced by IMTP initiative. They are a series of planned iterations of the TOGAF Architecture Development Method to document content, target and develop roadmaps:

- TOGAF 9 is the adopted architectural framework;
- multiple iterations of the TOGAF ADM¹⁰ are planned with iteration 1 being completed by the end of June 2010;
- iteration 1 will focus on high-level Target (to be) Architecture for IMTP as 'Core' Business, Information, Technology and Security architecture;
- iteration 2 will focus on assembling and organising Baseline (as is) architecture;
- iteration 3 will provide more detailed Target architectural artifacts;
- iteration 4 will expand on the key areas of Data, Metadata and Paradata Architecture.

12. Data architecture represents a proportionately larger part of the new architecture efforts.

C. Collaboration

13. The ABS has been an active participant, contributor and learner in the development of the current exceptional culture of goodwill and sharing that exists between international statistical organisations. The development of international statistical frameworks such as the System of National Accounts and Balance of Payments Manual, international classifications, and sharing of software infrastructure has been essential for most statistical agencies including the ABS.

¹⁰ TOGAF Architecture Development Method

14. National statistical organisations do not compete with each other in (almost) any dimension – but do compare in methodology, internal best practice, quality and efficiency and international reporting. Even in international government business terms, this is a unique situation. The potential for deep and wide cooperation and collaboration is extreme in the global ‘statistical’ industry.

15. The establishment of the National Statistical Service in 2004 formalised many lead-in activities occurring in the ABS. The NSS is the community of Australian government agencies, led by the ABS as Australia’s national statistical organisation, building a rich statistical picture for a better informed Australia. The NSS initiative seeks to improve the full suite of information produced by government. Government agencies across all levels are increasingly producing and/or using statistical information for developing policy, performance monitoring and also program evaluation. The NSS has provided the bulk of ABS collaboration experience in recent years.

16. ABS has observed, discussed and shared many similar collaboration experiences with other organisations. A summary of collaboration lessons is offered below with a stronger emphasis on the systems, project management, technology and architecture aspects of collaboration. These experiences are presented as a set of discussion points for MSIS members. They are not regarded as doctrines or collaboration rules by the ABS. They are synthesised as a set of factors which have improved the likelihood of collaboration success:

- The central aspect of any collaboration is ‘mutual value’ propositions – they might be interpreted differently for each collaborator. The need to define and ideally demonstrate a clear business benefit (“value proposition”) to all stakeholders including internal stakeholders is the binding element.
- One solution (whatever the granularity) is not always adequate. Healthy competition for at least some process solutions is beneficial, but they must technically interoperate within an agreed architecture.
- A common architecture, at the right level, is fundamental to enable collaboration beyond just sharing what has already been produced. An agreed services, data and metadata interchange framework can overcome differences in technology architecture.
- Genuine commitment (as opposed to ‘watching briefs’ and passive participation) in the collaboration is essential by all collaborators.
- Cultural, organisational and individual differences can be overcome with mutual respect and attention to detail, particularly with formal project management practices. Good project management discipline is needed. This is not a legal agreement but a ‘committed’ agreement possibly through a Memorandum of Understanding or something similar i.e. we won’t sue each other, but could lose confidence if one collaborator fails to deliver.
- Issues of intellectual property, software licencing, on-going support arrangements, legislative differences, technology differences, and project management practices usually can be overcome through careful planning and agreement ‘up front’. While complex issues which cannot be underestimated, formally managing them as risks and creating an escalation path to the collaboration program level if problematic, has created successful outcomes for ABS.
- While ABS is yet to experience human language issues (particularly when applied to software), we are aware of the enormous experience of our international colleagues in other agencies who has successfully addressed this. Again, this issue must be planned for.
- Senior executive ‘champions’ are necessary in all collaborating organisations in order to maintain collaboration discipline but more importantly maintain informal relationships at influential levels.
- Incremental delivery seems to work best – this suggests an ‘agile’ time-boxed project process. Timeframes can be considerably different/longer than internal projects.
- The ‘lead agency’ model does work for collaborations and defining roles and responsibilities allows all to appropriately contribute.
- There is strong benefit from out-posting staff to other collaborating organisations.

17. Overall, as many others have found, collaboration can prove harder than first envisaged. There are complications but they can be managed. Notably, the investments in collaboration projects can be kept modest, for what is a considerable to extremely high return. In a world where: more dynamic and complex information

needs, new content providers with limited quality capability and rapidly changing technology manifest, moving from ‘sharing’ to serious, productive collaborations is an essential, strategic capability for National Statistical Institutes (NSIs) to prosper and be collectively influential. Collaboration on new requirements presents a high value to participating organisations:

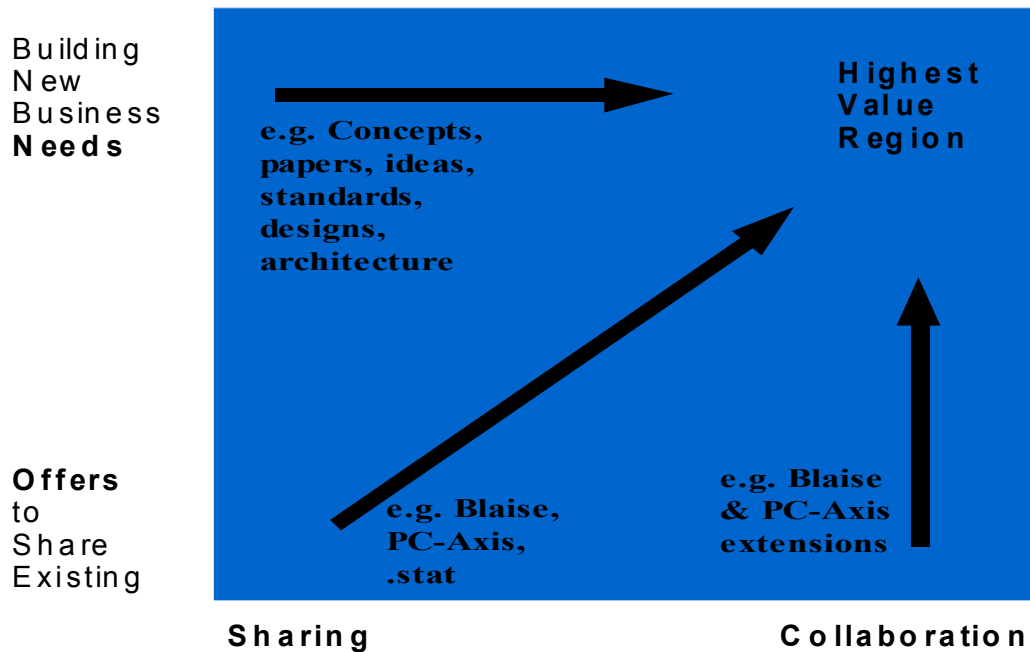


Diagram 5: Highest Value Area - Sharing and Collaboration

III. The Information Management Transformation Program (IMTP)

A. What Now?

18. For the ABS, the four threads of process, metadata, architecture and collaboration have grown and evolved at different times and rates. Observations from national and international visits, conferences and professional relationships with overseas colleagues, a mature understanding and enormous respect for the work of others, the realisation of a future which combines these four threads into the strategic fabric of the ABS (and maybe other organisations) is essential. In the statistical business context, process and metadata provide critical and more crucial elements of architecture. Common high-level architecture that delivers enhanced local and international benefit, can be achieved with collaboration.

19. In February 2010, IMTP commenced officially – the new program merged two ‘fledgling’ programs - International Collaboration Efforts (ICE) and the DDI-SDMX Implementation Program (DSIP). Both ICE and DSIP had identified architectural development as a major element requiring the integration of standard process and metadata. DSIP also has embraced a number of practical ‘pathfinder’ projects. The IMTP strategic outcome will enable data consumers to discover, create, relate and compare quantitative information models that address more complex issues of society, the economy and environment for improved decision-making and research. These models increasingly involve hybrid subject-matter integration using data from national and international sources. IMTP is a business transformation program with outputs aimed at:

- reducing cost;
- improving effectiveness and ability to respond;
- a holistic approach to managing and improving the entire statistical life-cycle; and
- improving the level of international collaboration.

20. ABS is pursuing a collaboration approach, developing and sharing of ideas, interfaces and tools through agreed architecture, but with acceptance of national differences. The approach builds on progress in

international statistical community standards (SDMX, DDI), and GSBPM. The aim is to make them work in practice. The approach is to contribute to pragmatic development of the standards, where appropriate.

B. IMTP and (some of the) Architectural Elements

Business Strategy and Business Architecture

21. ABS business strategy and motivators relating to IMTP have been presented in conferences in recent years - most recently MSIS 2009¹¹. An increasing number of issues require discoverability of sometimes less obvious data sources, reliable data, data linking, and our governments are asking to learn from and compare themselves to other governments when determining complex policies and programs. As an official statistics provider, we use quality as a differentiator. Our business model includes these broad functional operating modes:

- an information provider,
- an information aggregator,
- a service provider,
- a systems creator,
- a standards developer, promoter and user, and as
- a consultant.

22. Our business capability to not just operate but prosper in a national and international context is not as strong as we would like. This business driver led to the creation of the IMTP initiative as has been described in “The Case for an International Statistical Innovation Program – Transforming National and International Statistics Systems”¹², and supported by recent ‘strategic scenarios’ created from a series of interviews with ABS senior executive staff.

Data, Metadata and Paradata Architecture

23. While ABS has created several substantive improvements in metadata management using the well understood metadata management principles and approaches defined in the Common Metadata Framework¹³ and ABS documentation, the end-to-end, reusable, ‘active’ metadata objectives remains elusive. Our understanding of other NSIs shows similar experiences. The lack of sufficiently mature (or non-existent) standards in crucial areas of statistical processing metadata, had previously hampered progress. Formal adoption of DDI and SDMX is viewed as essential to create the metadata infrastructure and services for current and future business agility and demands. While limitations exist with DDI and SDMX, together they are now a suitable base, and can be further developed.

24. Metadata is viewed as the key to better approaches and process improvements and it has been in all previous ABS improvement programs¹⁴. ABS has a long history in trying to manage metadata (with mixed success). We need to understand it, rationalise it, share it, and use it to automate and drive processes and make the outputs more integrated and usable. Previous improvement programs have generally been much more limited, focussing on a few areas in a few ABS projects. Metadata management is a major part of IMTP: storing it, rationalising it, making it available for sharing and easy use, and presenting it in different ways, as is integrating with existing stores such as the ABS Input Data Warehouse, Data Element Repository and the ABS Information Warehouse (output). In architecture terms, we talk of a “registry-managed common metadata

¹¹ <http://www.unece.org/stats/documents/ece/ces/ge.50/2009/wp.3.e.pdf>

¹² Brian Pink – Australian Statistician, Jenine Borowik – ABS CIO, Geoff Lee – Head of Methodology and Data Management Division, now Program Manager of IMTP. Earlier concepts have been delivered at ISI 2007 by Brian Pink, MSIS 2009 by Jenine Borowik. This paper is attached for reference.

¹³ <http://www.unece.org/stats/cmfi/>

¹⁴ Adapted from METIS 2010 presentation by Bryan Fitzpatrick representing ABS. See “End-to-End Management of the Statistical Process”, Bryan Fitzpatrick, Rapanea Consulting Limited and Australian Bureau of Statistics, Work Session on Statistical Metadata (METIS), March 2010, Geneva

services layer” which means the metadata is easily available to all systems running in the ABS environment. We are currently defining what this means practically and how it should look, conducting a ‘metadata usage census’ of our business systems and creating “use cases” – examples of what business areas and their systems need to do with the metadata. The resulting metadata services will deliver various sorts of metadata in XML formats conforming to schemas from DDI and SDMX. IMTP focus will be on metadata that is “actionable” – this means we want it in a form that:

- both people and systems can use;
- can be easily stored and passed around; and
- that can be used easily to generate whatever format is required in any particular case including to/from XBRL and XForms, RDF, web pages, PDFs, manuals, other human-readable forms (SDMX and DDI both represent the metadata in XML with its associated benefits in format translation).

25. A major focus is on metadata management versioning and maintenance as defined in SDMX and DDI. This includes “confrontation” across collections and processes for consistent, standard, metadata across the organisation and consistent with international use wherever sensible. The synthesis of SDMX and DDI is pivotal to IMTP. The design of a federated metadata repository-registry physical architecture, where its services enable and support the GSBPM is a central architectural concept. This ‘to be’ architecture will also be joined with a summary ‘as is’ state, and a roadmap to move to the ‘to be’ state. ABS has engaged leading experts¹⁵ in these standards to build capability, advise and help design parts of our implementation. The integrated DDI-SDMX approach was recently presented by Arofan Gregory at METIS 2010¹⁶:

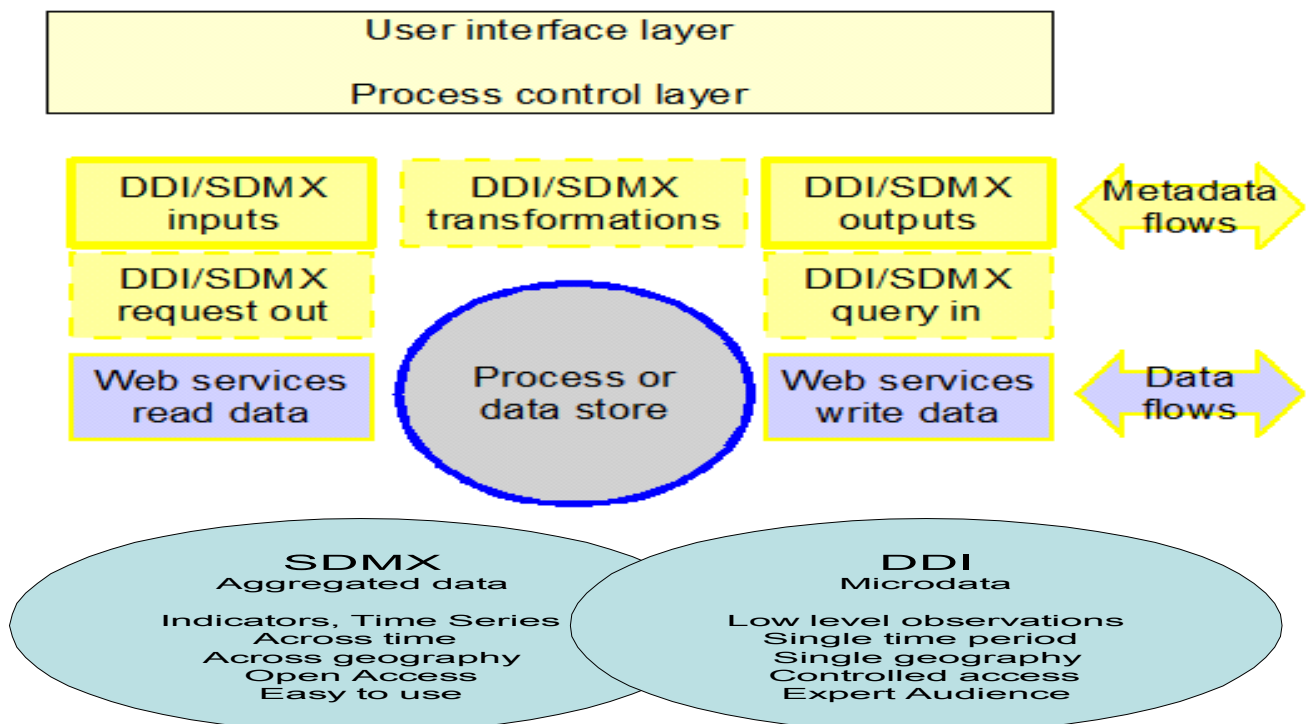


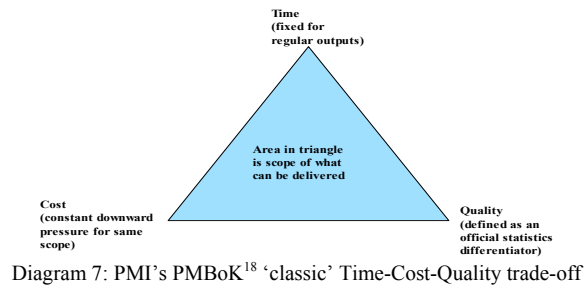
Diagram 6: Adapted concept diagram of the integrated DDI-SDMX Approach

26. Paradata¹⁷ is a specialised form of metadata and viewed as having enormous potential to drive and improve statistical processing. Commercial industry case studies are now well advanced in the use of six sigma and business activity metrics, to dynamically manage production processes and better respond to changing external demands. The business basis for this is seen in using a simple project management concept applied to the statistical process:

¹⁵ Bryan Fitzpatrick, Arofan Gregory, Wendy Thomas and Joachim Wackerow

¹⁶ <http://www.unece.org/stats/documents/ece/ces/ge.40/2010/wp.3.e.pdf>

¹⁷ For this paper, we will use a simple definition of paradata to include statistical quality metrics and business activity metrics.



27. Alternative ways to improve are to:

- process to quality rather than time (only), and
- to reduce activity costs and component time through real-time business-activity metric analysis.

A 'first generation' ABS initiative at using paradata was the ABS Quality Information System (QIS) - a sufficiently successful project to prove the value, but suffered from implementation issues.

Application (Process) Architecture

28. The clear and necessary linkage of metadata with process was well proven throughout the experience of previous ABS business transformation programs. The ESSNet CORA¹⁹ initiative also acknowledges that repeatable, workflow-enabled business process with granular software components create a superior approach. ABS recently expanded on our experiences with the GSBPM at METIS 2010²⁰. Almost every business transformation program developed its own statistical value process, but the overwhelming support for GSBPM (whatever its current inadequacies, which can be addressed²¹) makes it an easy 'statistical industry' choice. Process workflow (most commonly represented in BPMN) can be automated by the WS-BPEL standards-enabled process orchestration software products, creating pragmatic instances of the GSBPM Reference model. BPMN and WS-BPEL are also shareable and re-usable application processing architecture artifacts for a statistical industry architecture. The advancement of SOA, through design, standards and tooling has made creation of more granular software components with services interfaces more attainable. This supports the interoperability of solutions created by diverse groups with different programming tools. The ABS is acquiring and implementing a second generation, commercial business process modelling system /software suite at present. We use both Java (preferred) and .Net (accepted) development environments to produce and support both SOAP and RESTful state Web services.

29. The Application architecture will be based on employing the workflows ABS has developed over the last 6-7 years across many statistical processing areas. We wish to understand the CORA work better in this area. The diagram below shows our view of how workflows fit within the GSBPM:

¹⁸ <http://www.pmi.org/Pages/default.aspx>

¹⁹ <http://epp.eurostat.ec.europa.eu/portal/page/portal/essnet/cora>

²⁰ See <http://www.unece.org/stats/documents/ece/ces/ge.40/2010/wp.10.e.pdf>

²¹ Various comments have included weaknesses in support of microdata processing, complex analysis, external client interaction for content co-creation, support for compilation (non-survey) processing such as National Accounts. The author offers no opinion on these comments.

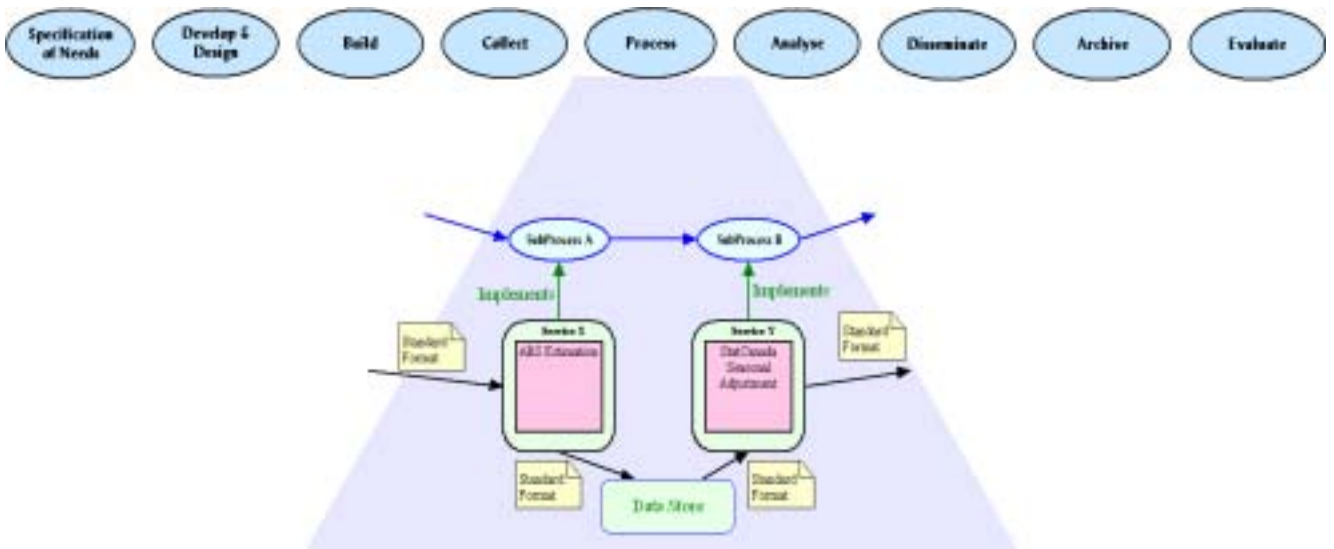


Diagram 8: From Reference Process to Workflows

30. A highly simplified high-level architectural approach that characterises IMTP is shown below:

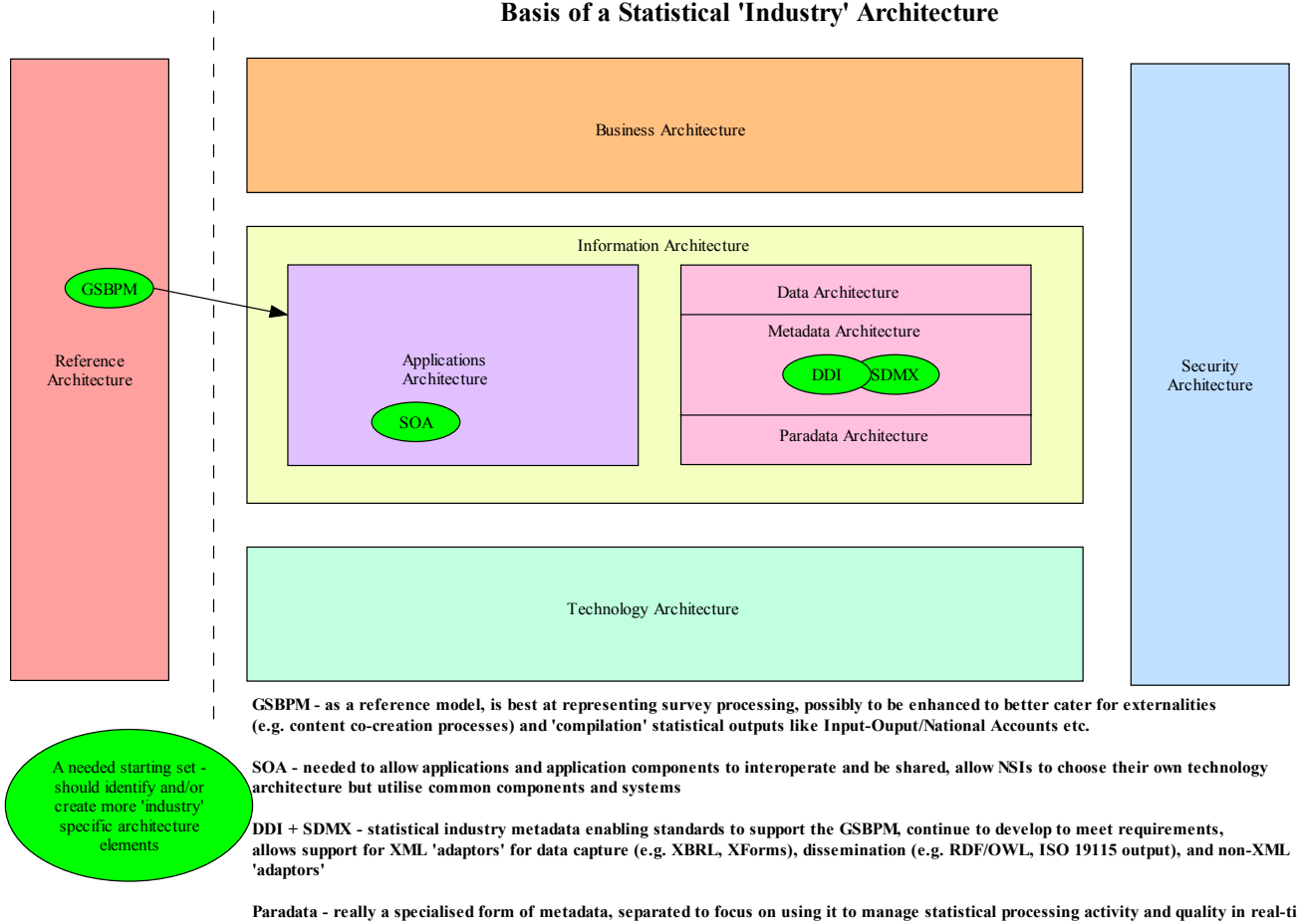


Diagram 9: Summarising a high-level TOGAF view - the chosen (starting) standards for IMTP

C. IMTP and Collaboration

31. International collaboration is an integral part of IMTP. Most NSIs are feeling financial pressures and struggling to build everything themselves and create the required business agility. As mentioned previously,

there need not be one solution for every part of the GSBPM and collaboration should not be confined to NSIs only – there is genuine value in working with commercial providers to our industry. Our ability to discuss, agree and collaborate may well define how influential NSIs are in global context, and whether we simply exist, or prosper. ABS has held discussions to advance a very practical collaboration approach. Agreed standards are an important enabler and collective participation of NSIs in evolution of standards for use in an international context is required. In reviewing the collaboration barriers and lessons mentioned in Section II c. and how might we manage them, we do not want too large a group of collaborators at the start, but when we define, design, build and share, it is done in a manner of value to all. ABS (and others) will continue to report to international forums and meetings on the managerial and technical aspects of this approach. Maintaining a current understanding of the work of others, and to contributing to existing initiatives (e.g METIS, CORA work, DDI and SDMX standards development), is an essential part of the strategy.

32. The diagram ²² below shows an evolving architectural metamodel (i.e. what architectural artifacts we wish to create in our IMTP-International Collaboration work). Note that ICE is our internal abbreviation for international collaboration efforts:

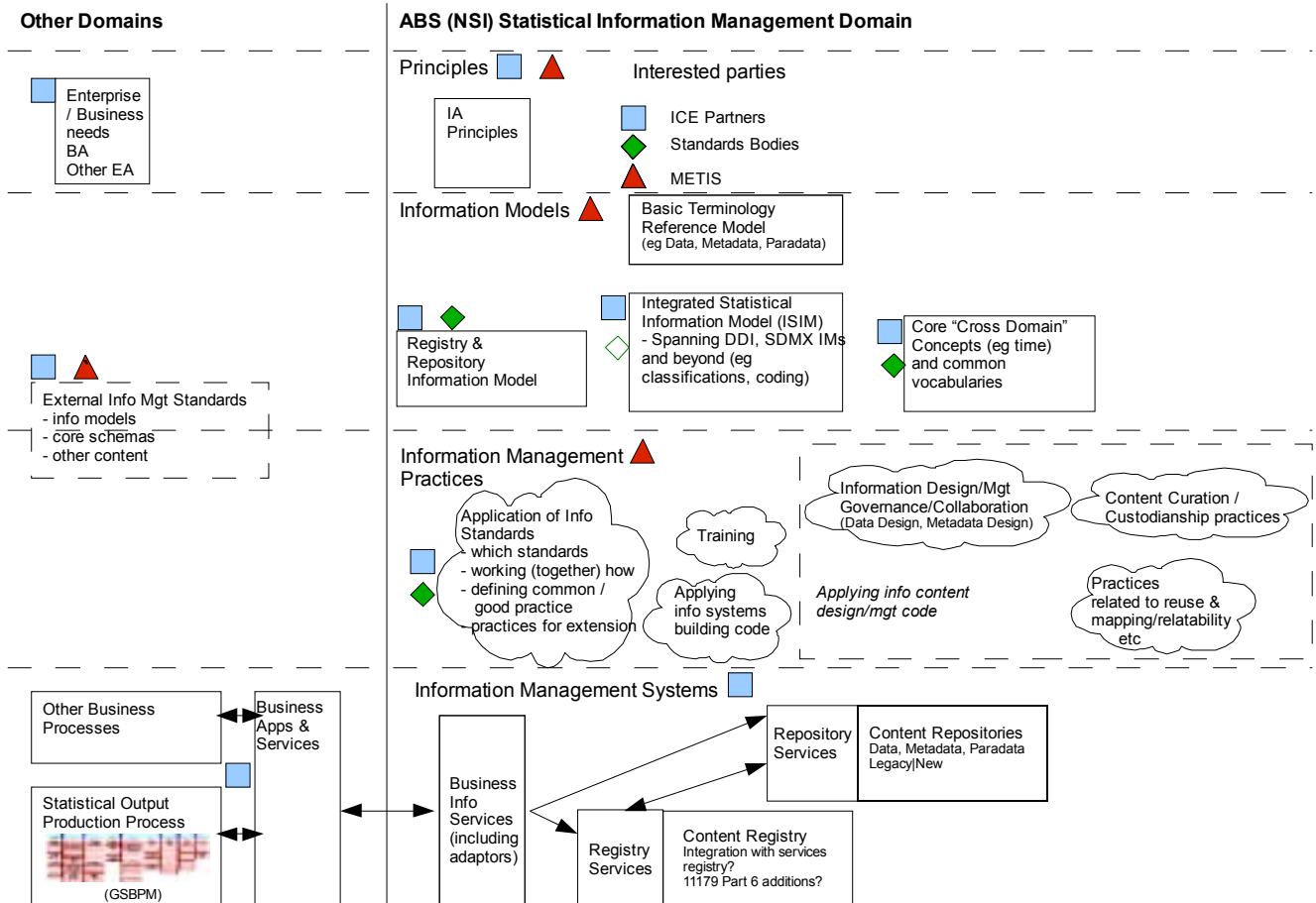


Diagram 10: Draft IMTP Architecture Metamodel

D. IMTP and the ‘Pathfinder’ Projects

33. IMTP subsumed ‘pathfinder’ projects which allow for a research to mitigate business and technology risk, develop staff capability and some will reach production status as part of the IMTP architecture. A short description of these is included to demonstrate that tangible progress is being made. The initial set of ‘pathfinder’ projects include (not a complete list):

- A major new microdata dissemination system being developed in partnership with Space-Time Research which will support a source DDI microdata feed into a dynamic query dissemination

²² Courtesy of my colleague Alistair Hamilton, Chief Metadata Architect in the IMTP team.

system which will support both a Web site user interface and Web services producing SDMX output (plans to extend to ISO 19115 geo-spatial output and possibly RDF output).

- The adoption of (OECD).stat as a major dissemination warehouse supporting SDMX services.
- The use of DDI to better integrate the ABS e-forms initiative using XForms.
- The application of DDI metadata to the ABS Input Data Warehouse ‘constellation’²³.
- Publishing of DDI described metadata on the ABS Web site with ideally, active linking to output data.
- A demonstration ‘new architecture’ implementation of the ABS Tourism Satellite Accounts processing system which will include the use of BPMS, a business rules engine, new process workflow user interface, and metadata services use of DDI and SDMX.
- Early design work of the federated metadata registry-repository architecture.

34. The diagram²⁴ below plots the current ‘pathfinder’ projects on GSBPM Version 4.0:

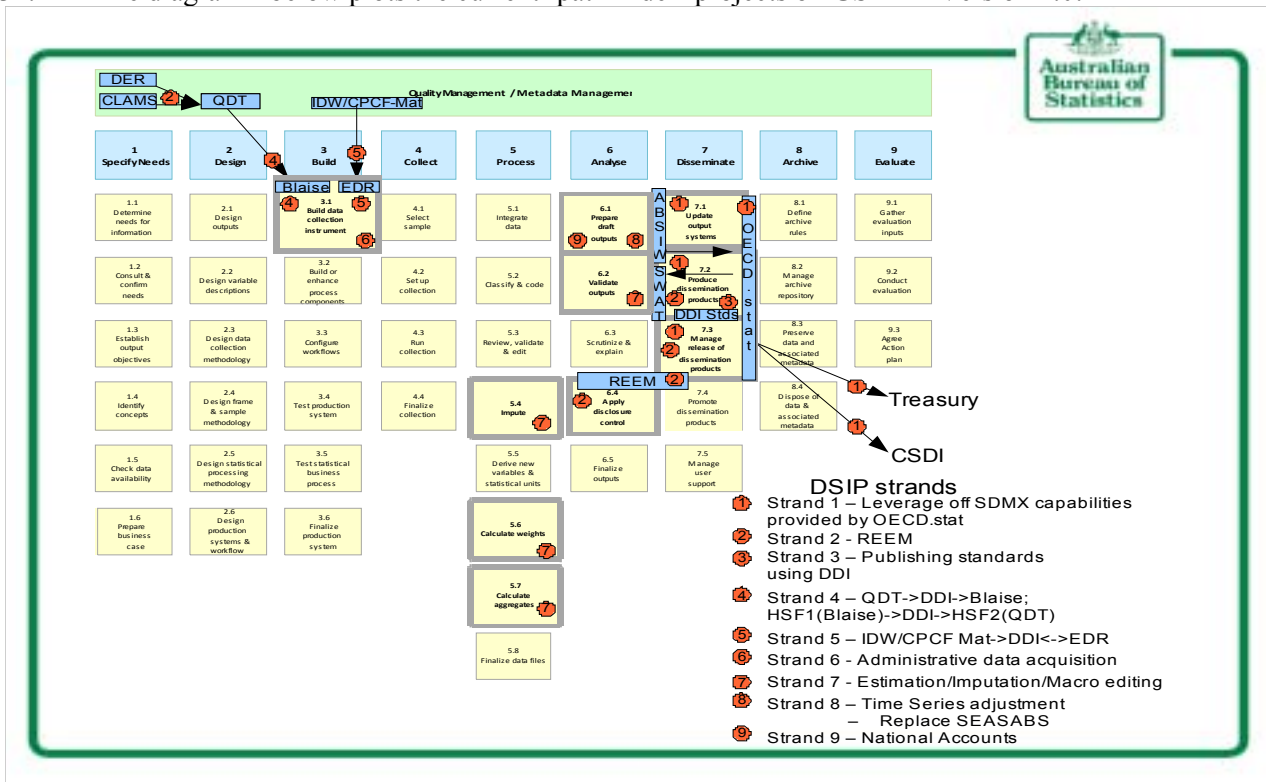


Diagram 11: IMTP ‘Pathfinders’ Plotted on GSBPM

IV. Conclusion

35. The Australian Bureau of Statistics (ABS) has accumulated experience in a range of business transformation, architecture, and collaboration areas in the last few decades. By drawing together :

- developments in process management,
- metadata management standards,
- a new approach to architecture with direction from recent business strategy, and
- recognising the need for a highly pragmatic approach to international collaboration with standards adoption to enable a common architecture,

the IMTP program was created to embody these directions. The ABS looks forward to merging our experiences and intellect with that of other NSIs in progressing the international aspects of IMTP at deeper and more practical levels in our respective organisations.

²³ The IDW is a series of star-schema input warehouses, linked by ‘conformed dimensions’ and a common access services layer.

²⁴ Contains some ABS specific acronyms not fully explained in this paper.