

Building a Reference Model of the Science Technology Research and Development

Meng-chyi Harn

Takming University of Science and Technology
Department of Information Technology
Associate Professor
harn@takming.edu.tw

Cathy M. Sung

Association of Chinese Enterprise
Architects
Secretary General
cathysung0714@gmail.com

Wen-hsiung Hsieh

Industrial Technology Research Institute
Industry College
Director
georgehsieh@itri.org.tw

Fang-you Huang

Industrial Technology Research Institute
Industry College
Senior Consultant
francis@itri.org.tw

Abstract

The purpose of this research is to assist the [enterprise architects](#) in [Science Technology Research and Development Program \(STRDP\)](#) to create the [enterprise architecture reference models](#) and save them into the [repository](#). They will be reused to duplicate the similar artifacts in the future. Since we use [enterprise architecture method](#) to model a project, [the STRDP reference models](#) should be represented by a formal discipline, called the [Enterprise Architecture Framework \(EAF\)](#). In this study, in order to rapidly depict the [view diagrams](#) we do [explore](#) only for [the reference model](#) and [enterprise architecture repository via the enterprise architecture methods](#). These models can be applied to writing [STRDP proposal](#) of a program that can be executed and closed and should be approved by the sponsors in advance. The subject areas of [science and technology research and development](#) are not limited to [information technology](#) but include each of the high-tech industry. The best practices of its application areas in our research are from traditional to innovative study, from public to private domain, from defense to civil society, from academic to industry research, from domestic to foreign countries, from a single to integrate mechanism, from technology to service transformation, from small to major case, from planning to executing program.

Keywords: Enterprise Architecture, Architecture Development Method, Architecture Modeling Language, Reference Model, Science Technology Research and Development Program (STRDP).

1. Introduction

Before creating any STRDP, the program leader generally discusses the following issues: research motivation, research objectives, problem definition, conditions of restriction, research methodology, business process, and resource contributions, for the research topic[7]. To learn the previous research results and others, program team members usually discuss the related party discourse, and clarify relevant technical background from references. The emphasis of STRDP mostly focuses on modeling assumption, modeling process, the expectation result of modeling and actual verification. If we write these contents to become one book, we call STRDP Proposal.

If STRDP Proposal is reviewed and passed, the program will be conducted by the proposal to run the technical modeling and actual verification by the investment of restrictions, such as human, material, financial and time resources, etc. Finally, the program review committee will evaluate the research contributions of the program according to the achievement for each Key Performance Identifiers (KPI).

Science Technology Research and Development Program (STRDP) here said means to seek technology-based R&D program. These programs are subject to review and examination by the government subsidies which are included Ministry of Science and Technology, R.O.C. (MOST), Ministry of Economic Affairs, R.O.C. (MOEA), Ministry of National Defense, R.O.C. (MND), Ministry of Education, R.O.C. (MOE), etc. Of course, our research discourse also includes a variety of private enterprise R&D programs.

STRDP Proposal is used to make the strategic planning to achieve program goal by program leader. Currently, each STRDP Proposal has a certain format and writing contents, although slightly different, but similar. Since the domestic STRDP program leader mostly executes the informal way for program application, implementation and closing, it is less rigorous to make the program effect underperform.

In view of this, we introduce enterprise architecture method to build STRDP reference model and make the strategy planning in STRDP have read-made formal models for reference. The program team can develop the various models which belong to the subject areas by these reference models to accelerate the writing and practice of STRDP.

We select the enterprise architecture method for our research methodology because the method is quite rich. Therefore, in order for the convenience to build the artifacts we only focus to use Architecture Development Method (ADM) and Enterprise Architecture Documentation Methodology. [1][8]

The former is used to complete the relevant reference model and establish the EA repository. The latter is to thereby complete the relevant EA documents after finishing STRDP enterprise

architecture. To build the reference model is based on the meta-discipline of STRDP to convert EA document specification, form EA reference model and save into EA repository for EA components. Finally, the enterprise architect models EA artifacts by gathering EA Documentation Framework in EA repository and combining with data collection in program.

2. Related Technology

Standardization of the documentations and artifacts of enterprise architecture is named enterprise architecture framework. Its abbreviation is Architecture Framework (AF). There are many sects in worldwide enterprise architectures. For example: EA³ Cube Framework, Business[1], Operational, Systems and Technology Framework (BOST Framework), Ministry of Defence Architecture Framework (MODAF), Atelier de Gestion de l'ArchiTEcture des systèmes d'information et de communication (AGATE), NATO Architecture Framework (NAF), Structure-Behavior Coalescence Architecture Framework (SBCAF), The Open Group Architecture Framework (TOGAF)[8], The Unified Profile for DoDAF/MODAF (UPDM) by Object Management Group (OMG), AUTomotive Open System Architecture (AUTOSAR), Structure-Behavior Coalescence (SBC)[2][3][4][5][13]etc.

The primary enterprise architecture frameworks related with Federal government of the United States are Zachman Architecture Framework[10][11], Federal Enterprise Architecture Framework (FEAF), Treasury Enterprise Architecture Framework (TEAF), Department of Defense Architecture Framework (DoDAF), etc. [12]

Framework is composited of basic tool elements by System Analysis and Design (SAD). It includes Structured Tools, Integrated Computer-Aided Manufacturing DEfinition Tools, ICAM DEfinition Tools, Entity Relationship Diagrams, ER Diagrams, Hierarchical Trees, Tables, Matrixes, Texts and Graphics, etc.

The essential of framework is formalization with unify and compliance meaning. Because the composite structures of the skeleton and hierarchy, it is referred to framework.

The evolution concept of international enterprise architecture framework from 1987 to 2003 is shown in Figure 1. The left side in diagram contains the Zachman Framework (1987), NIST Enterprise Architecture (1989), EAP (1992), TISAF (1997), FEAF (1999) and TEAF (2000). The left side in diagram contains POSIX, TAFIM, JTA, JTAA, TOGAF (1995), DoD TRM, C4ISR (1996), Army Enterprise Architecture Guidance (1998) and DoDAF (2003).[12]

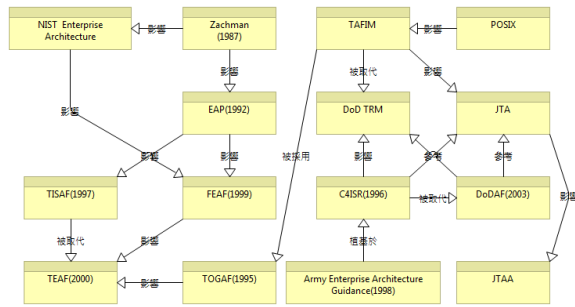


Figure 1. Important abroad Enterprise Architecture Development History Graph

3. Reference Model Mechanisms

3.1 Confirm all EA Components within Document Specification

We specify EA documentation methodology and define EA components and documented EA component specifications for each functional area and vertical threads area in STRDP.

3.2 Select the appropriate EA Documentation Methodology

It is very important to select the appropriate EA documentation methodology because it provides the necessary information of enterprise resource planning and decision making.[7] Chief Architect should discuss with EA stakeholder and EA team together to collect what kind of STRDP business data to assist of enterprise resource planning and decision making and what kind of method to produce EA documentation artifacts.

3.3 Select Software Applications/Tools to support Automated EA Documentation

Once the chief architect and EA team understand the level hierarchy, vertical functions areas and threads areas of EA component stereotypes in EA documentation specification, EA documentation and artifact gradually build up depending on EA component stereotypes by automated EA documentation software applications/tools, which is shown in Figure 2.

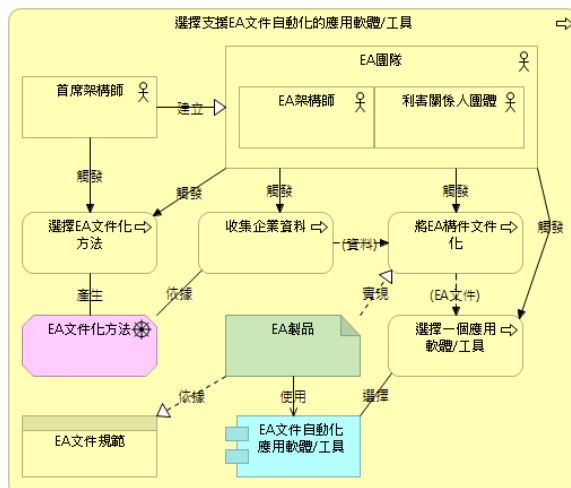


Figure 2. Select Software Applications/Tools to support Automated EA Documentation

3.4 Select and implement online EA Repository to save EA artifacts

To consider security and easy-to-access EA documents, EA repository should be implemented in enterprise internal local area network (LAN). EA repository save all of EA documents which include file directory, database files and other related artifacts.

The chief architect and his team usually implement another network communication platform, named EA portal to highlight ease-of-use of EA documents and facilitate the related stakeholder in EA program to capture EA documents in back-end database which is shown in Figure 3.

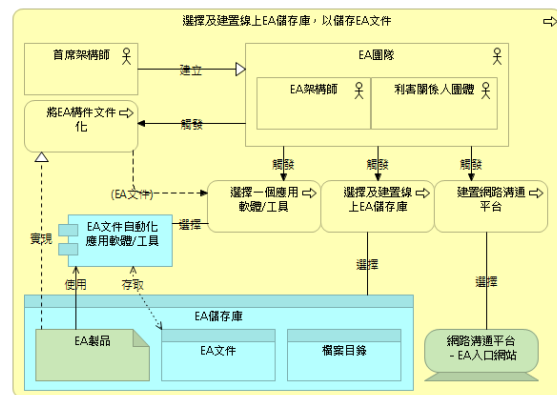


Figure 3. Select and implement online EA repository to save EA artifacts

4. STRDP Reference Model

4.1 STRDP Contents

In this study, the building block contents are the main content to specify a generic STRDP document specification contents which is listed as follows:

A_Industry Current Status and Problems

A_0_Industry Trends

A_1_Global Industry Trends

A_2_Domestic Industry Current Status and Problems

A_3_SWOT Analysis _ Topic 1

A_3_SWOT Analysis _ Topic 2

A_3_SWOT 分析_主題 3 SWOT Analysis _ Topic 3

A_4_Strategy Map_ Portfolio

B_Industrial Value Chain Analysis

B_0_Industrial Value Chain

B_1_External Value Chain

B_2_Internal Value Chain

C_Goal Forming

C_0_General Objective

C_1_Key Stakeholder

C_2_Stakeholder 1_Issues

C_2_Stakeholder 2_Issues	G_Past and future capacity planning
C_2_Stakeholder 3_Issues	G1_Nearly three years of performance
C_3_Goal forming Drivers_ Priority Issues	G2_Manpower planning
C_4_Sub-Goal Forming_ Goal forming Drivers	G3_Financial planning
C_5_Sub-Goal Forming_ Issues	H_Achievements use policy _Business Model
C_6_Sub Program Goal	H_00_Business Model Canvas
C_7_Sub-Goals Execution Each Year	H_01_Customer Segments
C_8_n+0 Year Sub-Goals Execution	H_02_Customer Relationships
C_8_n+1 Year Sub-Goals Execution	H_03_Channels
C_8_n+2 Year Sub-Goals Execution	H_04_Value Propositions
D_Program Forming	H_05_Key Activities
D_0_General Program	H_06_Key Resources
D_01_Program Requirements _ Goal forming Drivers	H_07_Key Partnerships
D_02_Program Requirements _ Goal	H_08_Cost Structure
D_03_Program Requirements _ Program	H_09_Revenue Streams
D_04_Program Constrain Conditions_Program	I_Key Performance Indicators (KPI) and Non-quantifiable Expected Results and Outputs
D_05_Program_Goal	I_1_Key Performance Indicators (KPI)
D_06_Program_Industry Value Position	I_2_Expected Results and Outputs _ Quantify benefits
D_07_Program_Industry Value Architecture	I_3_Expected Results and Outputs _ Non-quantifiable benefits
D_08_Program_Industry Technology	I_4_Expected Benefits
D_09_Program_Industry Technology Architecture	J_Spotlight on Benefits
D_10_Program_Other Related Program	J_1_Past executive performance_n+0 year
D_11_Program Architecture	J_2_Full expected benefits _ Quantify benefits
D_11_Program Architecture_Organization	J_3_Full expected benefits _ Non-quantifiable benefits
D_12_Program Architecture_n+0 Year Important Works	K_Coordinate plan and steps
D_12_Program Architecture_n+0 Year Important Works_Goal	K_Coordinate plan and steps
D_12_Program Architecture_n+0 Year Important Works_Schedule	L_Schedule and Check Point
D_12_Program Architecture_n+1 Year Important Works	L_Schedule and Check Point
D_12_Program Architecture_n+1 Year Important Works_Goal	M_Attachments
D_12_Program Architecture_n+1 Year Important Works_Schedule	M_Attachments
D_12_Program Architecture_n+2 Year Important Works	N_Reference Model
D_12_Program Architecture_n+2 Year Important Works_Goal	N01_BM
D_12_Program Architecture_n+2 Year Important Works_Schedule	N01_00_Business Modeling Process
D_13_Year Important Works Gap Analysis_n+0_n+1	N01_01_Customer Relationships
D_13_Year Important Works Gap Analysis_n+1_n+2	N01_02_Customer Segments
E_n+0 Year Program Deliverables	N01_03_Key Activities
E_1_Sub Program Deliverables_Evaluation Indicators	N01_04_Key Partners
E_2_Sub Program Deliverables_Other Opportunities	N01_05_Key Resources
E_3_Sub Program Deliverables_Significant Impact and Specific Benefits	N01_06_Value Propositions
E_4_Sub Program Deliverables_Comparison of Completion Indicators	N01_07_Marketing Channels
F_Implementation Strategy and Method in year n+0	N01_08_Cost Structure
F_1_Implementation Strategy in year n+0	N01_09_Revenue Streams
F_2_n+0 年度實施方法 Implementation Method in year n+0	N02_Strategy Planning
	N02_01_Outsourcing
	N02_02_Service Implementation
	N02_03_Gap Analysis
	N02_04_Organizational Operations
	N02_05_Strategy Goal-Stakeholder
	N02_06_Strategy Goal-Motivation
	N02_07_Strategy Goal-Principle
	N02_08_Requirement Realization – Business Services
	N02_09_Requirement Realization – Application Services

4.2 STRDP Enterprise Architecture Reference Model

Our research creates 95 enterprise architecture reference models with the enterprise architecture modeling language ArchiMate[6][9][13] for each important item in generic document specification contents of **STRDP**. These generic reference models will be the enterprise architecture specification in our paper. In Figure 4, A_0_Industry Trends View presents one of enterprise architecture specification in **STRDP**.

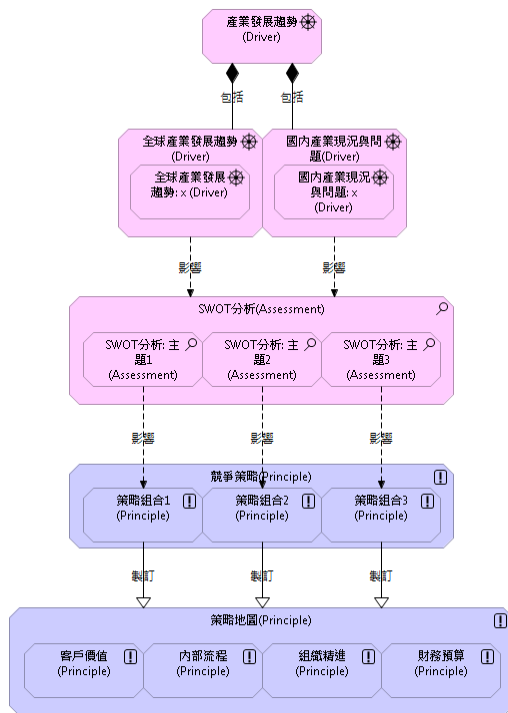


Figure 4. A_0_Industry Trends View

4.3 STRDP Enterprise Architecture Repository

Our research use ArchiMate Modeling Tool[6][9][13], Archi to make **STRDP** Enterprise Architecture Repository. The reference model to save in Enterprise Architecture Repository can be divided into three parts. There is EA view specification, EA document specification, and EA product samples. The enterprise architect selects EA view specification from view specification collections, and then makes the EA product in different application domain by EA document specification. The picture of Repository of Reference Model Examples is shown in Figure 5. The Repository of Reference Model Outline Expand is shown in Figure 6.

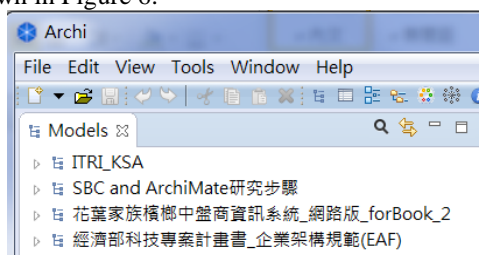


Figure 5. Repository of Reference Model Examples

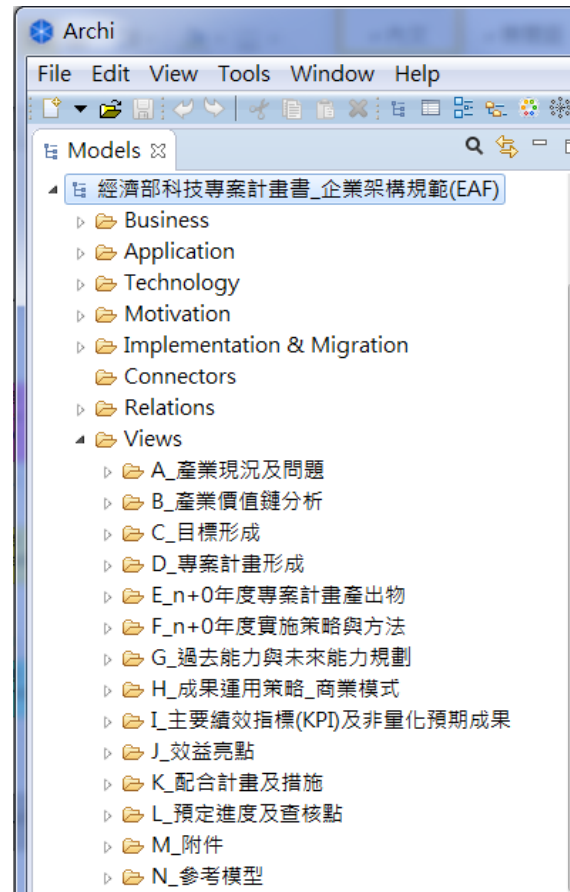


Figure 6. Repository of Reference Model Outline Expand

Outline Expand Contents are EA View Specifications. The industry as-is and problem contents is shown in Figure 7.

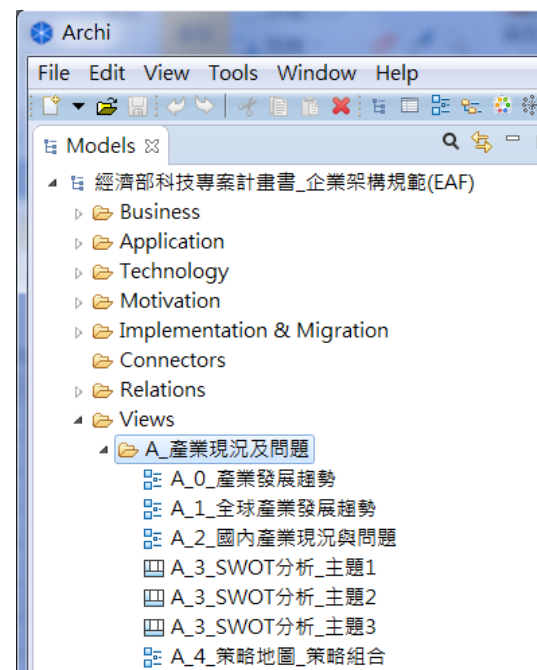


Figure 7. Industry As-Is and Problem Contents

5. Conclusion

We conduct hundreds of EA view diagrams that are constructed by ArchMate modeling tool Archi and build a repository to save them. The EA view diagrams can be reference models for constructing the new artifacts for a new program, especially for a to-be version of the best EA practice. The contribution of this paper is to set-up a website to link the repository for the architect to refer the models that can be modified to the **STRDP** needs. In the future work, we can collect the others that are created by the domain-specific architect for EA view diagram depicting.

Reference

- [1] S. A. Bernard, *EA3: An Introduction to Enterprise Architecture*, AuthorHouse.
- [2] William S. Chao, Shuh-Ping Sun, and Meng-Chyi Harn, *Systems Architecture: Hardware, Software, Enterprise, Knowledge, Thinking*, Research and Training Center of System Architecture, I-Shou University.
- [3] William S. Chao, *Systems Modeling and Architecting: Structure-Behavior Coalescence for Systems Architecture*, Amazon.
- [4] William S. Chao, *General Systems Theory 2.0: General Architectural Theory Using the SBC Architecture*, Amazon.
- [5] William S. Chao, *System: Contemporary Concept, Definition, and Language: SBC Architecture at Work*, Amazon.
- [6] H. Jonkers, I. Band, and D. Quartel, *ArchiSurance Case Study*, The Open Group.
- [7] S. H. Kaisler, F. Armour, and M. Valivullah, "Enterprise Architecting: Critical Problems," *Proceedings of the 38th Annual Hawaii International Conference on System Sciences*, p. 224.
- [8] The Open Group, *TOGAF Version 9: The Open Group Architecture Framework (TOGAF)*.
- [9] The Open Group, *Archi - ArchiMate Modelling, User Guide*, Version 2.3.
- [10] J. A. Zachman,, "A framework for information systems architecture," *IBM Systems Journal*, Vol. 26. No. 3.
- [11] J. A. Zachman, "The Zachman Framework: The Official Concise Definition," *Zachman International*.
- [12] 韓孟麒、謝文雄、黃芳祐、陳李惠慈 (2014), *企業架構指引－藍海布局與實踐策略*, 工業技術研究院產業學院。
- [13] 韓孟麒、陳文賢、巫宇昕 (2015), *以架構描述語言 ArchiMate 架構SBC六大金律*, 2015 第十一屆知識社群國際研討會論文集, 中國文化大學, 台北市。