

Government Enterprise Architecture in Singapore: Issues, Practices and Trends

**Government Enterprise Architecture as Enabler of Public Sector Reform
The World Bank, Washington DC**

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Dr. Pallab Saha

- Is currently a member of the faculty with the National University of Singapore (NUS). His current research and consulting interests include Enterprise Architecture, IT Governance, and Business Process Management. He has published several research papers in these areas. Pallab is an active researcher in the area of Enterprise Architecture and has published his first book titled “**Handbook of Enterprise Systems Architecture in Practice**” in 2007. He has just finished his second book titled “**Advances in Government Enterprise Architecture**” to be published in 2008. He is currently working on his third book as a co-author along with Scott Bernard, Gary Doucet and John Gotze.
- Leads the Information Systems Management research group within NUS–Institute of Systems Science. Dr. Saha teaches courses in Enterprise Architecture, IT Governance and Business Process Management at the post-graduate and senior executive levels.
- His current consulting engagements are in Enterprise Architecture for Singapore Government agencies. He has provided consulting and advisory services to Infocomm Development Authority of Singapore, Intellectual Property Office of Singapore, CPF Board, and Great Eastern Life Assurance among others. **Dr. Saha is the primary author of the Enterprise Architecture Methodology and Toolkit for the Government of Singapore.**
- He is also a contributing author of the Enterprise Architecture Management Guide being developed by the International Association of Enterprise Architects (a|EA) and is a frequently invited speaker at international and local conferences on Enterprise architecture and IT governance (including keynote sessions). Prior to academia, he was instrumental in managing Baxter's environmental health and safety offshore development centre in Bangalore as Head of Projects and Development.
- He has worked on engagements in several Fortune 100 organizations in various capacities. Pallab received his Ph.D in 1999 from the Indian Institute of Science, Bangalore. His Ph.D dissertation was awarded the best thesis in the department. His Ph.D. proposal was selected as one of the top five in India and received a special research grant for the same. Earlier he completed an M.B.A in Information Systems and prior to that gained a B.Sc. in Electronic Sciences from Bangalore University.

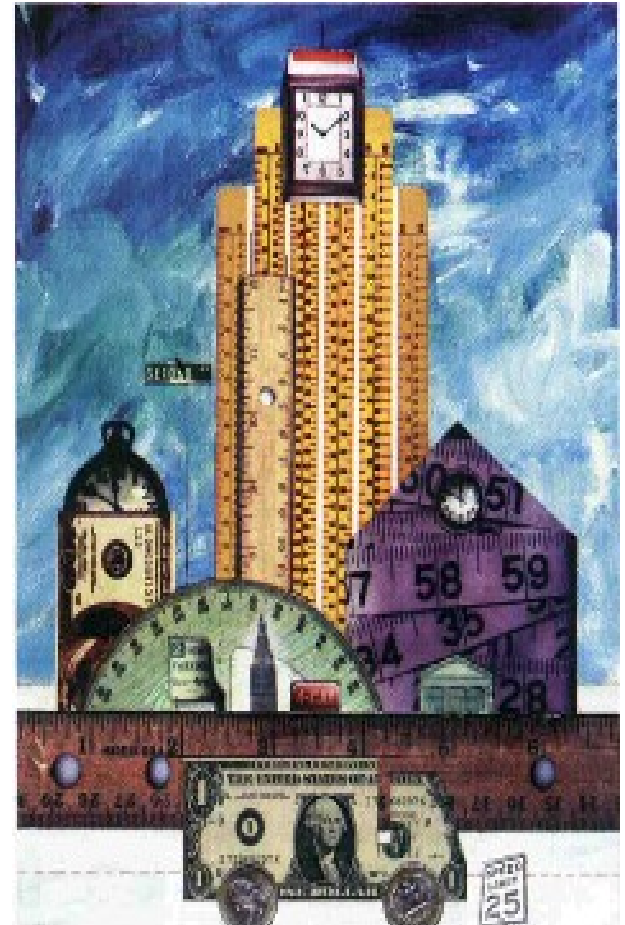
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Agenda

- ✓ **Background**
 - ✓ **E-Government (E-Gov)**
 - ✓ **Enterprise Architecture (EA)**
- Linking E-Government and EA
- Evolution of Singapore's E-Gov
- Singapore Government EA (SGEA)
 - Early Architecture
 - Reference Models
 - Methodology
 - Differentiated EA Design
- Integrated Enterprise Lifecycle
- Enabling Government Transformation
- Further Enhancements



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E-Government and E-Government Stage Models

- Refers to the use by government agencies of information and communication technologies that have the ability to transform relations with citizens, businesses, and other arms of government.
- Several available models (like the Gartner, Deloitte & Touché, UN).
- The key stages of E-Government Maturity include:
 - Web Presence
 - Simple, static information through websites. One-way communication.
 - Interaction
 - Simple interaction which is very agency centric.
 - Transaction
 - Conduct of complete online transactions. Needs some of cross-agency communication
 - Transformation
 - Integrated government (both vertical and horizontal).

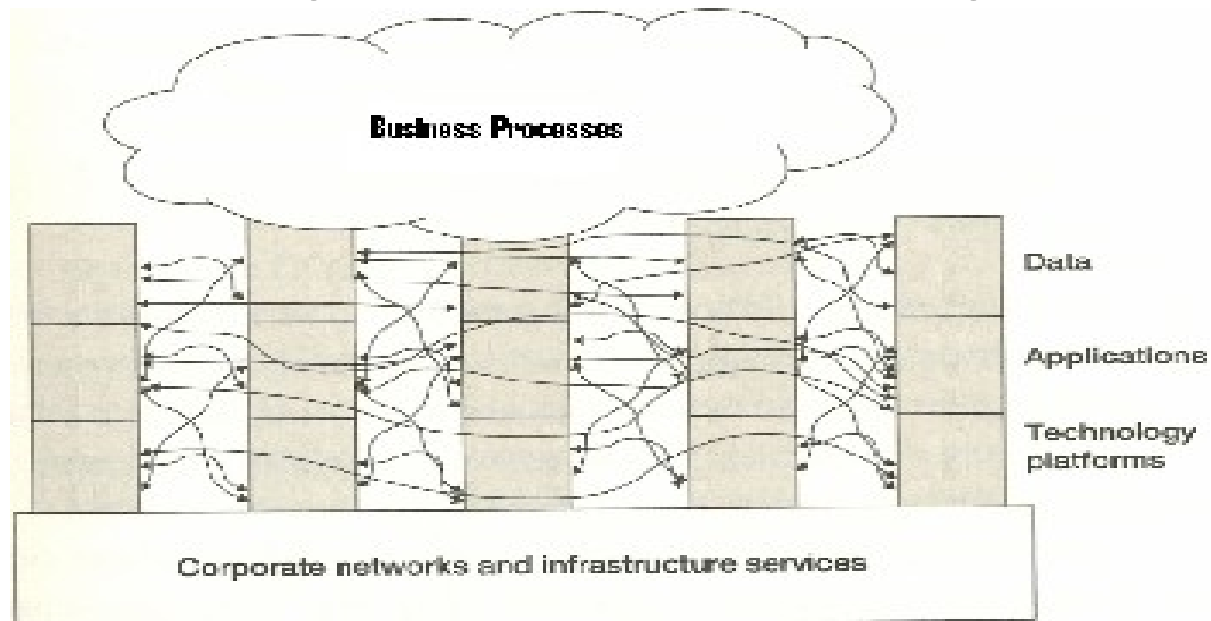
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Defining EA

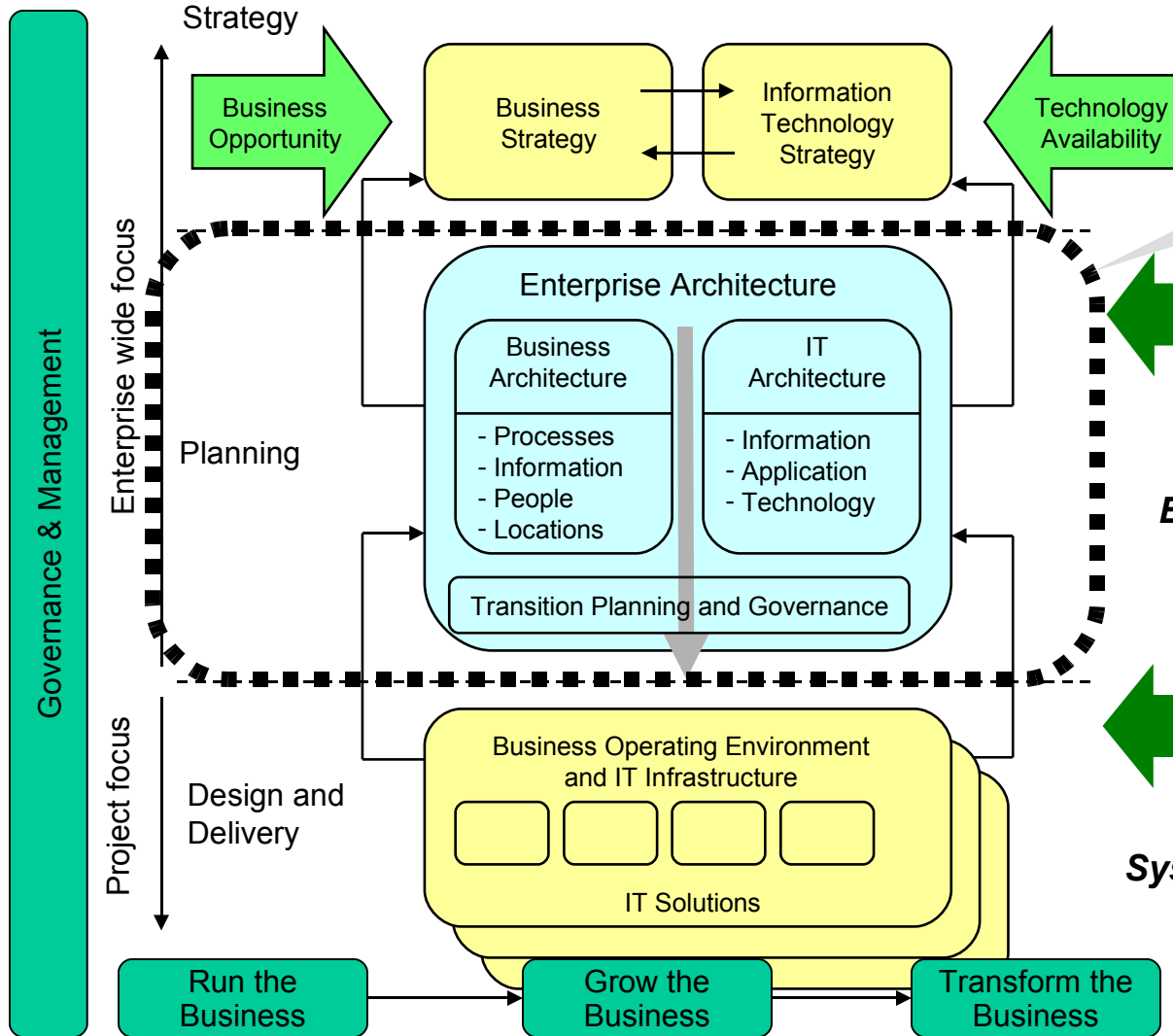
- An organization's enterprise architecture is the organizing logic for its core business processes and IT capabilities captured in a set of principles, policies and technical choices reflecting the standardization and integration needs of its operating model.



Source: Enterprise Architecture As Strategy; Weill, Ross, Robertson; 2006

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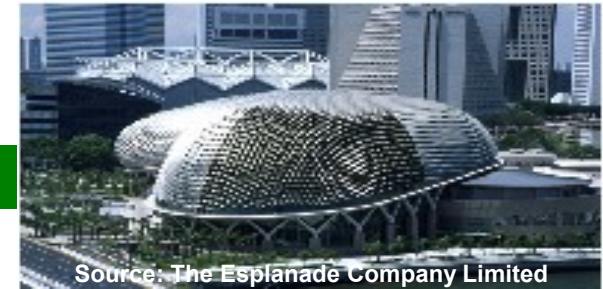
Understanding EA



EA provides a mechanism to instill discipline and control (governance) to business processes and their enabling IT infrastructures



Enterprise Architecture "the city plan"



System Architecture "the building design"

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Adapted From: IBM; 2006

Evolution of EA Maturity

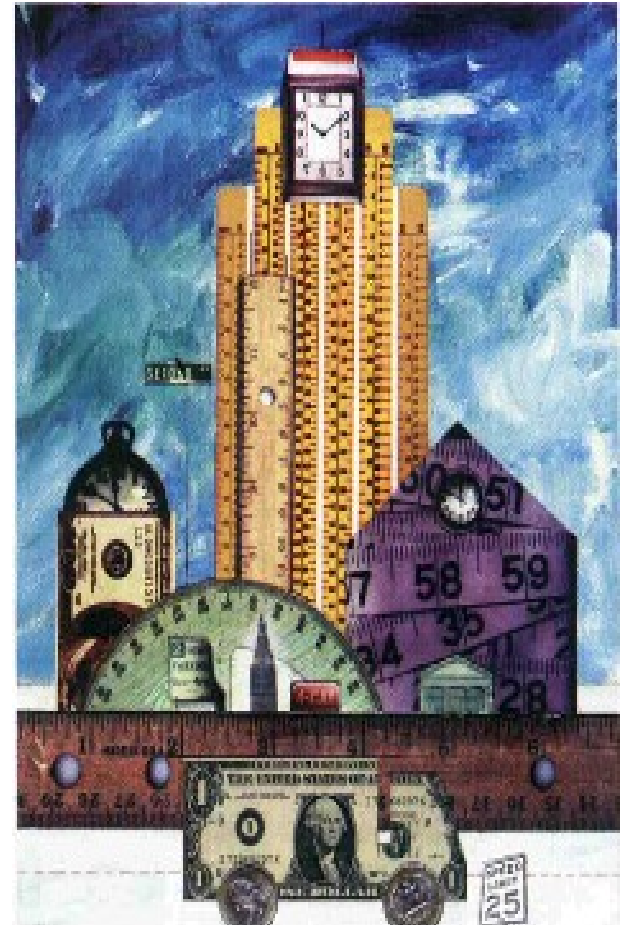
	Application Silo	Standardized Technology	Rationalized Data	Modular
IT Capability	IT applications serve isolated business needs	Firm-wide technology standards	IT focused on wiring core process	Modules enable business model extensions
Key Management Innovation	Technology-enabled change management	Standardization and exception management, refresh	Recognizing essence of the business	Practices facilitating reusability
Business Case for IT	ROI of applications	Reduced IT costs; interoperability	Improved business performance; integration	Speed to market; Strategic agility
Locus of Control	Local control	Senior management support of CIO	Senior management, IT, and process leadership	Senior mgmt, IT, process, and local leadership
Key Governance Issues	Estimate, measure, communicate value	Establish (local/ regional/ global) standard setting, exception & funding processes	Determine core processes and funding priorities	Define boundaries for business experiments

Source: Enterprise Architecture As Strategy; Weill, Ross, Robertson; 2006

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EA is Essential for E-Government

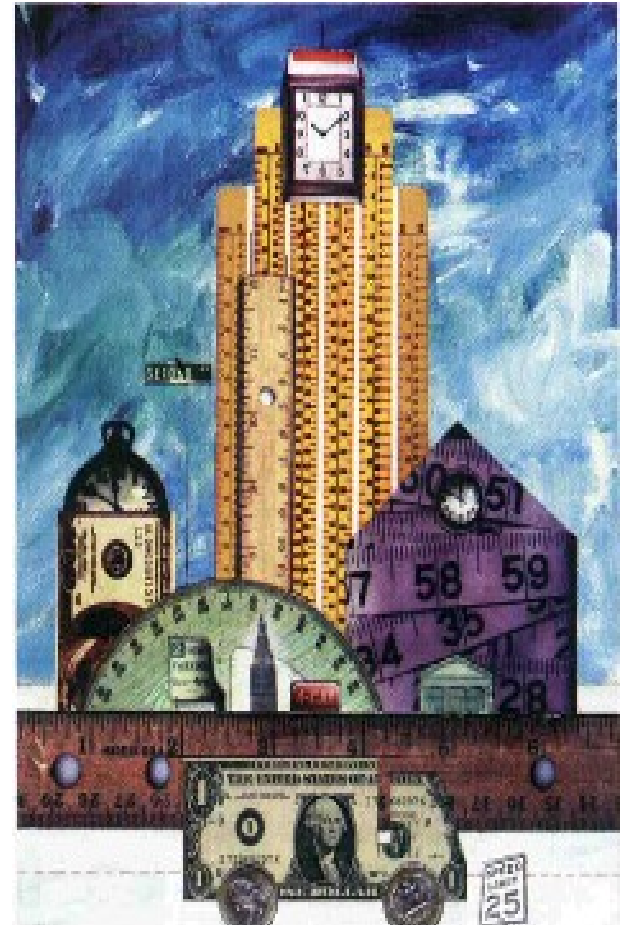
E-Government Stage	Enterprise Architecture Maturity Stage				Explanation / Notes
	Application Silos	Standardized Technology	Optimized Data and Applications	Business Modularity	
1. Web presence	✓				Agencies / departments still operate in their silos and almost don't need any architecture.
1. Interaction	✓	✓			Simple two-way communication needs very basic and few common technology standards, but still largely within their silos.
1. Transaction		✓ ✓	✓		Complete online transactions needs moderate level of cross-agency collaboration and sharing at the technology level.
1. Transformation (Connected)			✓	✓ ✓	Government appears and operates as ONE, high degree of integration needs common and shared business functions and outcomes.

Source: Advances in Government Enterprise Architecture; Saha; 2008

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Progress of Singapore's E-Government

E-

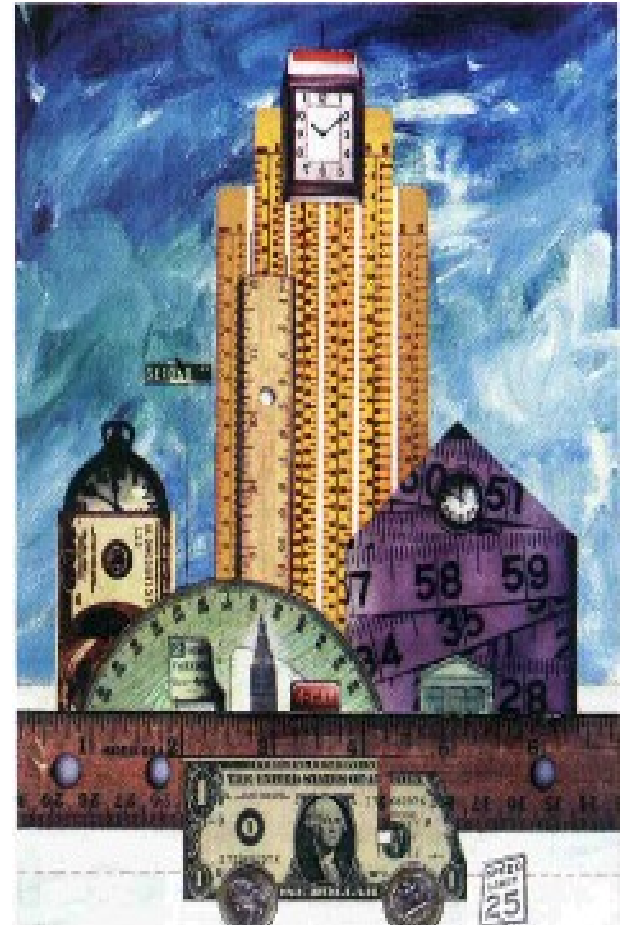
Government Plan	Key Points / Evolution Stage
1. Civil Service Computerization Plan (1980 – 1999) (Generations)	<ul style="list-style-type: none"> ■ Build the IT infrastructure foundation ■ Automation of simple activities (paperwork elimination) ■ Encourage the use of Internet ■ Maps to Web Presence and Interaction stages in the E-Government stage model
1. E-Government Action Plan I (1999 – 2003)	<ul style="list-style-type: none"> ■ Consolidation of computing resources ■ Establishment shared data center and civil services network ■ Maps to Interaction stage in the E-Government stage model
1. E-Government Action Plan II (2003 – 2006)	<ul style="list-style-type: none"> ■ Delivery of accessible, integrated and value added public services ■ Adoption of common infrastructure, information management and technical standards ■ Foster cross-agency collaboration ■ Maps to Transaction stage in the E-Government stage model
1. Integrated Government 2010 (2006 – 2010)	<ul style="list-style-type: none"> ■ Integration of government and public services ■ Enhancement of e-engagement, capacity and synergy ■ Maps to Transformation stage in the E-Government stage model

Source: Advances in Government Enterprise Architecture; Saha; 2008

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SGEA – Early Architecture (1/2)

- As part of its E-Government Action Plan I (E-GAP I), there was a need for a well-designed, reliable and scalable infrastructure
- Triggers for early architecture included:
 - Inter-operability
 - Economies of scale
 - Cross-agency collaboration at a technical level
- This led to the development of Singapore’s technology standard blueprint called the “Service-Wide Technical Architecture (SWTA)” in 1999.

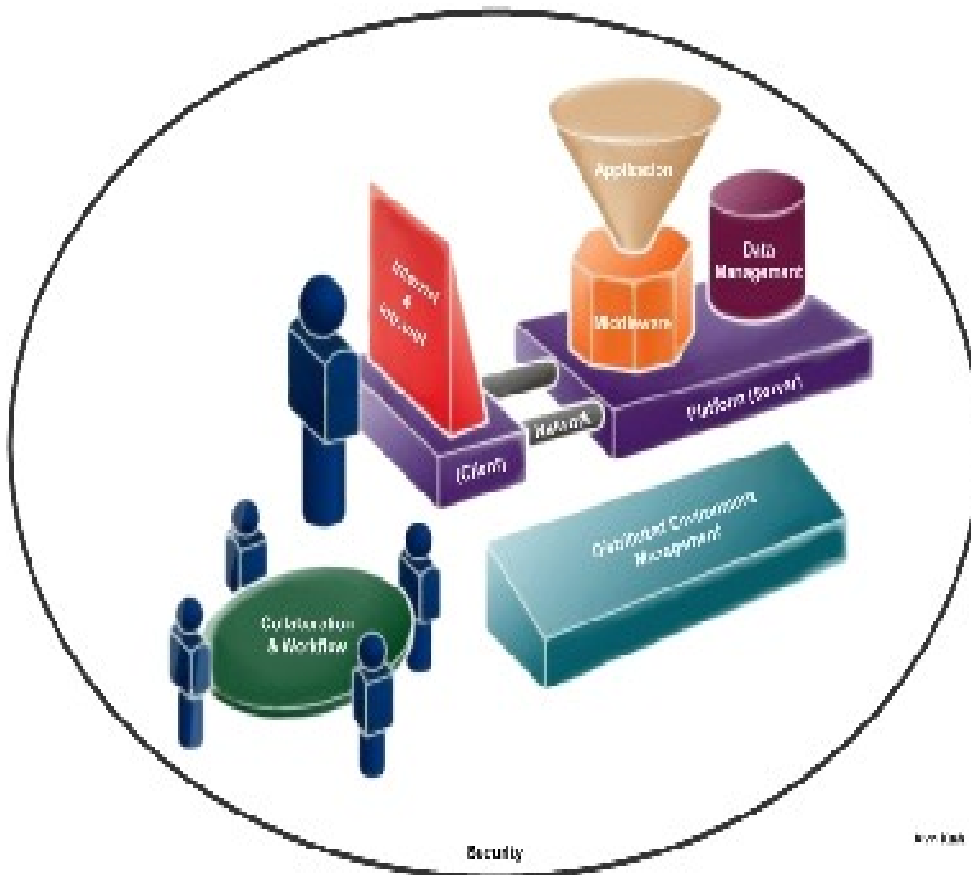
Source: Handbook of Enterprise Systems Architecture in Practice; Saha; 2007

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SGEA – Early Architecture (2/2)



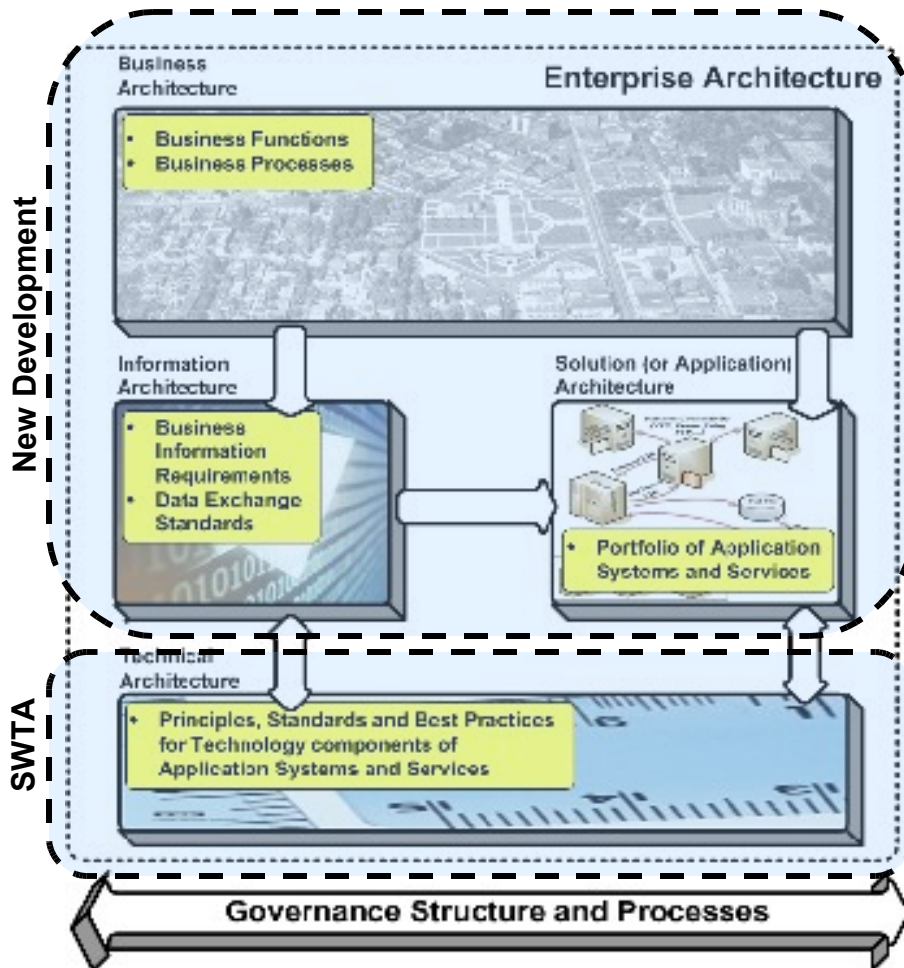
■ SWTA Quick Facts

- Collection of nine technical domains
- Consists of standards, guidelines, best practices and recommended implementations
- Meant for agencies to adapt / adopt
- Mandated as part of IT Governance policy
- Updated every six months

Source: Handbook of Enterprise Systems Architecture in Practice; Saha; 2007

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SGEA – The Next Generation



- Enterprise Architecture (EA) is a blueprint which links
 - Business functions;
 - Relevant data standards;
 - Common systems and services; and
 - Technologies
- Cross-agency in order to achieve enterprise level or whole-of-government (integrated) goals

Source: Handbook of Enterprise Systems Architecture in Practice; Saha; 2007

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SGEA – Reference Models

- Development of reference models which agencies can refer to, in order to find out which agencies they can collaborate with and what shareable data and components are available for use
 - Business Reference Model
 - Data Reference Model
 - Solution Reference Model
 - Technical Reference Model
- Identify key potential areas for collaboration
- Develop methodology to help agencies develop their own EA

Source: Handbook of Enterprise Systems Architecture in Practice; Saha; 2007

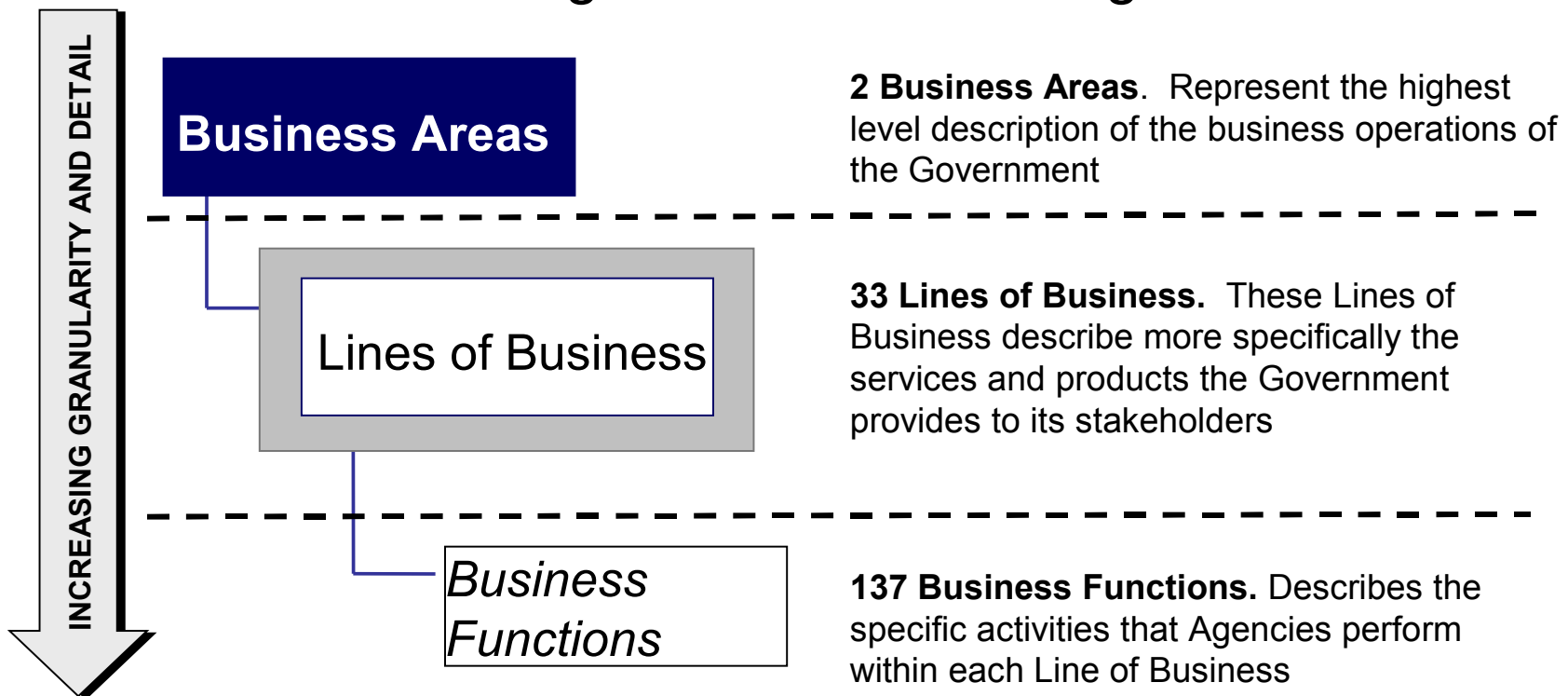
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SGEA – Business Reference Model (1/2)

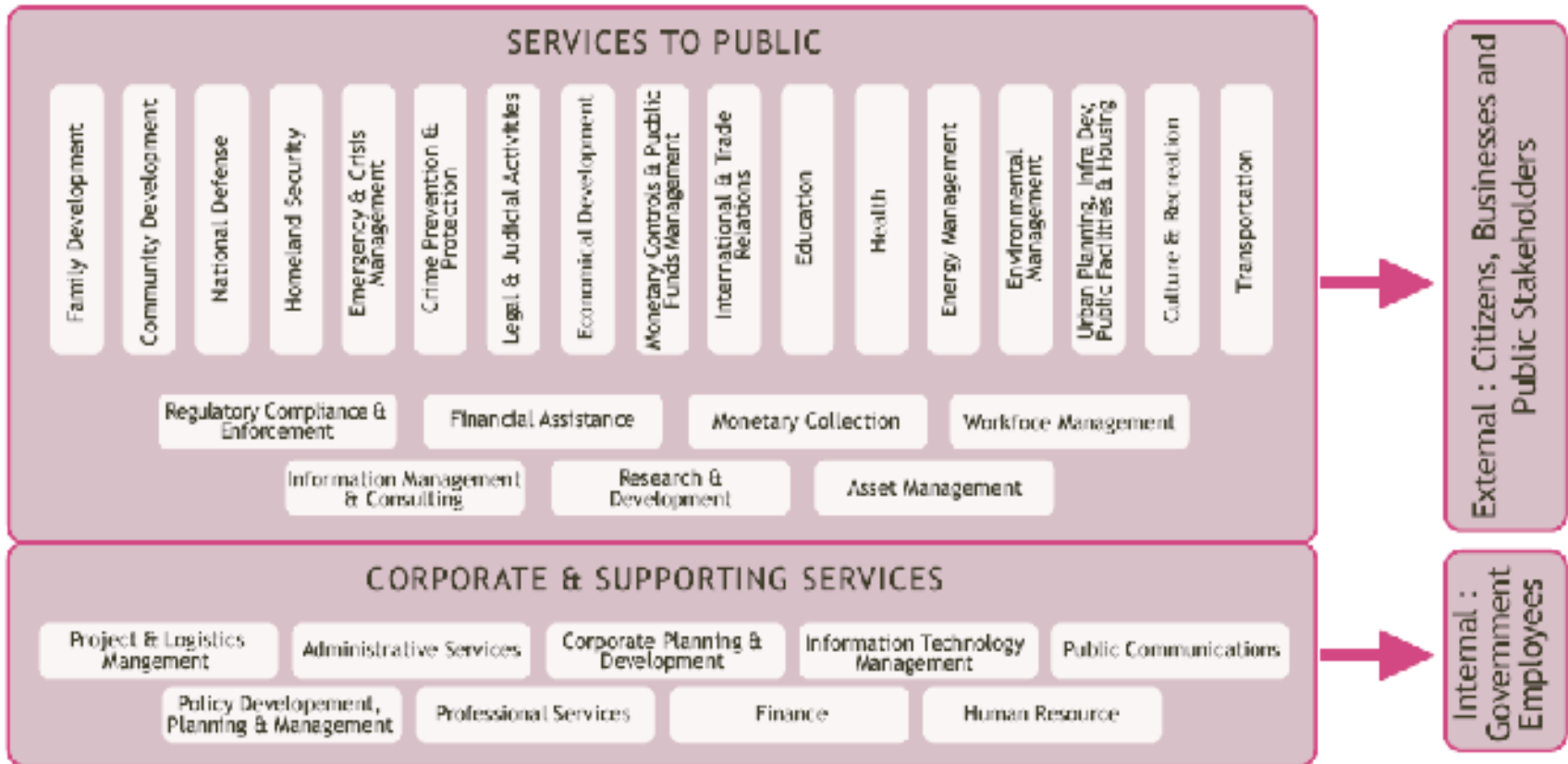
- Provides an organised view of the business of Government using common terminologies



Source: Singapore Government Enterprise Architecture; IDA; 2006

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SGEA – Business Reference Model (2/2)



Source: Handbook of Enterprise Systems Architecture in Practice; Saha; 2007

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SGEA – Data Reference Model

- Specifies definitions for data elements that are commonly used across agencies, to enable more effective data exchange
- DRM comprises:
 - Key data entities (Person, Company, Business, Limited Liability Partnership, and Land) and numerous data elements based on the People, Business, and Land Hub
 - Several sets of codifications

Source: Handbook of Enterprise Systems Architecture in Practice; Saha; 2007

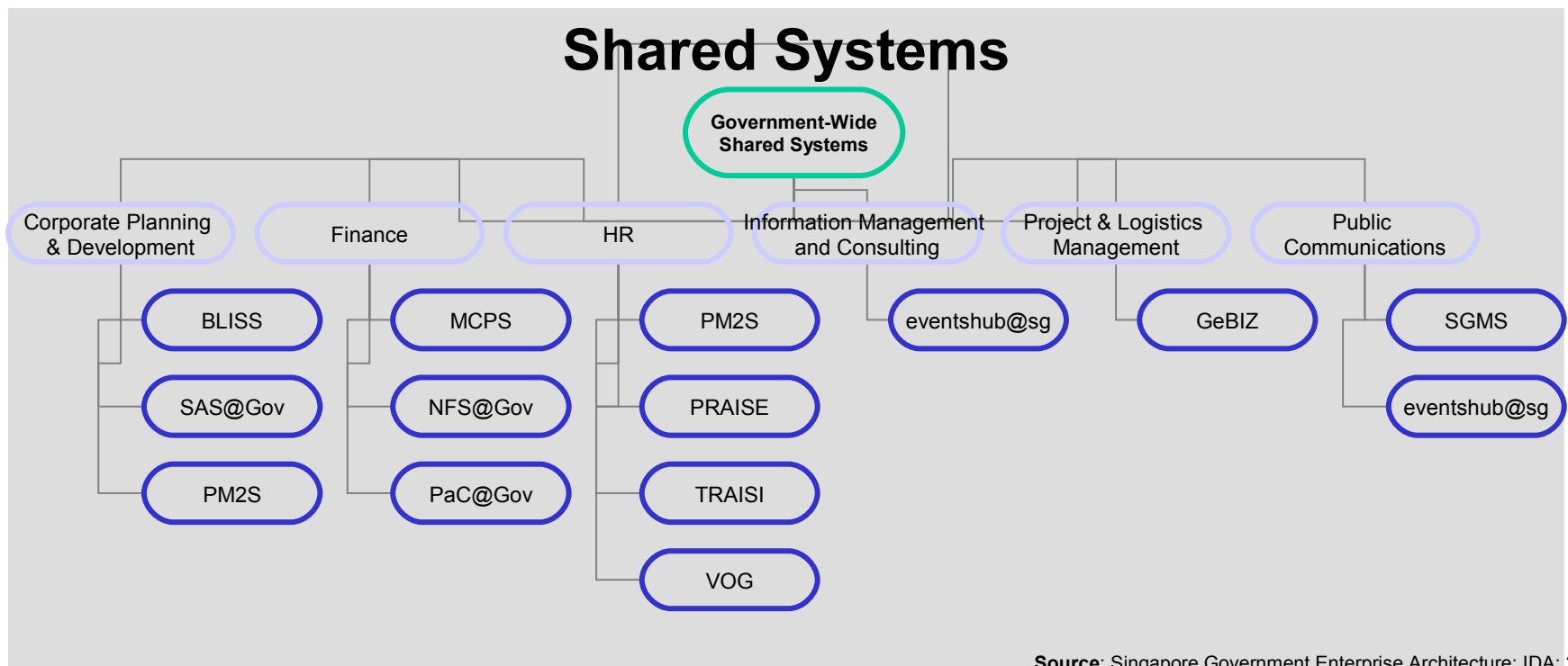
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SGEA – Solution Reference Model (1/2)

- Contains a portfolio of systems and service components that can be shared / reused across the Government



Source: Singapore Government Enterprise Architecture; IDA; 2006

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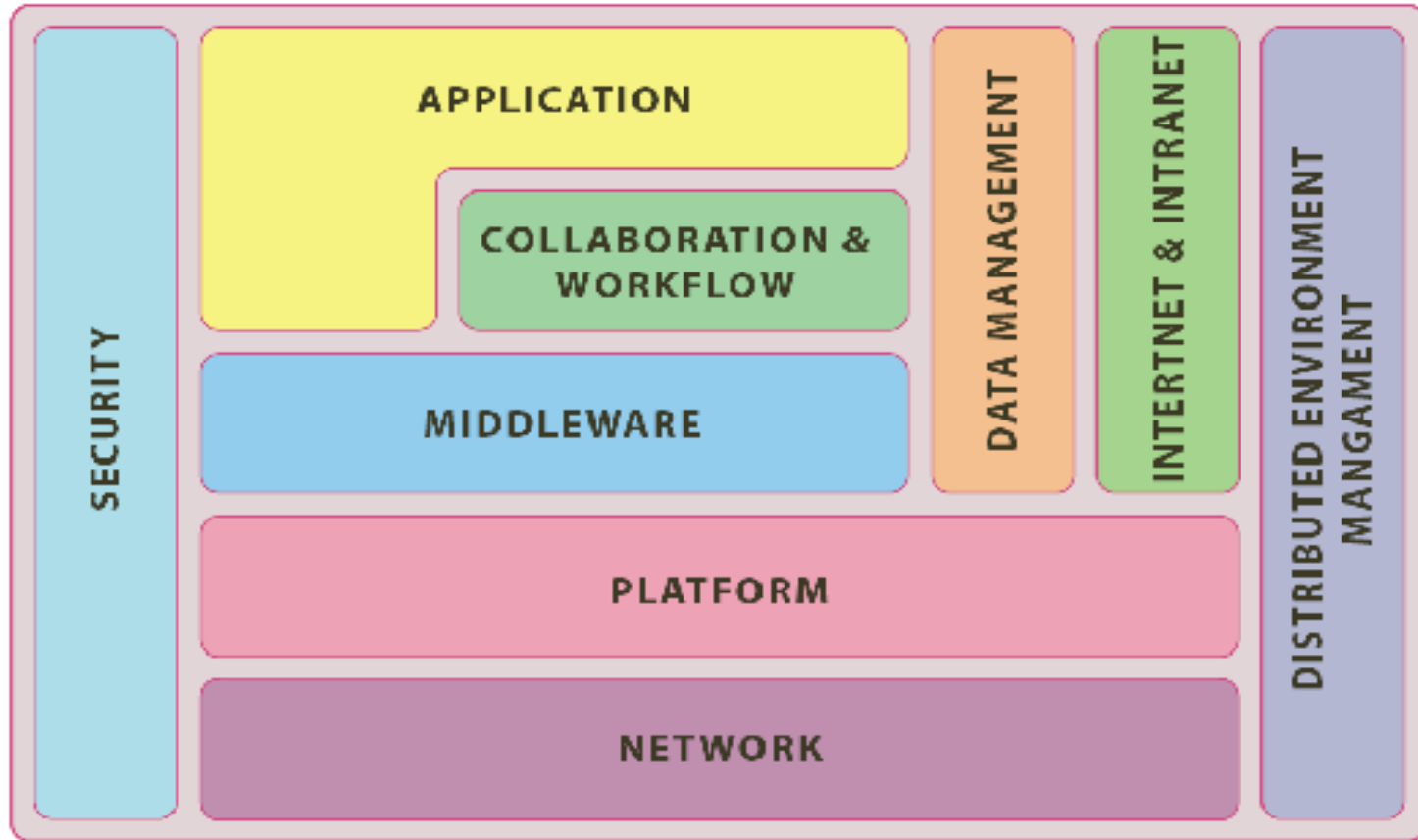
SGEA – Solution Reference Model (2/2)

No	Attribute	Description
1	Business Context	<Refers to business function in Business Reference Model>
2	Name	Government Electronic Business (GeBIZ)
3	Description	GeBIZ is an integrated end-to-end System, which allows public sector officers to perform a range of procurement and revenue tender activities. It also provides government suppliers access to procurement opportunities in the public sector and the option to trade electronically with the government
4	Owner	Ministry of Finance (MOF)
5	Platform	Web-based, BEA WebLogic
6	Database	Oracle
7	Status	PRODUCTION

Source: Singapore Government Enterprise Architecture; IDA; 2006

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SGEA – Technical Reference Model



Source: Handbook of Enterprise Systems Architecture in Practice; Saha; 2007

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SGEA – MAGENTA (1/6)

Methodology for Agency Enterprise Architecture (MAGENTA)

■ Aims:

- Build consensus and common foundation among agencies
- Fill knowledge gaps
- Encourage participation and establish commitment
- Raise levels of effectiveness, quality, efficiency, interoperability, and return on investment for EA capabilities
- Use of real life case study for validation

Source: Advances in Government Enterprise Architecture; Saha; 2008

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SGEA – MAGENTA (2/6)

■ Scope:

- A step-by-step guidance in developing and implementing EA
- A common unified approach to EA development and improve agency EA maturity and capability
- A mechanism to converge organisational efforts in the development and management of the EA blueprint rather than focus on framework related issues
- A common reference point for all architectural assets in terms of scope and intensity

Source: Advances in Government Enterprise Architecture; Saha; 2008

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SGEA – MAGENTA (3/6)

■ Representative Capability:

1. Business Performance

- What are our core business processes?
- Where can we achieve dramatic improvements?
- What are the areas where we need to collaborate with other agencies?
- What are our key information requirements to support core business processes?

2. Investment Performance

- Which business processes must receive our investments?
- How do we categorise our investments for IT-enabled transformation?

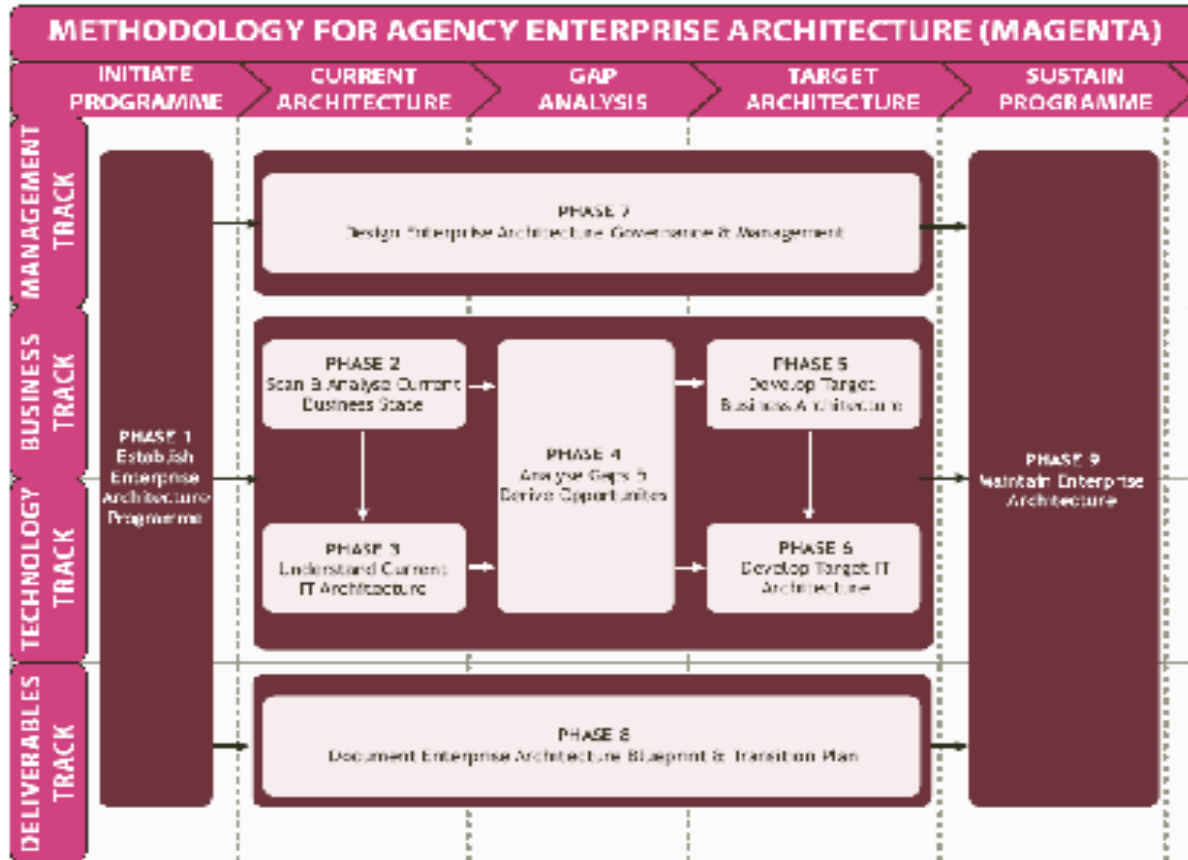
3. IT Performance

- Which business processes have no IT enablement and where are we overspending?
- Where can we take benefits of common data, applications and technology?
- Where do we have redundancies and overlaps?
- What metrics do we need to assess the programme effectiveness?

Source: Advances in Government Enterprise Architecture; Saha; 2008

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SGEA – MAGENTA (4/6)



Source: Advances in Government Enterprise Architecture; Saha; 2008

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SGEA – MAGENTA (5/6)

■ Methodology

- Step-by-step instruction oriented
- Structure

- **MAGENTA MAP:** Graphical view of MAGENTA identifying the phase that is being described.
- **OBJECTIVE:** The key intent of executing the phase.
- **INPUTS:** Items that are required to execute the phase. Each input contains a reference to the steps where it is utilised.
- **OUTPUTS:** Items that are produced as a result of executing the phase. Each output contains reference to the steps that are utilised to produce the specific output.
- **STEPS:** Activities performed in the phase shown both in graphical and detailed tabular form. Each step is numbered for easy reference. Each step makes reference to a Phase Tool / Phase Example where appropriate. Every step also identifies the role responsible for performing the step.
- **PHASE TOOLS:** Templates, guidelines and pointers that are useful in executing a specific step of the phase.
- **PHASE EXAMPLES:** Illustrations of outputs that are produced as a result of executing a specific step in the phase. The examples are intended to illustrate the outcome of executing specific steps.
- **DO'S & DONT'S, TIPS and FAQs**
- **CASE STUDY:** Demonstrates the use of the methodology with the development of EA for a Singapore Government Agency

Source: Advances in Government Enterprise Architecture; Saha; 2008

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SGEA – MAGENTA (6/6)

■ MAGENTA is intended for application at different agencies in the following clusters:

- Government administration
- Manufacturing and services
- Education and learning
- Healthcare and social services
- Justice and law enforcement

MAGENTA is being incorporated into a leading EA tool by the government

MAGENTA for Defense is currently under development

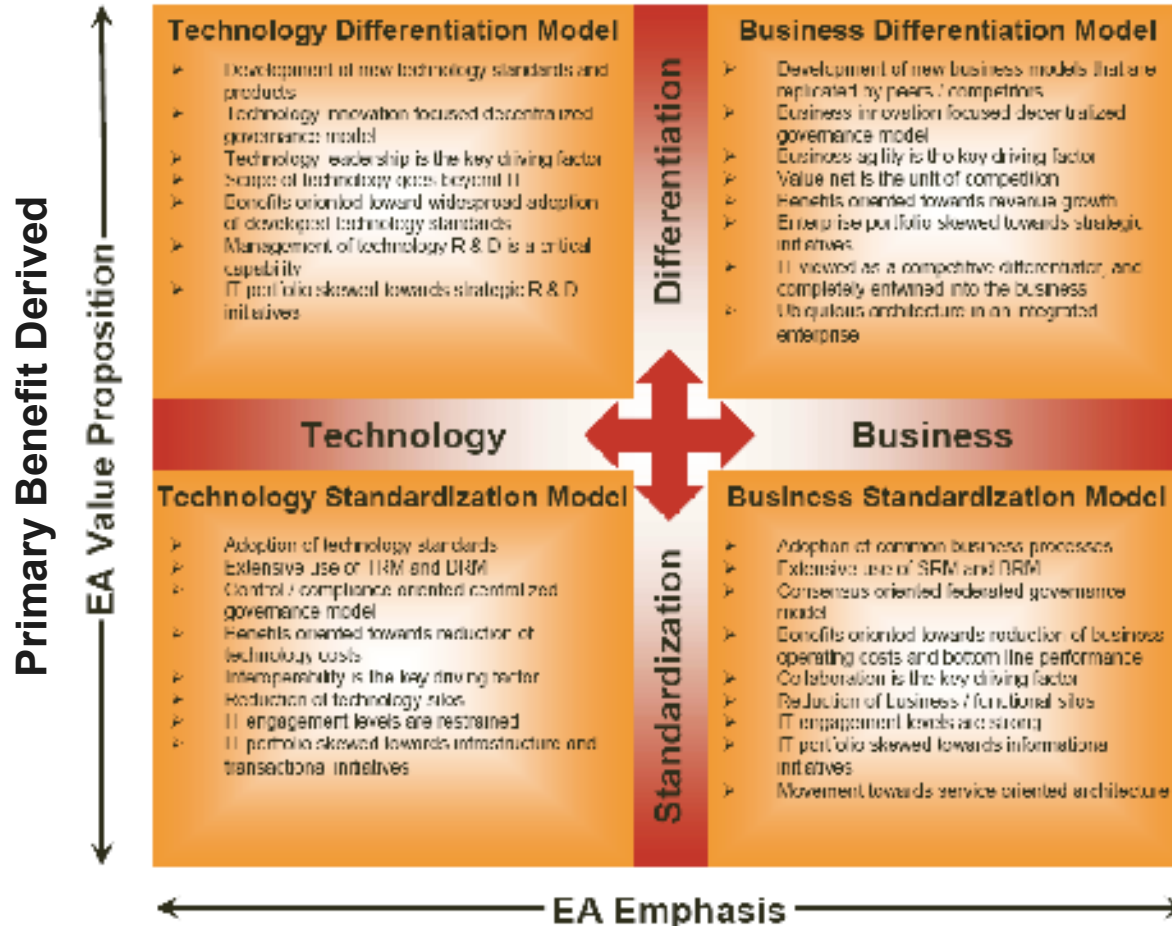
Source: Advances in Government Enterprise Architecture; Saha; 2008

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EA Design Models in MAGENTA



Source: Advances in Government Enterprise Architecture; Saha; 2008

Area of Special Importance

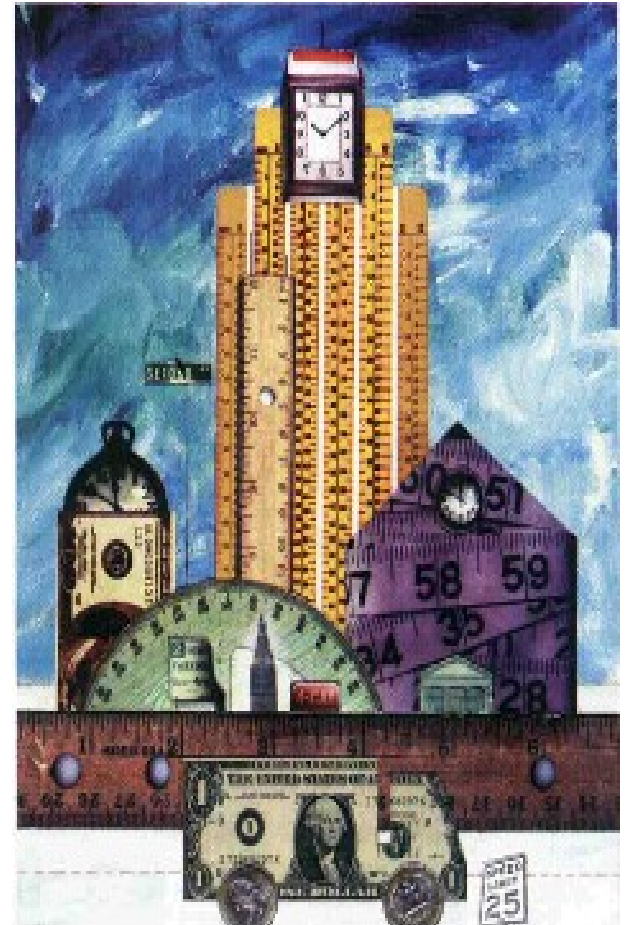
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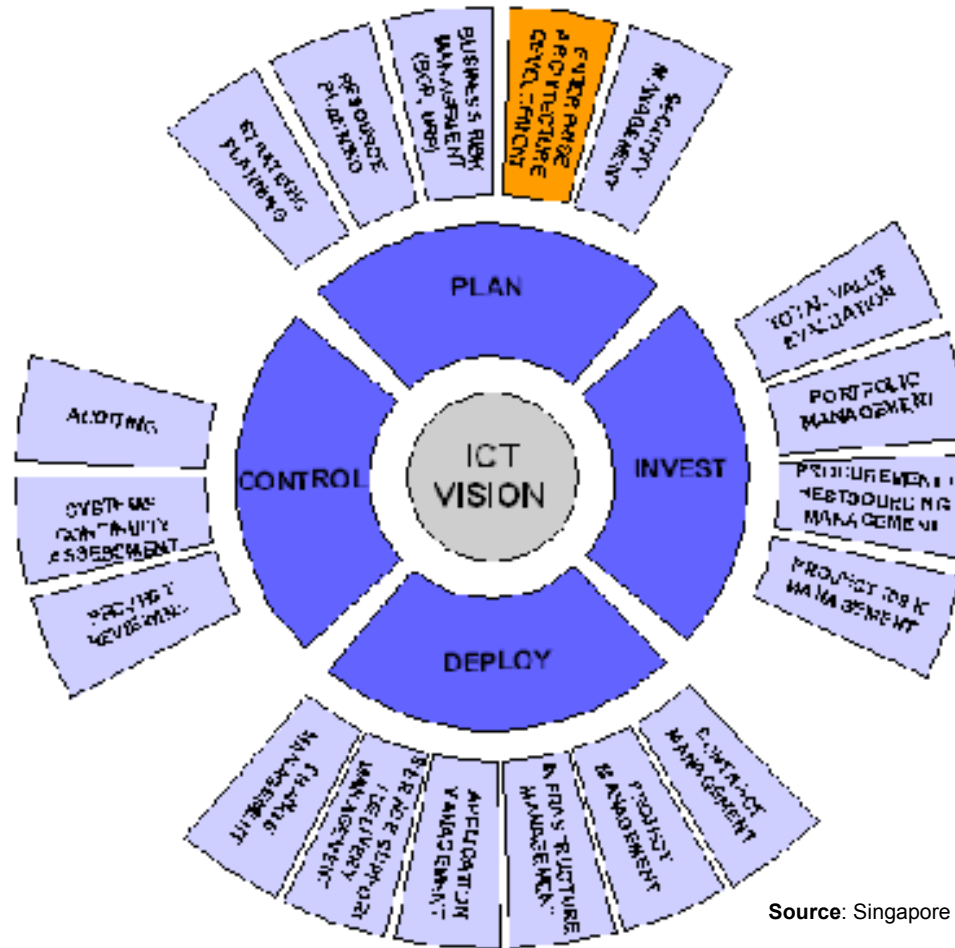


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Government IT Governance Framework



Source: Singapore Government Enterprise Architecture; IDA; 2006

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Classical IT Planning Based Approach



Source: Advances in Government Enterprise Architecture; Saha; 2008

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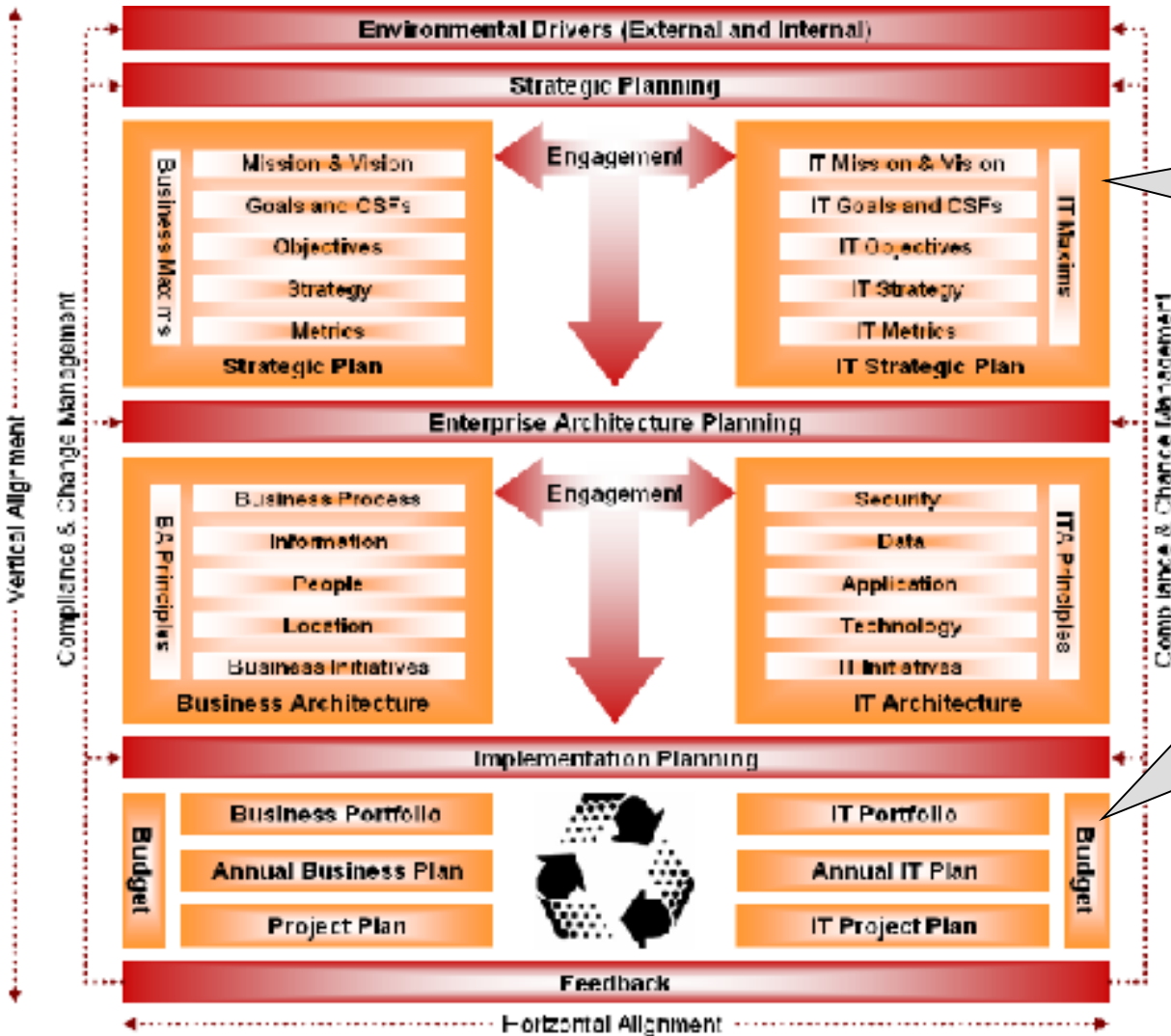
MAGENTA Derived EA Based Approach



Source: Advances in Government Enterprise Architecture; Saha; 2008

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Integrated Enterprise Lifecycle



On the upstream side, EA is linked to Strategies; Goals; Objectives; Metrics

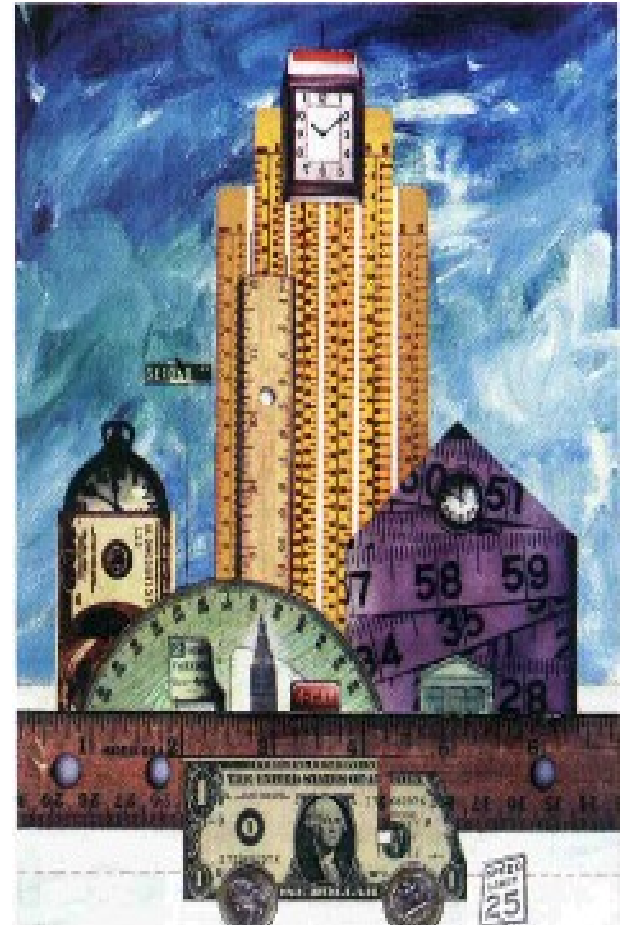
On the downstream side, EA is linked to Portfolio; Annual Planning; Project Plan; Budgeting Process

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Source: Advances in Government Enterprise Architecture; Saha; 2008

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Connected Government (1/2)

- The concept of connected government is derived from whole-of-government approach which utilizes technology as a strategic tool and as an enabler for public service innovation and productivity growth

Moving to Connected Governance

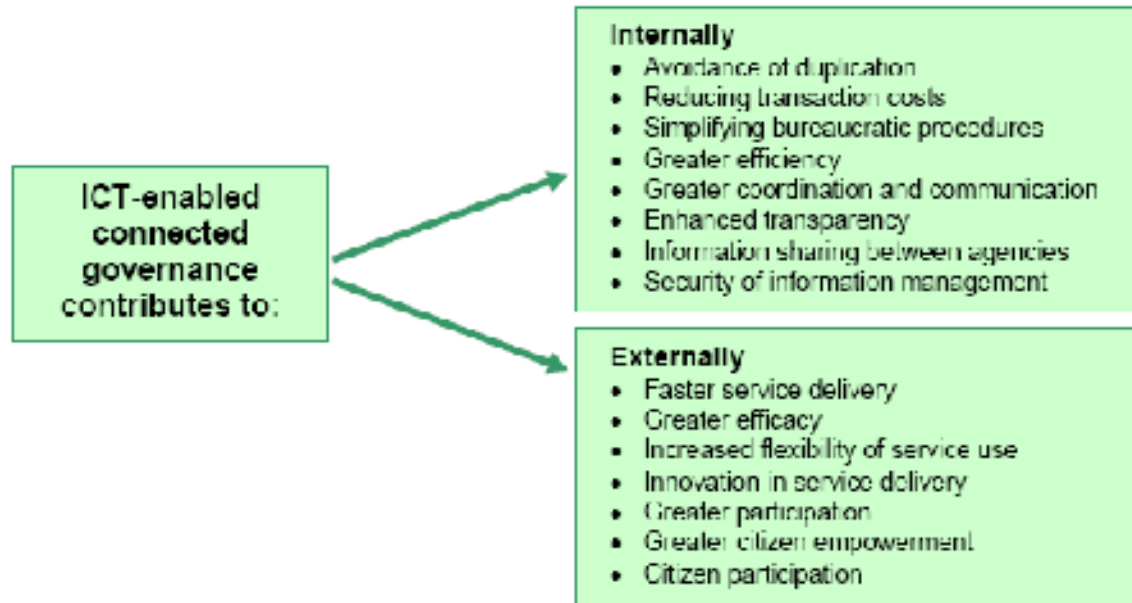
1. Intra-Government Process Re-engineering → efficient, responsive and tailored government to reflect citizen needs
2. Inter-Government Process Re-engineering → efficient, joined-up and borderless government
 - vertical cooperation/integration between levels
 - horizontal cooperation/integration between agencies at same level
 - multi-stakeholder cooperation (with private and third sectors)
- 3 Re-engineer legacy technology, processes, skills and mindsets

Source: UN E-Government Survey 2008; United Nations; 2008

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Connected Government (2/2)

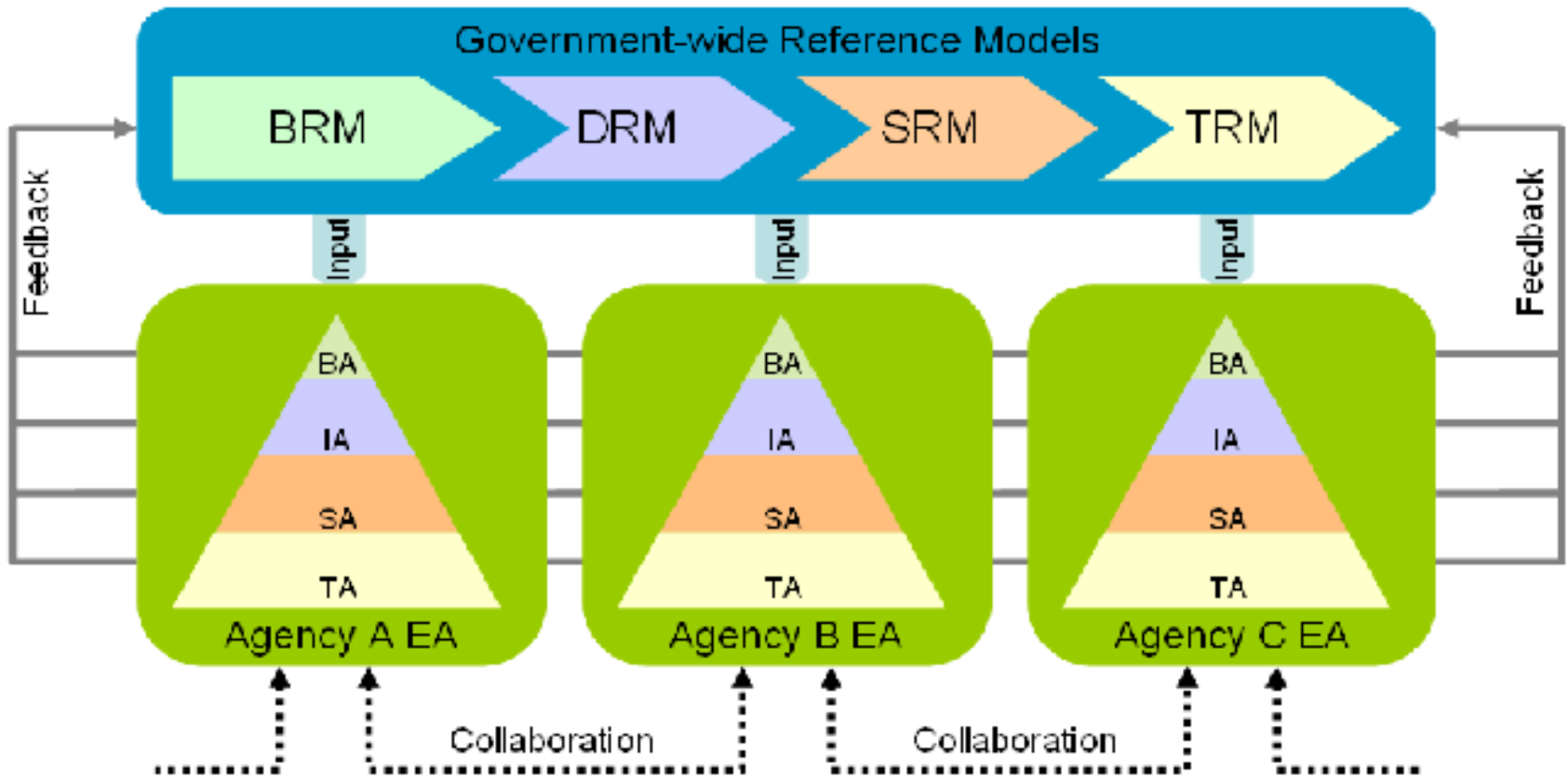
- Connected government leads to improved coordination of processes and systems within and across government agencies and organizations



Source: UN E-Government Survey 2008; United Nations; 2008

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Towards Connected Government with SGEA (1/2)



Source: Advances in Government Enterprise Architecture; Saha; 2008

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CUSTOMERS

Applicants

Partners

Employees

Suppliers

Management

Regulators

ACCESS CHANNELS

Online

Mail

Phone

In-Person

Fax

Data Transfer

LINES OF BUSINESS

LOB 1

LOB 2

LOB 3

LOB 4

BUSINESS FUNCTIONS

Primary Business Function 1

Primary Business Function 2

Primary Business Function 3

Primary Business Function 4

Primary Business Function 5

Primary Business Function 6

Supporting Business Function 1

Supporting Business Function 2

Supporting Business Function 3

Supporting Business Function 4

COMMON DATA

Person

Company

Business

Grantee

Regulation

Policy

Party

Resource

COMMON SERVICES / COMPONENTS

SECURITY

Network Identity Management

Authorisation/ Authentication

User Profiles & Security Policies

USER CENTRIC INTERACTION

Document Management

Search & Retrieval

Multi-Channel Enablement

Collection & Payments

Knowledge Management

Personalisation

Correspondence/Mail

Business Analytics

Meta Data Management

Workflow Collaboration

MANAGEMENT

Business Rules

Directory

Administration & Reports

INTEGRATION & INFRASTRUCTURE

Workflow Management

Integration

Scanning/Indexing/OCR

Audits & Logging

Utilities

Business Activity Monitoring

Content Management

Messaging & Middleware

ENTERPRISE SYSTEMS / APPLICATIONS

ERP System

CRM System

SCM System

Datawarehouse

BI Suite

SFA Suite

Lotus Notes Applications

Corporate Website

NFS@Gov

SAS@Gov

Towards Connected Government with SGEA (2/2)

EA Activity Using MAGENTA	Aspect of Connected Government (Transformation) Covered
1. Developing business architecture	<ul style="list-style-type: none"> • Core business processes • Agency process reengineering • Collaboration opportunities using BRM
1. Developing information architecture	<ul style="list-style-type: none"> • Core data entities • Agency meta-data • Use of common data entities with DRM • Contribution to DRM
1. Developing solution architecture	<ul style="list-style-type: none"> • Core systems and services • Agency service registry • Use of shared systems and services with SRM • Contribution to SRM
1. Developing technical architecture	<ul style="list-style-type: none"> • Core technologies • Agency technology inventory • Use of technology standards and common infrastructure • Contribution to TRM
1. Designing and Deploying Architecture Governance	<ul style="list-style-type: none"> • Linkages to integrated governance framework (strategic planning; IT planning; IT portfolio management; IT service management)

Source: Advances in Government Enterprise Architecture; Saha; 2008

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Using BRM to Identify Collaboration Opportunities

Agencies to Business Functions Matrix

Business Function	Agency A	Agency B	Agency C	Agency D	Agency E	Agency F	Agency G
Financial Assistance for business	●		●			●	●
Financial Assistance Portal (Social Sector)		●		●	●		
Post Secondary Education				●			
Public Health Monitoring					●		

Agency Grant process/application



Generic Grant process/application for multiple agencies

Source: Singapore Government Enterprise Architecture; IDA; 2006

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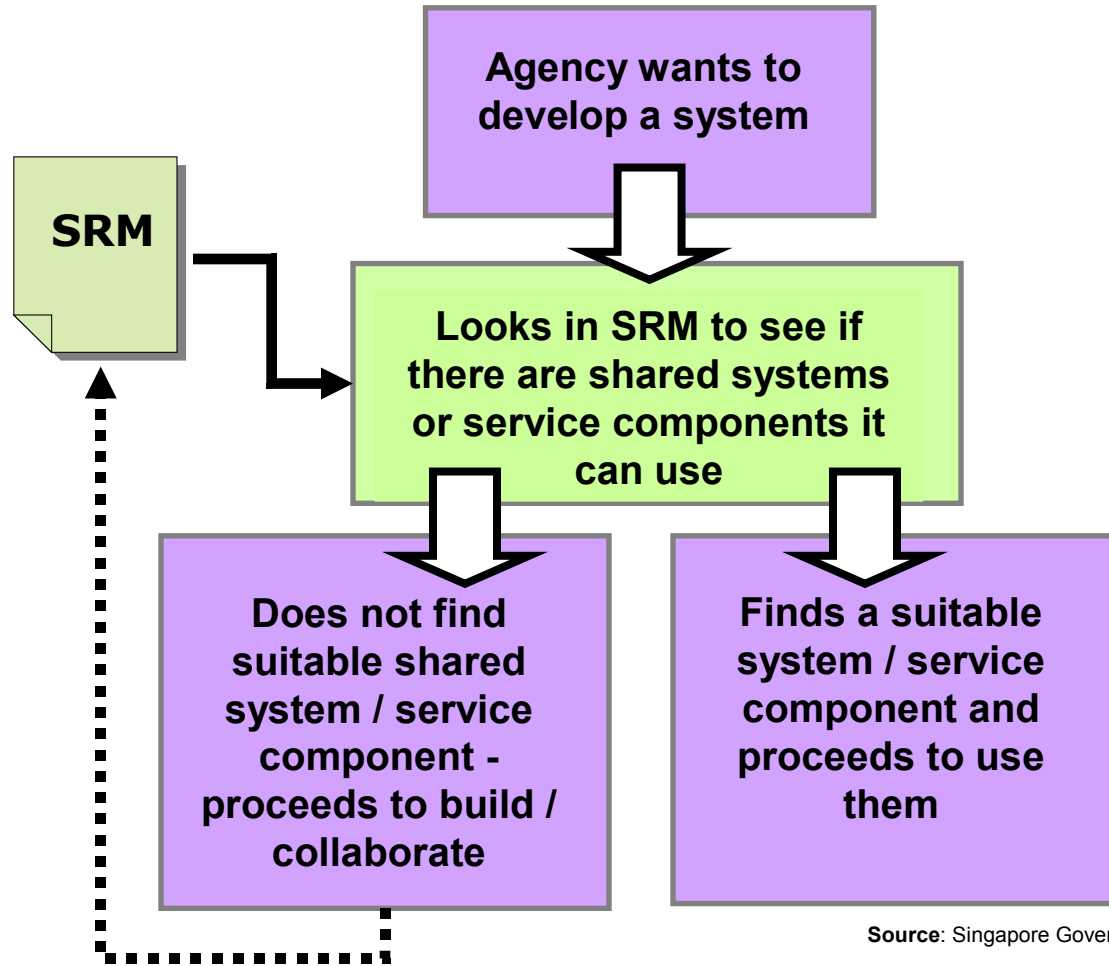
Using DRM to Build Agency IA

- To align agency data standards with the Data Reference Model
- To identify source data for data reuse (instead of collecting it again)
- As a reference for agencies to develop their own Information Architecture

Source: Singapore Government Enterprise Architecture; IDA; 2006

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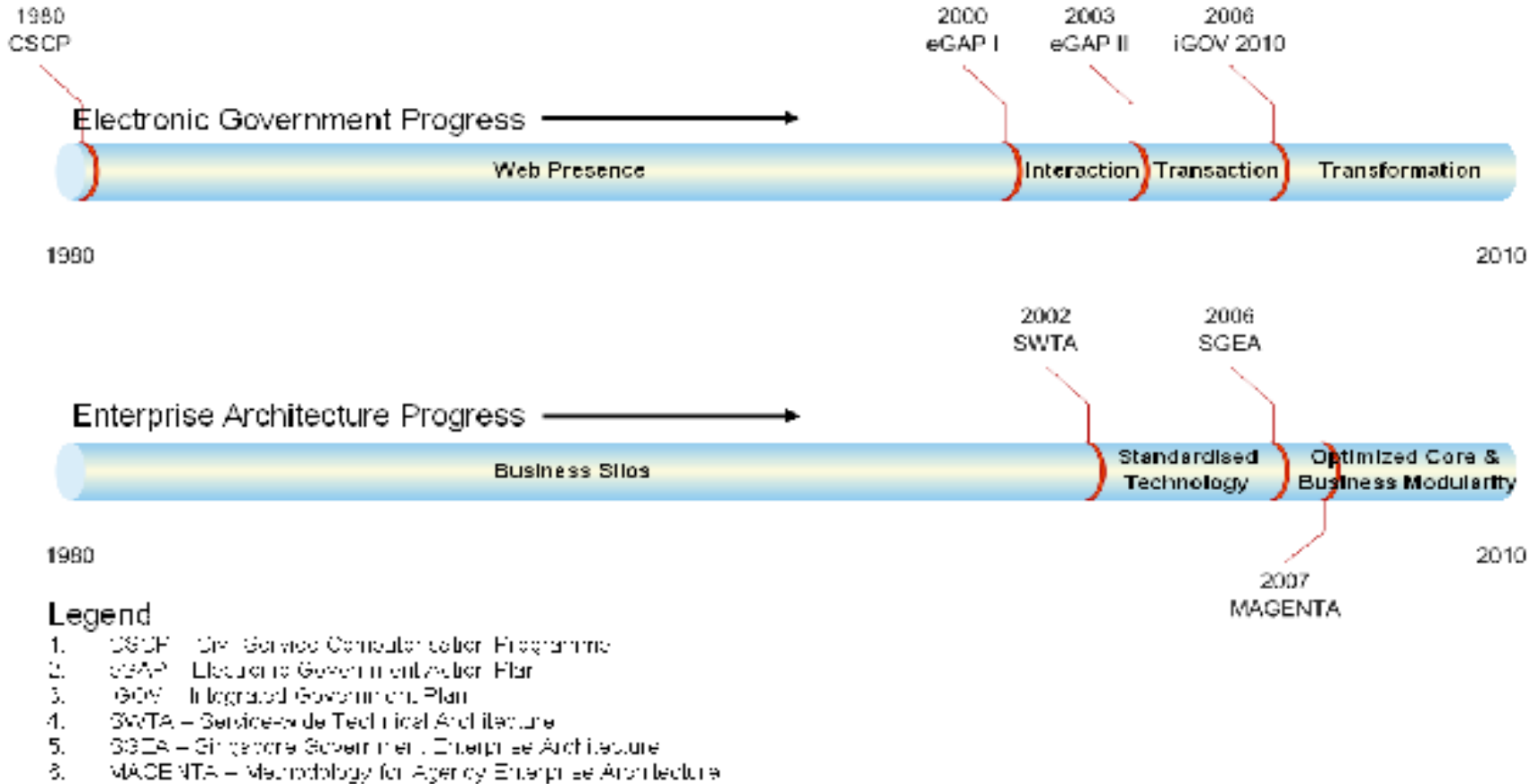
Using SRM to Build Agency AA



Source: Singapore Government Enterprise Architecture; IDA; 2006

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Mapping the Progress of EA vis-à-vis E-Gov



Source: Advances in Government Enterprise Architecture; Saha; 2008

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Positioning SGEA in iGOV 2010

strategic thrusts

vision

To be an Integrated Government that delights customers and connects citizens through infocomm

Increasing Reach & Richness of e-Services

- Develop insights to enhance e-Services to customers
- Deliver proactive, user-friendly, responsive and integrated e-Services
- Extend the reach of e-Services

Increasing Citizens' Mindshare in e-Engagement

- Deliver clear and useful information online in a vibrant and interesting manner
- Attract participation in online public consultations and feedback

Enhancing Capacity & Synergy in Government

- Create synergy through shared data, processes & systems
- Enrich public officers' work experiences through innovative use of infocomm
- Foster innovative exploitation of infocomm in public sector

Enhancing National Competitive Advantage

- Enhance economic competitiveness through sectoral transformation
- Collaborate with Infocomm industry in iGov solutions
- Showcase and promote iGov solutions

key enablers

- Infocomm Management and Governance
- Public Sector Infocomm Competency Development
- Infocomm Security and Infrastructure

EA appears 41 times in the latest UN Report and Page 89 refers to SGEA

Source: Singapore Integrated Government 2010; IDA; 2006

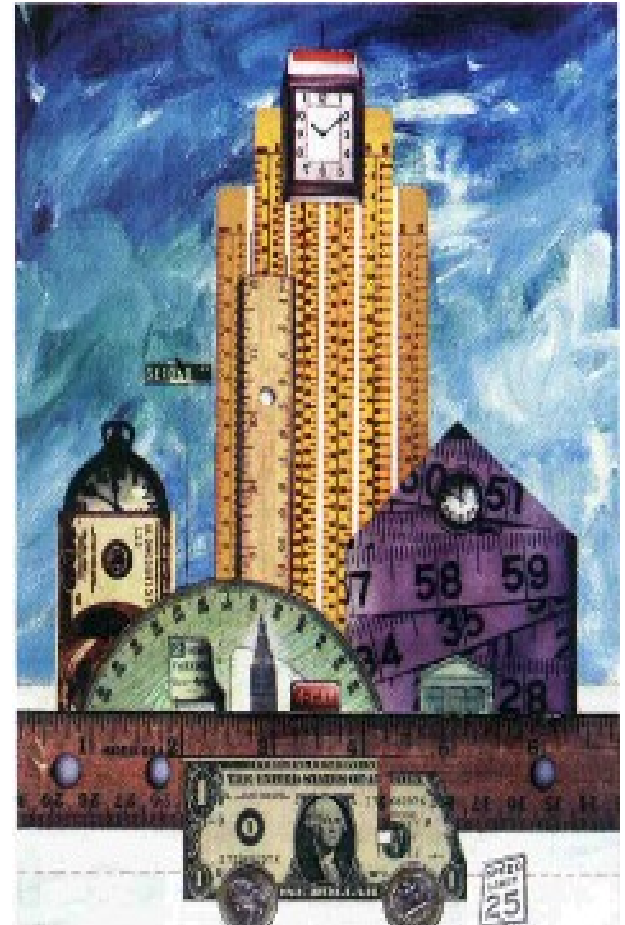
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- Integrated Enterprise Lifecycle
- Enabling Government Transformation
- ✓ **Further Enhancements**



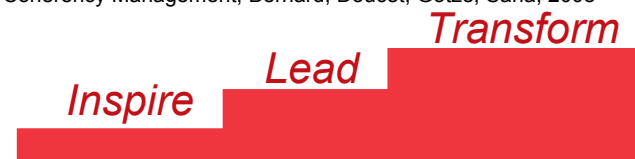
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 Transform

Current State of EA Around the World

1. EA is still very much IT department / CIO led program (credibility plays a key role)
2. (Somehow) the main purpose of EA is building good IT systems (it is a system centric perspective)
3. The footprint of the EA program is variable
4. (Usually) EA programs are disconnected / isolated from the rest of the organization (need special engagement mechanisms)
5. EA (and their artifacts) become the end (leading to legislations and compliance requirements)

This is good, but not enough.

Source: Coherency Management; Bernard, Doucet, Gotze, Saha; 2008



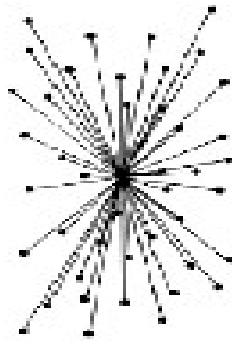
Coherency Management - Central Theme in Enterprises

■ Coherence

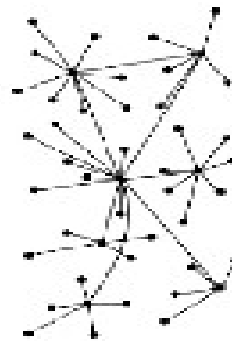
- Logical, orderly and consistent relation of the parts to the whole
- Necessary in designing and operating complex enterprises that must continually adapt to changes in mission and market conditions

Goal →
Means →
Outcomes →

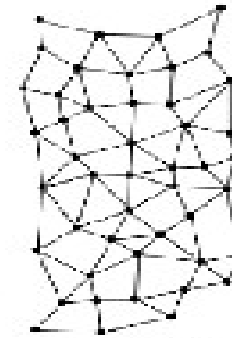
Coherence
Enterprise Architecture
Alignment, Agility and Assurance



Centralized
(1)



Decentralized
(2)



Distributed
(3)

Source: Coherency Management; Bernard, Doucet, Gotze, Saha; 2008

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Three (Independent) Dimensions of EA

	Foundation Architecture	Extended Architecture	Embedded Architecture
Strategic Drivers <small>(What is needed to?)</small>	<ul style="list-style-type: none"> Technology and business standardization Systemic engineering IT asset utilization 	<ul style="list-style-type: none"> Business transformation Product/service leadership Business agility Enterprise engineering 	<ul style="list-style-type: none"> Enterprise design & management Enabled agility Service-oriented enterprise Utiligility
Locus of Control <small>(Who leads the programme?)</small>	<ul style="list-style-type: none"> CIO/IT Organization 	<ul style="list-style-type: none"> CXO involved during change Business and IT lead by process owners 	<ul style="list-style-type: none"> CXO involved all the time
Critical Management Innovations <small>(How to it work better?)</small>	<ul style="list-style-type: none"> Architecture by compliance Replacement approach Fixed programme integrity and scope Project oriented 	<ul style="list-style-type: none"> Enterprise Business architecture Organizational improvements Architecture by push with siloed processes Adhocratic architecture 	<ul style="list-style-type: none"> Organic design Architecture by pull with intrinsic processes Architecture is everyone's job Management DNA Outcome driven
Key Governance Mechanisms <small>(What is used to accomplish it?)</small>	<ul style="list-style-type: none"> Specialized EA team Project business cases Architecture review board Led by CIO 	<ul style="list-style-type: none"> Cross-institutional governance Value based tracking Business leadership in IT projects Led by CXO 	<ul style="list-style-type: none"> Diffused architecture team Enterprise architecture by stealth Control neutrality Led by CXO, but not separately
Programme Metrics <small>(How to it measure?)</small>	<ul style="list-style-type: none"> Cost efficiency IT responsiveness IT risk management Business-IT alignment 	<ul style="list-style-type: none"> Time to market Business responsiveness Strategic alignment Conformity in IT and non-IT space 	<ul style="list-style-type: none"> Aligned organization Decision capability Shared delivery Comprehensive services excellence
Benefits & Outcomes <small>(What is we get?)</small>	<ul style="list-style-type: none"> Shared technology platforms Economies of scale Reticular systems design 	<ul style="list-style-type: none"> Shared business platforms Business value of IT Reticular information governance 	<ul style="list-style-type: none"> Better corporate governance Disruptive engagement Enhanced enterprise Unnoticeable EA effort

Balanced

(Alignment, Agility, Assurance)

Source: Coherency Management; Bernard, Doucet, Gotze, Saha; 2008

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Is Coherent Government the Next Stage in Evolution?

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Content Credits and Acknowledgments

■ Content Sources

- **Handbook of Enterprise Systems Architecture in Practice;** *Pallab Saha; 2007.*
- **Advances in Government Enterprise Architecture;** *Pallab Saha; 2008 (In-Press).*
- **Coherency Management–Architecting the Enterprise for Alignment, Agility and Assurance;** *Scott Bernard, Gary Doucet, John Gotze, Pallab Saha; 2008.*

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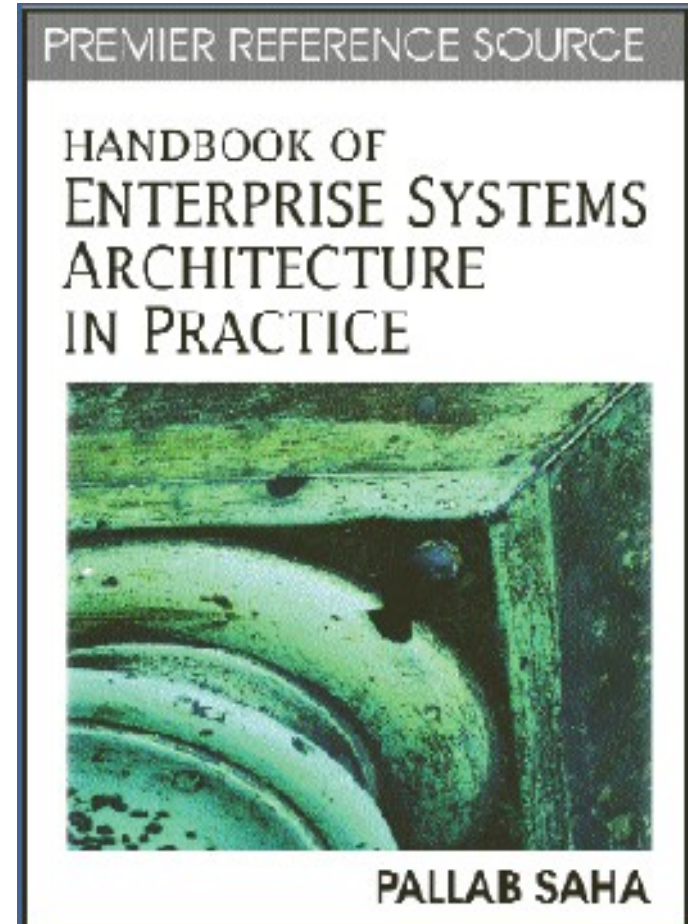
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Thank You

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