E-government Data Interoperability Framework in Hong Kong

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Since its first release in 1998, the Digital 21 Strategy has been serving the blueprint for Hong Kong to develop the information and communications technology infrastructure. With government leadership as an important component, the Strategy has put forward the development of an e-government that can realize one-stop delivery of public electronic services. In 2003, Hong Kong Government has launched the Interoperability Framework (IF) as an e-government initiative to facilitate implementation of cross-department joined-up government services. IF comprises two parts: (1) definition of a set of recommended technical specifications as a single point of reference for departments and contractors to implement joined-up projects, (2) a framework for formulating and managing XML message standards for G2G and G2B data exchange. This paper discusses about the second part of the IF, mainly on the XML Schema and Design Guide, and its real-life applications.

Keywords: Hong Kong e-Governemnt Interoperability Framework, XML Schema Design and Management Guide

I. 1INTRODUCTION

A. *HKSARG Interoperability Framework for E-Government*

First launched by the Hong Kong Special Administrative Region Government (HKSARG) in 1998, the Digital 21 Strategy [1] is a strategy paper setting out the blueprint for development of information and communications technology (ICT) in Hong Kong. In 2001 Digital 21 Strategy, one focus area was "to ensure that HKSARG leads by example by driving e-government, providing e-option for more services, and actively pursuing e-procurement and outsourcing." An important e-government initiative is to provide client-centric joined-up government services to the public. In HKSARG, public services are offered by different HKSARG Bureaux and Departments (B/Ds) in a distributed fashion. To provide one-stop comprehensive services, seamless flow of information across individual B/Ds is a prerequisite. In 2003, the HKSARG *Information Technology Services Department*, now known as *Office of Government Chief Information Officer* (OGCIO) [3], established the *Interoperability Framework (IF) for E-Government* [2] to meet this objective.

B. *Three Dimensions of Interoperability*

IF addresses three dimensions of interoperability, namely *technical interoperability*, *data interoperability*, and *process interoperability*. The *XML Schema Design and Management Guide* [4] describes these terms as follows:

- **Technical interoperability**: agreement on what communication protocol and message format to be used when one party sends information to another; e.g. the purchase order shall be encoded in XML, as defined by a specific XML schema, and XML Encryption and XML Signature shall be applied on certain content components, and the XML message shall be sent via HTTP.
- **Data interoperability**: agreement on what information has to be transmitted from one party to another, and the definition and representation of such information; e.g., the "delivery date" has to be specified on a purchase order, and the definition of "delivery date" is the date on which goods shall be received by the buyer, and the representation of "delivery date" adopts the ISO 8601 standard [16].
- **Process interoperability**: agreement on how the business activities of the concerned parties affect each other; e.g., when the seller receives a purchase order from the buyer, the seller should accept or reject this order within a specified time period.

To address these dimensions of interoperability, IF maintains two sets of documents. The first set of documents, *HKSARG Interoperability Framework* [5], recommends a collection of technical specifications for implementation for application in different interoperability areas. For example, in the Application Integration Domain, SOAP v1.1, WSDL v1.1, and UDDI v2 are recommended for simple functional integration in an open environment while ebXML Message Service v2 is recommended for reliable message exchange between application systems in an open environment for business document oriented collaboration. This means when a new e-government project is recognized to fit a particular interoperability area, the B/D responsible for the project and their IT contractors are required to adopt the recommended technical standards in system implementation.

The other set of documents are collectively called *XML Schema Design and Management Guide* [4] (Schema Guide). They are developed to address data and process interoperability. Section II outlines the contents of this Schema Guide. We describe the Design Guide part and the Management Guide part respectively in Section III and Section IV. Section V lists some e-government projects that have applied this framework in production environment. Finally, Section VI concludes this paper.

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II. XML SCHEMA DESIGN AND MANAGEMENT GUIDE

The Center for E-Commerce Infrastructure Development [8] of The University of Hong Kong was commissioned to develop the XML Schema Design and Management Guide to help B/Ds and IT contractors define and adopt e-government data standards. This Guide provides the following to address the data and business interoperability of government-to-government (G2G) and government-to-business (G2B) joined-up services:

- a methodology for business analysts to specify the definitions and representations of information in a consistent and structured way as reusable information models,
- an approach for programmers to convert the information models of the data elements into W3C XML Schema Definition (XSD) [7] code,
- the guidelines for concertedly aligning and

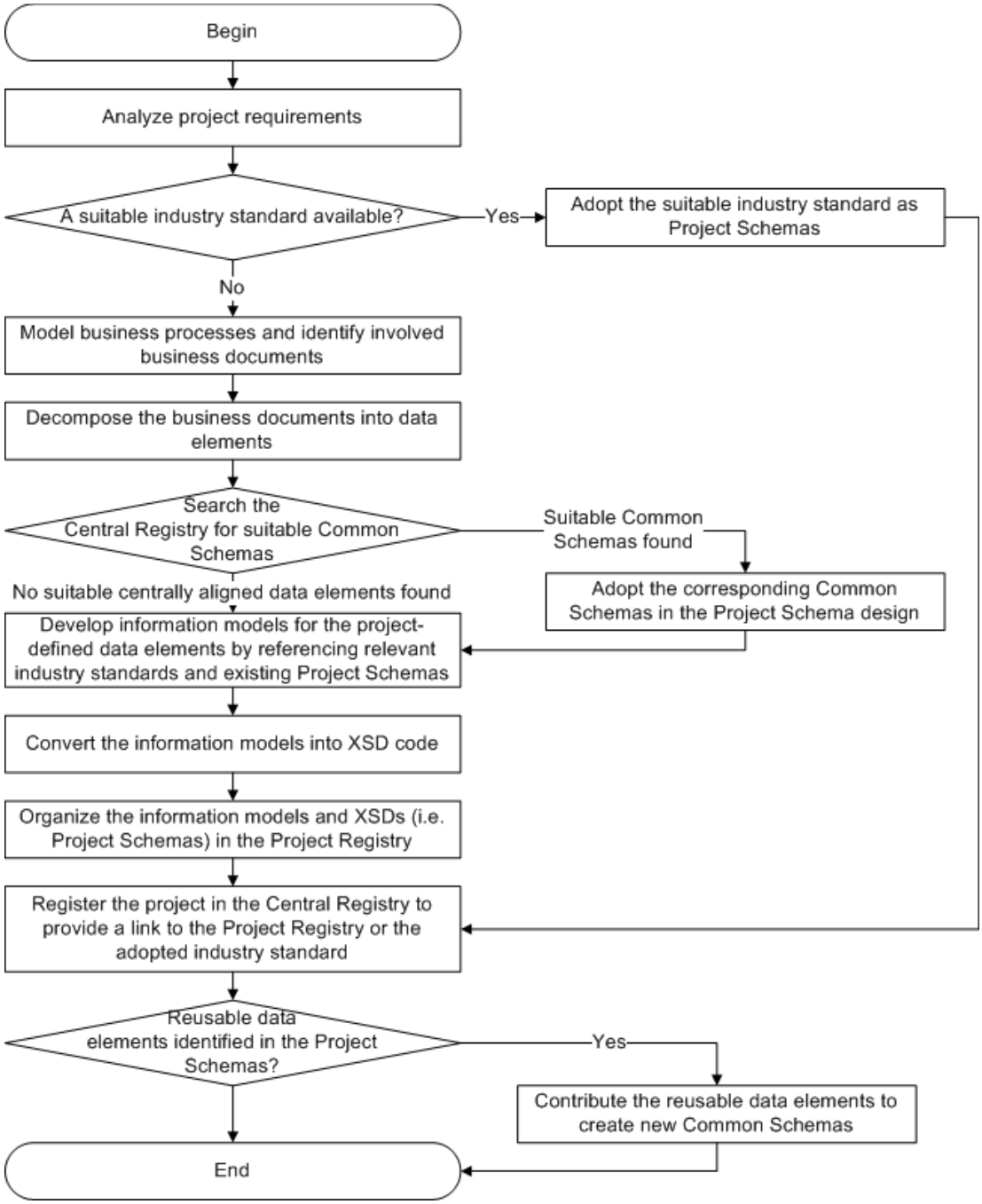


Figure 1. Schema design process flow.

standardizing the definitions and representations of data elements that have potential for reuse, and
- the guidelines for project teams to adopt suitable Common Schemas and also to contribute reusable data elements for creating new data standards.

The Guide consists for four parts:
- PART I: Overview states the objectives of the Guide and outlines its contents, and describes the data interoperability problems and strategy in e-government development. This part also covers the data interoperability measures and the guiding principles.
- PART II: XML Schema Design Guide provides a systematic schema design methodology for business analysts to model business process and information requirements. It also provides the rules for programmers to convert the information models into XSD code.
- PART III: XML Schema Management Guide serves as a handbook for various parties to align data elements from different projects to create data standards among B/Ds. It facilitates the development and management of reusable XML Schemas. It also helps project teams understand the process of data alignment, and their role in contributing reusable data elements for concerted alignment.
- PART IV: Appendices provide supplementary information to help the readers understand this Guide. Most importantly, there is a case study on using the Guide to define data standards for application for import and export licences for pharmaceutical products.

III. XML SCHEMA DESIGN GUIDE

The XML Schema Design Guide (Design Guide) documents a comprehensive XML schema design methodology. There are four core sections: (1) Schema Design Process, (2) Business Process Modelling Methodology, (3) Business Information Modelling Methodology, and (4) XML Schema Definition Development. The Design Guide provides analysts and developers with an end-to-end and seamlessly integrated schema design methodology. It covers modelling techniques from business process modelling, data modelling to XSD coding.

A. Schema Design Process

This schema design process guides a project team to develop the XML data interface, i.e., XSD, for a government system to exchange data with other government or business systems. The process involves two types of schemas: *Project Schemas* and *Common Schemas*. A Project Schemas only needs to satisfy the specific requirements of a particular project while Common Schemas are reusable across projects. Common Schemas are centrally standardized in the government and are shared publicly in the Central Registry [11]. Another difference between Project Schemas and Common Schemas is as follows. A Project Schema is usually document-oriented, like purchase order, because it is ready for use for data exchange. A Common Schema is data-element-oriented, such as address, person name, while it is used as a building block to construct Project Schemas.

The process flow is shown in Fig. 1 and is summarized as follows. First of all, the project team collect and analyze the user requirements to see if there is a suitable industry standard. The team starts to design a custom schema only when no industry standard is suitable. Then, the business analyst models the business process in which a system exchanges data with other systems, and identifies the business documents involved in the exchange. For each identified document, the business analyst builds its information model, i.e., the document structure as well as data constraints. The data models are converted into XSD code of the Project Schema by programmers or by software. If the project team anticipates some data elements in the Project Schema are generic enough for reuse by other projects and B/Ds in future, they can propose these data elements for central standardization as Common Schemas.

B. Business Process Modelling Methodology

The business process modelling methodology is derived from the *ebXML Business Process* [6] modelling approach. A business process is modelled as a collection of *business collaborations*. A business collaboration is a choreography of business transactions. A business transaction is an abstraction of a single document exchange, which can be a one-way or two-way document flow between two parties involved in the collaboration. When the flows of documents between different parties are identified, these documents will be modelled in the next stage.

The Design Guide provides a set of modelling worksheets for business analysts to fill in the requirements of business collaborations and business transactions. For example, the worksheet in Fig. 2 documents an *order entry* business collaboration, which involves a *buyer* as the requesting role and a *seller* and the responding role. Two business transactions, namely *Request Quote* and *Create Order*, are identified in the collaboration. The *Request Quote* transaction involves an exchange of two documents *Quote Request* and *Price Quote* while the Create Order transaction is an exchange of *Purchase Order* and *Order Confirmation* documents. These documents will be used for business information modelling. The process model can be specified as a UML activity diagram.

BUSINESS COLLABORATION WORKSHEET

A. Worksheet Information	
Worksheet ID: BCWS-ORDERENTRY	**Project ID:** XMLGL
Technical Contact: Josia Chan / CECID	**Administrative Contact:** Thomas Lee / CECID

B. Business Collaboration Properties
Name: Order Entry
Description: A buyer and a seller exchange price quotes and create an order.
Scope: The buyer requests the seller to quote the offered prices of the goods for ordering. If the buyer agrees on the prices, it can place an order to the seller.
Pre-conditions: 1. The buyer and the seller have agreed to transact with each other.

C. Roles	
Name	*Description*
Buyer	The firm that places an order.
Seller	The firm that fulfills the order.

D. Business Transactions	
Name	*Description*
Request Quote	The buyer requests a price quote from the seller.
Create Order	The buyer places a purchase order to the seller.

E. Business Documents	
Name	*Description*
Quote Request	Request that the buyer sends to the seller for a price quote.
Price Quote	Price quote that the seller replies to the buyer on a quote request.
Purchase Order	Request by the buyer to place an order to the seller.
Order Confirmation	Indication whether the order request is accepted or rejected.

F. Activity Diagram

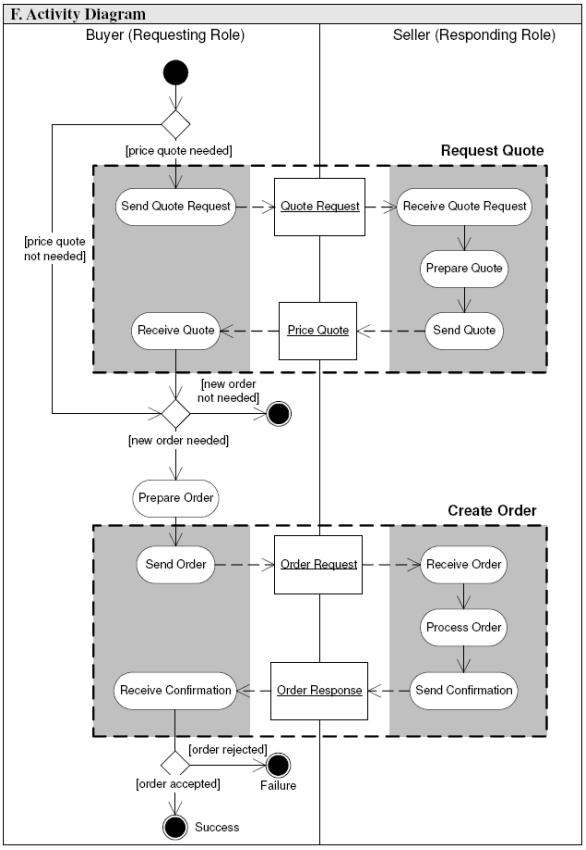


Figure 2. Sample modelling worksheet for a business collaboration.

C. *Business Information Modelling Methodology*

The business information modelling (BIM) process gathers the requirements for the business documents identified in the business process modelling. These requirements are usually in form of paper and electronic copies of those documents that are currently exchanged manually or in old electronic fashion. The modelling methodology simplifies and extends the *Core Components Technical Specification* (CCTS) [10] and allows business analysts to specify documents and data elements as the following information models:

- **Business Document** models an electronic document as a unit for business information exchange; a root Aggregate Business Information Entity is used to provide the representation of the document,
- **Aggregate Business Information Entity** (ABIE) models an object class and aggregates Basic and Association Business Information Entities as the properties.
- **Association Business Information Entity** (ASBIE) models a complex property in an object class.
- **Basic Business Information Entity** (BBIE) models a singular property in an object class.
- **Core Component Type** models a basic business data type as a building block for the above models. BIM provides a set of *Core Component Types* (CCTs) as the basic business data types for building other the information models, e.g., Amount, Date Time, Code, Quantity, etc.

The relationships of these information models can be represented by a UML class diagram like Fig. 3. BIM also provides a modelling spreadsheet as shown in Fig. 4 for business analysts to enter the specifications of information models. The spreadsheet contains user-friendly macros that guide users to enter various attributes required by different models on specific dialog boxes. It also allows users to import and select existing models for reuse in defining new models. Moreover, the spreadsheet models can be converted into XSD through macro programs without coding.

D. *XML Schema Definition Development*

The Design Guide provides a comprehensive specification to standardize the conversion from an information model into XSD code. For example, each BBIE or ABIE is converted into an XSD complex type. A standard XSD library for all CCTs is provided for import into developed XSDs. Since the conversion mechanisms from information models to XSDs have been standardized in the Guide, the XSD generation can be automated by software.

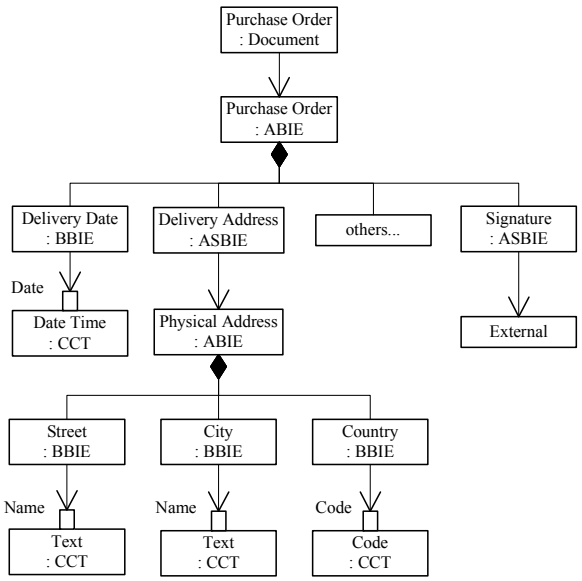


Figure 3. Sample information model for a purchase order document.

IV. XML SCHEMA MANAGEMENT GUIDE

The XML Schema Management Guide (Management Guide) defines the framework (e.g., policy, organization structure, etc.) to manage the Project Schemas and Common Schemas defined using the Design Guide. The Management Guide describes:

- the considerations for the managing Project Schemas as well as their controlled vocabularies, e.g., code lists, namespace, etc.,
- the management process and organization structure for concerted alignment of reusable data elements proposed by B/Ds for standardization of Common Schemas, and
- the guidelines for building a Project Registry and the Central Registry for sharing Project Schemas and Common Schemas respectively.

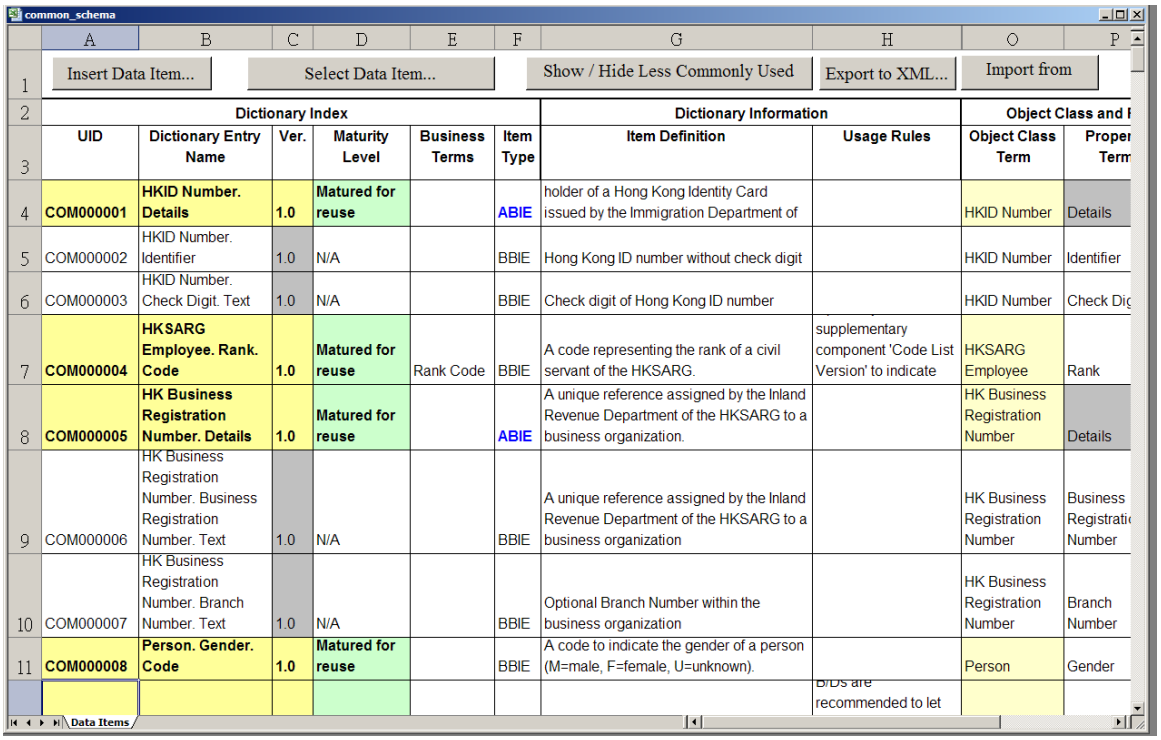
Each Common Schema is associated with one of the following three maturity levels.

- **Level 0 – Agreed in principle**. Among the B/Ds that believe the Common Schema might be applicable to their business, the majority anticipate that they require further investigation and analysis before adopting the Common Schema.
- **Level 1 – Recommended for reuse**. Among the B/Ds that believe the Common Schema might be applicable to their business, the majority anticipate that they are ready to adopt the Common Schema in most of their future projects. Common Schemas are reviewed by all B/Ds regularly. In a review, when more B/Ds vote on a Common Schema for Level 1 than for Level 0, this Schema will be promoted to Level 1.
- **Level 2 – Matured for reuse**. Among the B/Ds that believe the data element might be applicable to their business, the majority anticipate that they are ready to adopt the Common Schemas in future projects. In addition, the Common Schema has already been used in some projects and has remained stable for a certain period. When at least 5 B/Ds are using a Level-1 Common Schema which has not been changed for 6 months, this Schema will be automatically promoted to Level 2.

V. APPLICATION IN E-GOVERNMENT PROJECTS

Many e-government projects have applied the Guide to create their Project Schemas. The following are some examples:

- **Automation of dangerous goods manifests submission** [14]. The project facilitates shipping companies to automate submission of dangerous goods manifests to the Marine Department through the Internet using ebXML Message Service.
- **XML weather information publishing** [12]. The Hong Kong Observatory publishes weather information in XML for businesses, such as media and transport companies, and government departments to automate processing of weather information.
- **Works Project Information Standard** [13]. The Works Branch Development Bureau defines a large-scale XML data standard for various building and construction domains to realize electronic data exchange among various stakeholders in construction projects.



common_schema

	A	B	C	D	E	F	G	H	O	P
1	Insert Data Item...		Select Data Item...			Show / Hide Less Commonly Used		Export to XML...	Import from	
2	Dictionary Index						Dictionary Information		Object Class and P	
3	UID	Dictionary Entry Name	Ver.	Maturity Level	Business Terms	Item Type	Item Definition	Usage Rules	Object Class Term	Proper Term
4	COM000001	HKID Number. Details	1.0	Matured for reuse		ABIE	holder of a Hong Kong Identity Card issued by the Immigration Department of		HKID Number	Details
5	COM000002	HKID Number. Identifier	1.0	N/A		BBIE	Hong Kong ID number without check digit		HKID Number	Identifier
6	COM000003	HKID Number. Check Digit. Text	1.0	N/A		BBIE	Check digit of Hong Kong ID number		HKID Number	Check Dig
7	COM000004	HKSARG Employee. Rank. Code	1.0	Matured for reuse	Rank Code	BBIE	A code representing the rank of a civil servant of the HKSARG.	supplementary component 'Code List Version' to indicate	HKSARG Employee	Rank
8	COM000005	HK Business Registration Number. Details	1.0	Matured for reuse		ABIE	A unique reference assigned by the Inland Revenue Department of the HKSARG to a business organization.		HK Business Registration Number	Details
9	COM000006	HK Business Registration Number. Business Registration Number. Text	1.0	N/A		BBIE	A unique reference assigned by the Inland Revenue Department of the HKSARG to a business organization		HK Business Registration Number	Business Registrati Number
10	COM000007	HK Business Registration Number. Branch Number. Text	1.0	N/A		BBIE	Optional Branch Number within the business organization		HK Business Registration Number	Branch Number
11	COM000008	Person. Gender. Code	1.0	Matured for reuse		BBIE	A code to indicate the gender of a person (M=male, F=female, U=unknown).		Person	Gender
								BIDs are recommended to let		

Data Items

Figure 4. BIM spreadsheet.

- **Macao Government Interoperability Framework** [15]. The Guide is being translated into Chinese and Common Schemas for the Macao environment are under construction.

VI. CONCLUSIONS

The HKSARG XML data interoperability framework provides a comprehensive XML schema design methodology and the necessary schema management infrastructure to facilitate e-government data standardization. A library of reusable Common Schemas has been developed, and shared in a data standards registry for developing Project Schemas for new government services. While these schemas are designed for government projects, they are also published publicly to facilitate adoption by the business sector. Moreover, the XML Schema Design Guide is a generic integrated methodology, which covers all necessary steps in e-business modelling, from requirement analysis, to business process and information modelling, to XSD coding. Business enterprises and other governments can easily adapt it to establish their own data interoperability infrastructures.

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