

**PUBLIC AUTHORITY FOR INDUSTRY  
KUWAIT**

**ENTERPRISE ARCHITECTURE / ENTERPRISE  
INFORMATION ARCHITECTURE PROJECT**

**EA/EIA STRATEGIC MODELING PHASE  
ENTERPRISE ARCHITECTURE  
PORTFOLIO PLAN (EAPP)  
REPORT**

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# 1. EXECUTIVE SUMMARY

- This document comprises the *Enterprise Architecture Portfolio Plan (EAPP) Report* for the Strategic Modeling Phase of the EA/EIA project. It is the result of Strategic Modeling, carried out over three weeks from September 25 – October 13, 2000. It documents the Strategic Model for PAI. This has been used to define associated project plans for more detailed definition of the *Enterprise Information Architecture* for the Public Authority for Industry (PAI) in Kuwait.
- Enterprise Architecture considers design and operation of an enterprise from many perspectives. The catalysts for Enterprise Architecture are Strategic Business Plans defined by senior management. These address the requirements of the Planners and Owners of the enterprise.
- For Public-Sector enterprises, the Government is both the Planner and Owner. The Public Authority for Industry in Kuwait was established from “*The Industrial Law for the State of Kuwait No. 56 Year 1996*”. We will refer to this as the *PAI Law*. It forms the basis for definition of PAI Strategic Plans. As PAI had not defined its Strategic Plans by 2000, we used the PAI Law as the catalyst for Strategic Modeling.
- The Designers of the enterprise are senior managers and managers from Business Units or Functional Areas. Information Technology staff work with the managers and their business expert advisors. From the enterprise business design, they work as Designers of the information systems and databases that will provide the required information needed by management for decision-making.
- From the data, activity, process and object models documented by the Designers, IT Builders (analysts, database administrators and programmers) build databases, application systems and workflows as Information Systems that meet the defined needs of the enterprise.

## 1.1 Summary of EA/EIA Strategic Modeling Phase

- The *EA/EIA Strategic Modeling phase* used the PAI Law (the basis for PAI Strategic Plans) to identify major databases and business activities in a Strategic Model, for detailed definition in later *EA/EIA Tactical, Operational and Activity Modeling phases*.
- Following the Tactical, Operational and Activity Modeling phases for the EA/EIA project, these detailed databases and activities will later be implemented in the IIS *Industrial Information Warehouse (IIW)* and the *Industrial Information Service Bureau (IISB) Corporate Portal*.
- The Strategic Model of PAI was analyzed and documented using Visible Advantage Enterprise Architecture Edition. This software product identified the major databases and business activities that are required by PAI. It used Entity Dependency Analysis, to define the PAI Enterprise Architecture and Enterprise Information Architecture.
- *It is essential that PAI managers and staff specify their information needs in the Tactical and Operational Modeling phase of the EA/EIA project. This will ensure that their information needs are included in the later IIW and IISB Corporate Portal, when implemented.*
- The PAI Organization Structure was defined to Visible Advantage as Model Views, to allow different views of the data and information relevant to each sector and its reporting departments to be examined. The PAI Sector Organization Structure is:
  - ILD - Industrial Licensing and Development
  - ISS - Industrial Specifications and Service
  - AFA - Administrative and Financial Affairs
  - OD - Other Departments
- Visible Advantage was used to analyze the Strategic Model: to identify *Business Activities*; and to derive *Project Plans*. This analysis enables priority information that

is needed by PAI managers to be developed early in the IIW and IISB Corporate Portal projects, so that it can be delivered to management first.

- Following development of the Strategic Model by the EA/EIA Project Team, Visible Advantage produced detailed reports that are included as Appendices as follows.
  - Appendix 1: Model Views and Strategic Data Maps
  - Appendix 2: Cluster Reports of Activities and Databases
  - Appendix 3: Planning Statement Reports for PAI Law
  - Appendix 4: Article of Law by PAI Sector Matrix
  - Appendix 5: Business Activity by PAI Sector Matrix
  - Appendix 6: PAI Article of Law by Strategic Data Matrix
  - Appendix 7: PAI Strategic Model Entity Report
  - Appendix 8: Zachman Framework for Enterprise Architecture
  - Appendix 9: Visible Universal Model Business Plans
  - Appendix 10: Visible Universal Model Business Objects
- Each Appendix is discussed in the relevant Appendix Cover Page, which also describes the content and meaning of each of the enclosed reports. However for PAI Confidentiality reasons, the content of each Appendix is not included in this version of the PAI EAPP Report on the Internet.

## 1.2 Summary of Recommendations

Recommendations arising from this Enterprise Architecture Portfolio Plan (EAPP) Report are discussed next. Some are general recommendations, while other recommendations are for PAI Management. Further recommendations apply to the EA/EIA Project Team.

### General Recommendations

- PAI management identified the following Business Activities as their highest priority, for early delivery of priority information by the IIW and IISB Corporate Portal:
  - Licensing Management
  - Industrial Lot Management
  - Industrial Service Management
  - Industrial Control Management

These priority activities are documented in the Appendix 2 Cluster Report. The data needed by these activities are defined in the relevant clusters, named as listed above.

- Before required data and information can be delivered to PAI managers by the IIW and IISB Corporate Portal projects, the Strategic Model must be expanded to greater detail for these priority activities in terms of the data and activities it contains. This is defined using *Tactical Data Modeling*, then *Operational Data Modeling* methods.
- *Activity Modeling* will also need to be used to define the priority business activities in greater activity detail. Activity Modeling documents the resources required by, and the costs associated with, component activities. These costs are defined using Visible Advantage for *Activity Based Costing* (ABC). This will enable PAI to determine the most cost-effective approach to be used to implement defined activities.

### PAI Management Recommendations

- The above modeling is completed in the *Tactical, Operational and Activity Modeling* phase of the EA/EIA project. To ensure that the information needs of each Sector and Department of PAI are identified, ***it is vital that PAI managers make their most experienced business experts available to the EA/EIA Project Team.***

- Business experts will participate in scheduled meetings (typically half-day or full-day duration) when their detailed knowledge is required. These meetings will be facilitated modeling sessions conducted by the EA/EIA Project Team. This will enable their PAI knowledge to be included in relevant Sector and Department data models and activity models, as the *Tactical, Operational and Activity Modeling* phase progresses.
- This data and activity modeling is time-consuming, but it is **absolutely essential** to ensure PAI information needs are addressed by the IIW and IISB Corporate Portal.
- To reduce the time involved (and hence the cost) – and also increase the final quality of the IIW and IISB – predefined *Tactical* and *Operational Business Objects* can be selected that address specific needs of PAI. These Business Objects comprise data and business processes for major PAI activities, such as PAI Resource Management: a part of *Industrial Lot Management*.
- These Business Objects can be rapidly tailored to unique PAI needs and terminology. They comprise part of the Visible Universal Model. The EA/EIA Project Team will evaluate these Business Objects. They can then advise whether selected objects can be used to achieve time and cost savings for PAI in *Tactical, Operational and Activity Modeling*; with later improved quality for the IIW and IISB Corporate Portal.

#### **EA/EIA Project Team Recommendations**

- The EA/EIA Project Team will evaluate the Visible Universal Model Business Objects in relation to the Strategic Model. They will advise PAI Management whether selected objects can be used to achieve time and cost savings in the next EA/EIA phase, with later improved quality for the IIW and IISB Corporate Portal.
- Project Maps and Project Plans for the priority business activities listed above will be developed by the EA/EIA Project Team, to schedule participation by Sector and Department business experts. The project maps and clusters in the Strategic Model will be used for project planning of the detailed modeling that will be carried out, to include expert PAI knowledge.
- Reports in the Appendices for this Strategic Model will be replaced by the relevant *Tactical Data Model* reports, *Operational Data Model* reports and *Activity Model* reports as the *Tactical, Operational and Activity Modeling* phase progresses. This will evolve this document to an *Enterprise Information Architecture Portfolio Plan Report*.
- The *Enterprise Information Architecture Portfolio Plan Report*, with selected reports in the Appendices, document high-level PAI information needs. It should be supplied to potential vendors of software products for the IIW and IISB Corporate Portal.
- The vendor(s) selected to implement the Industrial Information Warehouse (IIW) and IISB Corporate Portal will use the final *Enterprise Information Architecture Portfolio Report* as PAI data and information requirements for implementation in those phases.

## 2. INTRODUCTION

The Public Authority for Industry (PAI) in Kuwait issued a Request for Proposal (RFP), closing November 21, 1999. The RFP focus was for the development and deployment of the PAI Industrial Information Systems (IIS) project. The RFP defined the IIS scope of work as the following integrated subprojects:

- One: Development and Deployment of an Enterprise Architecture (EA) and Enterprise Information Architecture (EIA).*
- Two: Development and Deployment of a Workflow-based Transaction Processing System (WTPS) that fulfills the core business activities and the operational system requirements for PAI. The scope of the current WTPS development requirements is to address those core business activities that cover the industrial firms and workshops affairs in terms of licensing, lot allocation, etc. Activities related to the financial and human resource sectors are to be covered in future systems and are not within the scope of this project. However the integration of the current WTPS system with these two future systems is extremely important for any other system, and should be clearly defined. This should be accomplished by providing a set of API's for WTPS to interface and integrate with other systems.*
- Three: Development and Deployment of an Industrial Information Warehouse (IIW) that fulfills the informational system requirements for decision making, analysis and planning.*
- Four: Development and Deployment of an Industrial Information Services Bureau (IISB) that provides a **web-based information portal** to the local and international business community.*

The initial selection by PAI was for Subproject One above, for development and deployment of an Enterprise Architecture (EA) and Enterprise Information Architecture (EIA). This is called the EA/EIA project.

Information Engineering Services Pty Ltd (IES of Perth, Western Australia) was selected to provide Enterprise Architecture education and consulting services for the EA/EIA project. Visible Systems Corporation (Visible of Boston MA USA) was selected to provide software products that support the IIS EA/EIA project. Clive Finkelstein, IES Managing Director, was nominated as the consultant to work with PAI on the EA/EIA project.

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### 2.1 What is Enterprise Architecture?

Consider building construction, with a history of thousands of years. Over this time it was found that Architecture is an essential prerequisite for the construction of all buildings. These buildings may include residential houses, all commercial and government buildings, and skyscrapers. In fact every building, except perhaps very simple huts, can benefit from Architecture. For without proper planning and design as carried out by architects, problems can arise as follows:

- The design or construction materials used for the building may not be adequate, and so it may fail. This failure can be in terms of quality that may lead to complete collapse.
- The design or construction materials used for the building may in fact be adequate, but the method of construction may take longer and so cost more than it should.

- The building may be constructed correctly, but not meet specific needs of planning authorities, or of the owners and occupiers and can represent wasted effort and cost.
- An architect will specify standard sizes for doorways and windows so prefabricated components can be used to reduce the time and cost of construction dramatically.

Architecture applies to other activities: the design and manufacture of airplanes for example. Airplane architecture has a history of 100 years. Without proper architecture in the design and construction of an airplane, the chance of it flying without crashing is severely compromised. This is the role of aeronautical designers and engineers, who use architecture for airplane design and construction. We would never consider flying in a plane that had not been correctly designed, tested and built.

Consider now the use of computers in business, which have a short history of only 50 years from their first use in the early 1950s until the present time. But in contrast to building or airplane construction, architecture has not been used in the building of information systems in enterprises. Because Enterprise Information Architecture (EIA) has not been used for effective planning and design of computer databases and applications, many problems arise as follows:

- Application and database design for computer applications and databases may not be adequate, and so they may fail. This failure can be in terms of quality that may lead to complete collapse of the applications. This is a common problem today.
- The application and database design approach may in fact be adequate, but the method of development may take longer and so cost more than it should. This also is common.
- The application and database development approach may be correct, but the finished systems and databases may not meet the specific needs of the owner and/or end users and so can represent wasted effort and cost. This is one of the greatest problems with application and database development today.
- An Information Architect specifies standard components for application development, so that pre-built program components can be used to reduce time and cost of application development dramatically. This is based on the use of Object-Oriented (O-O) application development, drawn from O-O analysis and design methods.

The above problems correspond to those discussed for building architecture, but have been avoided there – due to the accepted use of building architecture. The lack of Enterprise Information Architecture (EIA) for information system development, in contrast, is one reason why these problems are endemic. The use of Enterprise Information Architecture minimizes the impact of these information system development problems in enterprises.

Now consider the way that enterprises are formed and grow. Ideally, the establishment of every enterprise should be based on well-defined business plans. Business plans should reflect the Strategic Plans defined by management. These plans are analogous to an architect's plans for the business.

A Strategic Business Plan defines the Mission, Vision and Value statements of an enterprise. Based on the industry and market focus defined by management, Policy statements are developed for the enterprise. These policies are qualitative guidelines defining boundaries of responsibility for business units or functional areas of the enterprise.

From Policies established by management for each business unit or functional area, Goals and Objectives are defined. While policies are qualitative, Goals and Objectives must be quantitative and measurable. Goals are typically long-term, while objectives are short-term. Some enterprises may reverse these – with objectives long-term and goals short-term – but the effect is the same: they must be quantitative and measurable.

Once quantitative measures are defined, alternative strategies can be evaluated. While a goal or an objective indicates “what” is to be achieved, a strategy indicates “how” that achievement will be realized. Strategies therefore depend on goals and objectives. Strategies may have many steps involved in their execution: called Tactics.

Once a strategy or tactic is defined to achieve a goal or objective, its implementation will need to be managed. This is achieved by Key Performance Indicators (KPIs) defined for each strategy or tactic. A KPI is an objective that is typically defined for implementation of specific strategies or tactics, in support of the achievement of goals or objectives by business units or functional areas. KPIs measure the performance of the managers of those business units or functional areas, whose responsibility is the effective implementation of the relevant strategies or tactics.

To define a strategy or tactic – to focus on **how** something is to be done before knowing **what** is to be achieved – is the ultimate futility in strategic planning. It certainly generates work, but it rarely generates results. For if no measures have been defined for achievement then no results can be assessed against those measures.

So to be quantitative and measurable, all goals and objectives must exhibit three characteristics: *measure*, *level* and *time*. A goal or objective statement must clearly indicate “*what*” is to be achieved (measure), by “*how much*” (level) and “*when*” (time).

For example, a **hypothetical** statement that says: “*a lot will be allocated to an industrial firm when its license is approved, based on the required area specified in the firm’s proposal*” defines **how** lots are allocated, not what is to be achieved. It is therefore a strategy, not a goal or objective. On the other hand, the statement: “*a lot will be allocated to an industrial firm within two days following license approval, based on the required area specified in the firm’s proposal*” indicates **what** is to be achieved. It has the three characteristics of an objective. The **measure** is defined as the *allocation of a lot*, the **time** is defined as *two days*, and the statement implies a **level** that lots are allocated for *100% of firms* that are granted a license and request lot allocation in their proposal.

Senior managers accept that Strategic Business Planning is their responsibility. The development of the strategic plan in many enterprises is carried out by a Corporate Planning Department, which reports directly to senior management. Effective strategic plans typically emerge in this situation. Unfortunately though, for most enterprises the strategic plans are mainly statements of strategy. They are not measurable, and so are unable to be managed precisely. Only when measurable goals and objectives are clearly defined as quantitative measures can management exercise effective management control.

*Senior managers are the architects of the enterprise.* Strategic Business Planning is the catalyst for Enterprise Architecture (EA). Government, Commercial and Defense enterprises use strategic planning to ensure that the enterprise follows defined management directions. The Mission, Vision, Values, Policies, Goals, Objectives, Strategies, Tactics and KPIs should be statements that provide clear direction to all managers within the enterprise.

Where strategic planning is not applied effectively, management cannot be certain of the results that will be achieved by the enterprise. The enterprise then becomes very difficult to manage; few measures are available for management to assess performance achievement. The following problems typically arise in such enterprises:

- If the strategic business plans are not well-defined or are non-existent, the enterprise has no clear direction. If not corrected in time, this failure can lead to the complete collapse or failure of the enterprise.
- If the strategic business plans are well-defined, but not used effectively to manage all parts of the enterprise and at all levels, required business changes in the enterprise may take longer and so cost more than they should. In the rapid business change climate of today, such delays can be serious. At best they may lead to lost opportunities; but at worst they can lead to the failure of the enterprise.
- If the strategic business plans are well-defined, but no longer meet the specific needs of the enterprise, then the business may be moving in directions that are no longer appropriate. This can represent wasted effort and cost ... and once again, lost opportunities.
- Clear strategic plans, with an understanding by management of Enterprise Architecture and its integration with Enterprise Information Architecture (EIA), can enable standard business procedures and integrated databases to be defined

throughout the enterprise. This can lead to enormous cost savings through dramatic improvements in business efficiency. For example, common procedures as well as integrated databases lead to common training of staff, easy staff reallocation due to common skills used in the business, and elimination of redundant processing otherwise needed to maintain redundant databases current and up-to-date.

Once again, the above problems correspond to those discussed for building architecture, but were avoided there due to the accepted use of building architecture. The lack of Strategic Business Planning and the absence of Enterprise Architecture (EA) that is applied by senior management, in contrast, is one reason why many enterprises operate at less than optimum efficiency ... or may even fail. The use of Strategic Business Planning and Enterprise Architecture minimizes the impact of these problems in enterprises. We can learn much from building architecture and apply similar principles to Enterprise Architecture.

## 2.2 The Importance of Architecture for Enterprises

Building architecture considers the design of a building from many perspectives. The catalysts are the requirements of the Planner and the Owner of the building. The Planner is interested in a broad overview of the building's purpose. This indicates WHY the building is to be constructed, WHO is to occupy it, and WHEN it is to be built. The Owner supplies the purpose and these other details for planning approval. The Owner will also have other requirements to ensure the building meets his specific needs.

From the Planner's and the Owner's perspectives above, the Designer (who is an architect) designs the building to address their needs. The Designer then documents the design in a format and in terms relevant to the Builder: as construction blueprints or diagrams; and as construction specifications. They indicate WHAT materials are to be used, HOW construction is to be undertaken, and WHERE various elements of the building are to be located. From the Designer's perspective, the Builder documents construction details for the Subcontractor to guide construction of components of the building. The end-result of this use of architecture is a building that meets the needs of the Planner and Owner, when built.

Enterprise Architecture considers the design and operation of an enterprise also from many perspectives. The catalysts for Enterprise Architecture are Strategic Business Plans defined by senior management. These address the requirements of the Planners and Owners of the enterprise. For Public-Sector enterprises, the Government is both the Planner and Owner. The government's requirements are expressed in Laws governing establishment and operation of the relevant authorities. In the case of the Public Authority for Industry (PAI) in Kuwait, these requirements are expressed in "*The Industrial Law for the State of Kuwait No. 56 Year 1996*". We will refer to this as the *PAI Law*.

The Strategic Business Plans for an authority such as PAI are based on the *PAI Law*, which is defined in 55 Articles. They indicate WHY the authority was established and WHO it is to support, as expressed in Articles 27 and 28 of the *PAI Law* as follows:

**Article 27:** "*An autonomous public authority, called the Public Authority for Industry, shall be established under the supervision of the Minister of Commerce and Industry.*"

**Article 28:** "*The Authority aims at developing, enhancing and supervising the industrial activity in the country, for the realization of the objectives of the national economy which include the following:*

- 1- *Encourage, develop and protect local industries.*
- 2- *Expand the industrial and enterprise production base.*
- 3- *Diversify the National Income resources.*
- 4- *Support, develop and encourage the production of strategic commodities deemed necessary for national and food security.*
- 5- *Provide a favorable climate to attract more national manpower of technically qualified skills.*
- 6- *Support, develop and encourage industrial enterprises.*

- 7- *Increase industrial awareness among citizens, emphasize the positive role of industrial development methodology, prepare and publish studies and researches, and provide information systems and industrial data, as well as encourage development, and creativity of innovative skills and talents.*
- 8- *Co-ordinate among the existing industries and the future ones to be established in the countries of the Arab Countries of the Gulf Co-operation Council (GCC) in particular, and in the other Arab Countries in general, so as to achieve integration and avoid harmful competition.*
- 9- *Consolidate industrial co-operation with the various countries and international organizations in order to secure the expertise and information required for domestic industrial development.*

Other Articles in the PAI Law define WHAT is to be achieved by PAI for Kuwaiti industry and the controls that are to be established. They define HOW it is to carry out its duties, WHO in PAI is involved and also WHEN, WHERE and WHY various activities should be undertaken.

As we saw earlier, an Enterprise defines its Strategic Business Plans in terms of its Mission, Vision and Values at the highest level. From these, it can establish Policies based on specific constraints defined in the Law. These Policies are qualitative guidelines defining boundaries of responsibility. They are also used to define the Organization Structure of the enterprise, made up of Business Units and Functional Areas.

Policies lead to definition of Goals that define what the enterprise has to achieve (measure), by when (time) and the degree of achievement (level). In turn, Goals result in the definition of Strategies designed to achieve those goals. The Strategies are then allocated to responsible business units or functional areas for their implementation.

Within each Business Unit or Functional Area, the responsible managers define Objectives to ensure that the Strategies are implemented to achieve the higher level Goals. In turn, these Objectives lead to definition of more detailed Tactics, Tasks or Business Processes that are designed to achieve the relevant Objectives. The Implementation of tactics, tasks or business processes is further managed at lower levels by the definition of Key Performance Indicators (KPIs).

Taken together, the above statements document the Strategic Business Plan of an enterprise. They define WHY the enterprise exists (Mission and Vision), WHAT is to be achieved and by WHEN (Goals and Objectives), HOW they are achieved (Strategies and Tactics), WHO are involved (managers and staff), and WHERE (locations, Business Units and Functional Areas).

In the design of an enterprise, there are many ways of representing things that are of interest to Planners and Owners, from their perspectives. These are expressed in terms of text in the Strategic Business Plan. The strategic plan can also be expressed as diagrams, lists of things of interest to management, and planning details or specifications representing the enterprise. These are documented in a Strategic Model. The Strategic Model and the Strategic Business Plan indicate WHAT, HOW, WHERE, WHO, WHEN and WHY. From these, more detail and different types of diagrams, lists and specifications can be used to address the perspectives of the Designer, Builder and Sub-Contractor. Again, they are interested in WHAT, HOW, WHERE, WHO, WHEN and WHY.

Based on the Strategic Business Plan and the Strategic Model, a clear expression of the requirements of the Planners and Owners of the enterprise can be determined, for use by the Designers. The Designers of the enterprise are typically senior managers and also managers from the Business Units or Functional Areas. They determine WHAT data and information are required to support decision-making by management. They define HOW data and information are used in business processes. They determine WHO, WHEN and WHERE the data and processes are to be made available throughout the enterprise.

Information Technology staff (data administrators, business analysts and systems analysts) work with these managers and their business expert advisors. From the enterprise business design, they work as Designers of the information systems and databases that will provide the required information needed by management for decision-making. They identify the Business Rules that define WHAT data and information will be used in processes, as well as WHY and HOW. These business rules are used to define application systems and workflows to support managers and staff throughout the enterprise. From this, they define WHAT data is required, and also HOW, WHEN and WHERE it will be processed based on WHO the end-users are.

The documentation produced includes Tactical and Operational Data Models, Activity Models, Process Models and Object Models that document these designs.

From the data, activity, process and object models documented by the Designers, IT Builders (systems analysts, database administrators and programmers) build databases, application systems and workflows as Information Systems that meet the defined needs of the enterprise.

### 2.3 The Framework for Enterprise Architecture

We discussed how the disciplines of architecture and manufacturing evolved to manage the design, construction and maintenance of buildings and complex manufactured products such as airplanes. John Zachman, an international consultant, saw that experience from these disciplines could also be applied to management of the design, construction and maintenance of similarly complex systems – such as the information systems that support enterprises. The wide variety of lists, text documents, specifications and diagrams in a typical enterprise are difficult to visualize reference and manage. To assist this management, he defined two frameworks: the Zachman Framework for Information Architecture; and later, the Zachman Framework for Enterprise Architecture.

He saw that columns representing the interrogatives of WHAT (for data), HOW (for process) and WHERE (for location) could be considered from different perspectives, represented as rows in Figure 1:

	<b>WHAT</b> <i>Data</i>	<b>HOW</b> <i>Process</i>	<b>WHERE</b> <i>Network</i>
<b>Objectives/ Scope</b> <i>Planner</i>	List of Things	List of Processes	List of Locations
<b>Enterprise Model</b> <i>Owner</i>	Conceptual Enterprise Model	Business Process Model	Business Logistics System
<b>System Model</b> <i>Designer</i>	Logical Data Model	Application Architecture	Distributed System Architecture
<b>Technology Model</b> <i>Builder</i>	Physical Data Model	System Design	System Architecture
<b>Detailed Representations</b> <i>Subcontractor</i>	Data Definition	Program	Network Architecture
<b>Functioning Enterprise</b>	Data	Function	Network

**Figure 1: Concepts of the Zachman Framework for Enterprise Architecture**  
 [Source: “Building Corporate Portals with XML”, Clive Finkelstein and Peter Aiken, McGraw-Hill (2000)]

- Row 1 considers objectives and scope from the perspective of the Planner
- Row 2 considers the conceptual enterprise model from the perspective of the Owner
- Row 3 considers the logical system model from the perspective of the Designer
- Row 4 considers the physical technology model from the perspective of the Builder
- Row 5 considers detailed representations from the perspective of the Subcontractor

Different documentation or representations may be utilized in each cell of the Zachman Framework. For example, the *Industrial Information Warehouse* (IIW) for PAI focuses mainly on data: this is the WHAT (Data) column of Figure 1. The PAI *Industrial Information Service Bureau* (IISB – or Enterprise Portal) focuses on both the WHAT and the HOW columns. The *Workflow-based Transaction Processing System* (WTPS) focuses on the HOW column.

The cell formed by intersection of the Objectives / Scope row (of interest to the Planner) and the Data column in Figure 1 shows that a “List of Things” is appropriate for this cell. At the intersection of the Process column is a “List of Processes”, while the intersection with the Location column shows a “List of Locations”.

Consider now the Enterprise Model row (of interest to the Owner). The cell for the Owner row and the Data column shows that “Conceptual Data Model” documentation is appropriate for this cell. This is sometimes also called a “Strategic Data Model”. At the intersection of the Process column for the Owner row is a “Business Process Model”, while the intersection with the Location column shows a “Business Logistics System”.

The next row addresses the System Model from the perspective of the Designer. The cell for this row and the Data column shows that “Logical Data Model” documentation is appropriate. At the intersection of the Process column for the Designer row is the “Application Architecture”. The intersection with the Location column is “Distributed System Architecture”.

The Builder row addresses the Technology Model. The cell at the intersection of the Builder row and Data column contains “Physical Data Model”. At the intersection of the Process column for the Builder row is the “Systems Design” cell. The intersection of this row with the Location column represents the “Network Architecture” cell.

Finally the Subcontractor’s row addresses detailed representations: the “Data Definition” of databases in the Data column, “Programs” in the Process column, and “Network Architecture” in the Location column. These result in completion of the required databases and systems.

We have shown and discussed only three columns in Figure 1. The complete Zachman Framework has three additional interrogatives for a total of six columns – WHO (people), WHEN (time) and WHY (motivation). The six-column *Framework for Enterprise Architecture* is illustrated in Appendix 8. It is discussed in the context of Information Warehouses and Enterprise Portals in Chapter 15 of the book: *Building Corporate Portals with XML* by Clive Finkelstein and Peter Aiken (McGraw-Hill, 2000). Copies of this book were supplied to PAI in conjunction with the RFP Submission from Information Engineering Services Pty Ltd (IES).

The Zachman Framework is a useful way to discuss complex activities and representations for *Enterprise Architecture* and also *Enterprise Information Architecture* in the EA/EIA project of PAI. It will enable PAI to precisely plan, design, develop and manage the later *Industrial Information Warehouse (IIW)* and *Industrial Information Service Bureau (IISB)* Corporate Portal of the PAI *Industrial Information System (IIS)*.

Following this discussion of Enterprise Architecture and Enterprise Information Architecture, we will now discuss the application of these principles to the EA/EIA project at PAI.

### 3. THE EA/EIA PROJECT AT PAI

The *Enterprise Architecture / Enterprise Information Architecture (EA/EIA)* project for the PAI *Industrial Information System (IIS)* completed the Strategic Modeling phase of that project in three weeks, from Sep 25 – Oct 13, 2000. The *EA/EIA Strategic Modeling phase* uses available legislation and strategic plans to identify major databases and business activities in a Strategic Model. As PAI has not yet defined its strategic plans, the *PAI Law* was used as an alternative catalyst for Strategic Modeling. This strategic model will be used for more detailed definition in subsequent *EA/EIA Tactical, Operational and Activity Modeling phases*.

Following the Tactical, Operational and Activity Modeling phases for the EA/EIA project, these detailed databases and activities will later be implemented in the IIS *Industrial Information Warehouse (IIW)* and the *Industrial Information Service Bureau (IISB)* Corporate Portal.

The PAI Strategic Model addresses the Planner and Owner rows of the Zachman Framework for Enterprise Architecture (see Figure 1). It addresses the WHAT (Data) and HOW (Function) columns, based on the WHY (Motivation) column (see Appendix 8) which documents the PAI Law (at the Planner row) and the PAI Strategic Business Plan (at the Owner row).

These two rows represent the *PAI Enterprise Architecture (EA)*. They drive detailed definition of the *PAI Enterprise Information Architecture (EIA)* at the Designer row. The Designer row defines Tactical and Operational Logical Data Models in the WHAT (Data) column, as well as Activity Models in the HOW (Function) column. These models are defined during the EA/EIA Tactical, Operational and Activity Modeling phases, following the Strategic Modeling phase. As discussed above, they will be defined in still greater detail at the Builder row for later implementation of the IIW and IISB Corporate Portal.

### 3.1 Input to the Strategic Modeling Phase

Clive Finkelstein conducted a Strategic Modeling Facilitated Session with PAI management on Sep 25 – 26. This defined a high-level Strategic Model of PAI that was analyzed and documented using Visible Advantage Enterprise Architecture Edition over the period Sep 27 – Oct 13. This software product identified the major databases and business activities that are required by PAI. As discussed above, these will be defined in greater detail in the EA/EIA Tactical, Operational and Activity Modeling phases, later to be implemented as part of the IIW and IISB Corporate Portal projects.

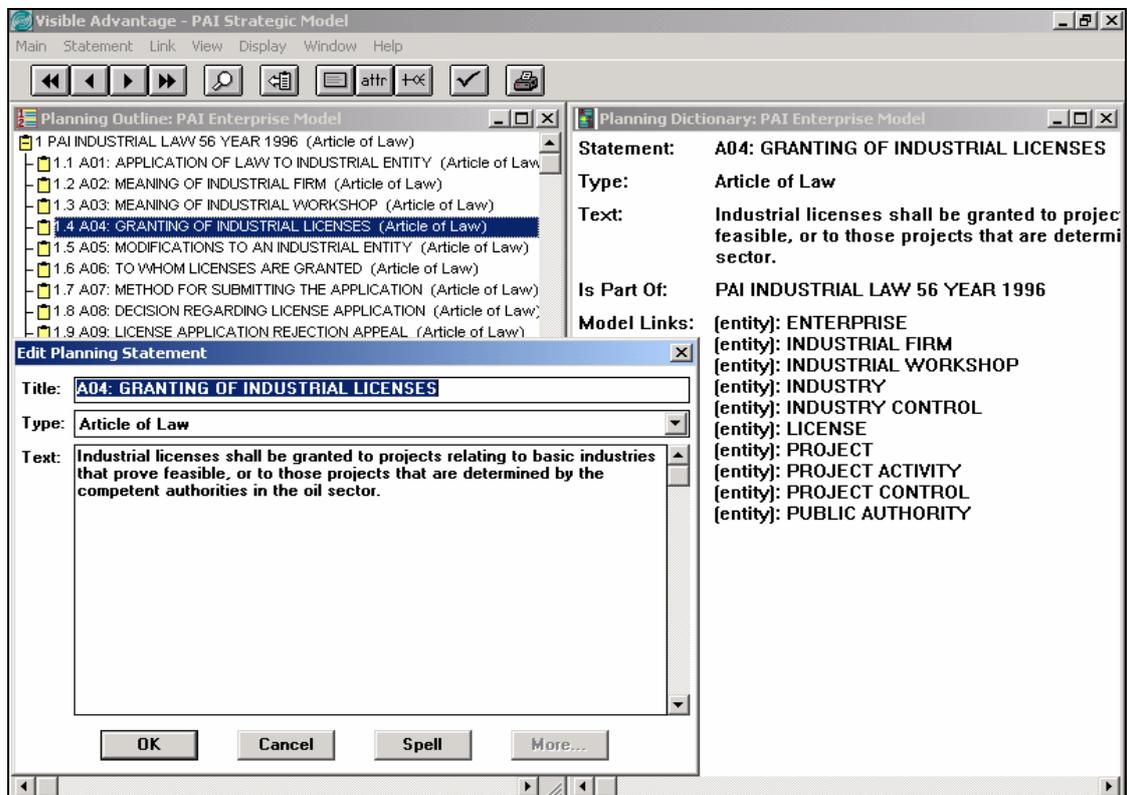
The results of this Strategic Modeling phase and Strategic Analysis were documented as an *Enterprise Architecture Portfolio Plan Report* in this current document, for review by PAI management on October 13, 2000.

The catalyst for the facilitated session with management was legislative articles of the *PAI Law*. Each *Article of Law* clearly identified data and information that are needed by PAI management to implement the relevant legislation. This was illustrated as a diagram on a white board, showing the relationships between the relevant data, information and business activities that PAI uses to manage the implementation of the legislation. This diagrammatic representation is called a *Strategic Data Map*.

### 3.2 Articles of Law used for the Strategic Model

The Strategic Data Map developed in the facilitated session with management was entered into Visible Advantage Enterprise Architecture Edition for Strategic Analysis and definition of the PAI Enterprise Architecture and Enterprise Information Architecture as discussed above.

The Strategic Data Map was defined in the facilitated session from PAI Law, so those Articles of Law were entered into Visible Advantage. This enabled the data and information needed by PAI to implement the direction and intent of the law to be assigned to the relevant articles. An example of the Articles of Law in the Planning Dictionary of Visible Advantage is shown in Figure 2. An extract from the Planning Statement Report for Articles 1 – 4 is shown as Figure 3. The complete PAI Law is Included as Appendix 3.



**Figure 2: Planning Dictionary, showing Article 4 for the Granting of Industrial Licenses**

Figure 2 shows a Planning Outline window on the left, which lists articles in the PAI Law as Planning Statements. The Planning Dictionary window on the right shows the content of each

Planning Statement. It indicates the type of statement and the statement text. The text is shown fully in the window at bottom left. Figure 3 shows this in a Planning Statement Report.

The statement shown in the right window of Figure 2 is part of “PAI INDUSTRIAL LAW 56 YEAR 1996”. It lists a number of defined Model Links from the Planning Statements to the data entities in the Visible Advantage Data Dictionary. These data entities will be defined in detail during Tactical and Operational Modeling phases of the EA/EIA project. They will be implemented later as database tables in the IIW and IISB Corporate Portal, to provide information needed by PAI. Because of this, PAI managers and their advisors will need to indicate their information needs during the later Tactical and Operational Modeling to ensure those needs are included.

The Model Links in Figure 2 show that Article 4, titled “A04: GRANTING OF INDUSTRIAL LICENSES”, is supported by several data entities. These are: ENTERPRISE, INDUSTRIAL FIRM, INDUSTRIAL WORKSHOP, INDUSTRY, INDUSTRY CONTROL, LICENSE, PROJECT, PROJECT ACTIVITY, PROJECT CONTROL and PUBLIC AUTHORITY. These model links show the relationship in the Planner row of the Enterprise Architecture between the WHY (Motivation) column for the PAI Law, and the WHAT column for supporting data.

Of course there is much information that PAI managers and staff need to know for each these data entities. This information comprises data attributes in each data entity. For example, the entity PROJECT would contain data attributes of *project name*, *project start date*, *project status* and *project completion date* (say). Some of these illustrative attributes may not be needed; many other attributes will also be required and so need to be identified for inclusion in the data entity. PAI managers and staff will define these attributes in detail during the later Tactical and Operational Modeling phases of the EA/EIA project as determined.

*It is essential that PAI managers and staff specify their information needs as attributes in the Tactical and Operational Modeling phase of the EA/EIA project. This will ensure that their information needs are included in the later IIW and IISB Corporate Portal, when implemented. Obviously, required information cannot be delivered by the completed IIW and IISB if they do not first specify their needs during this phase.*

The Planning Statements and Model Links shown in Figure 2 are documented in a Planning Statement Report printed by Visible Advantage. An extract from the complete Planning Statement Report in Appendix 3 is shown in Figure 3.

Figure 3 is a report of selected planning statements, from Articles 1 – 4. It clearly shows the category or type of each statement as an “Article of Law”. Other statement types are: Mission, Vision, Policy, Strength, Weakness, Opportunity, Threat, Goal, Objective, Strategy, Task and many more. These statement types can be tailored to address the specific strategic planning terminology used by PAI. For example, statement types: “Article of Law” and “Business Activity” were defined to Visible Advantage for the EA/EIA project. These enabled the PAI Law to be entered, and also allowed the business activities implemented by PAI to support the law to be used for later strategic analysis. Appendix 3 includes the complete report.

**PAI Strategic Model** Planning Statement Report  
 Selected Statements in The Entire Model Page 1  
 Tue Oct 03 15:04:55 2000

**A02: MEANING OF INDUSTRIAL FIRM**

Statement: **A02: MEANING OF INDUSTRIAL FIRM**  
 Category: Article of Law

Text: An industrial craft is any establishment engaged basically in transforming raw or primary materials into either finished, semi-finished or intermediate products, or transform the latter two into fully processed products. This function shall also include mixing, separating, forming and reforming, assembling, filling or packing of products, in case the work is mechanically done in the craft.

- Model Links: (entity) ACTIVITY  
 (entity) ACTIVITY CONTROL  
 (entity) INDUSTRIAL FIRM  
 (entity) INDUSTRY  
 (entity) INDUSTRY ACTIVITY  
 (entity) INDUSTRY CONTROL  
 (entity) INDUSTRY PRODUCT OR SERVICE  
 (entity) INDUSTRY RESOURCE  
 (entity) LICENSE

**A03: MEANING OF INDUSTRIAL WORKSHOP**

(entity) PRODUCT OR SERVICE  
 (entity) RESOURCE  
 (entity) RESOURCE CONTROL

Statement: **A03: MEANING OF INDUSTRIAL WORKSHOP**  
 Category: Article of Law

Text: An industrial enterprise means any activity related to production or maintenance, which depends on manual technical skill, using simple equipment, and which products accordingly, are not stereotyped.

Model Links: (entity) ACTIVITY  
 (entity) ACTIVITY CONTROL  
 (entity) INDUSTRIAL WORKSHOP  
 (entity) INDUSTRY  
 (entity) INDUSTRY ACTIVITY  
 (entity) INDUSTRY CONTROL  
 (entity) INDUSTRY PRODUCT OR SERVICE  
 (entity) INDUSTRY RESOURCE  
 (entity) LICENSE  
 (entity) PRODUCT OR SERVICE  
 (entity) RESOURCE  
 (entity) RESOURCE CONTROL  
 (entity) SKILL

Statement: **A04: GRANTING OF INDUSTRIAL LICENSES**  
 Category: Article of Law

Text: Industrial licenses shall be granted to projects relating to basic industries that prove feasible, or to those projects that are determined by the competent authorities in the oil sector.

Model Links: (entity) ENTERPRISE  
 (entity) INDUSTRIAL FIRM  
 (entity) INDUSTRIAL WORKSHOP  
 (entity) INDUSTRY  
 (entity) INDUSTRY CONTROL  
 (entity) LICENSE  
 (entity) PROJECT  
 (entity) PROJECT ACTIVITY  
 (entity) PROJECT CONTROL  
 (entity) PUBLIC AUTHORITY

**Figure 3: Planning Statement Report Extract, showing Articles 1-4 from the PAI Law**

### 3.3 PAI Organizational Structure

Figure 4 is a Model View window illustrating the PAI Organization Structure. It has been defined hierarchically to Visible Advantage as comprising Sectors (S), with Departments (D) that report to each Sector. The *Industrial Licensing and Development* sector is illustrated.

The complete PAI Organization Structure was defined to Visible Advantage as Model Views. They enable different views to be examined of the data and information relevant to each sector and its reporting departments. The PAI Organization Structure follows:

- ILD - Industrial Licensing and Development (S)
  - ISC - Integrated Service Centre (D)
  - ILR - Industrial Licensing and Register (D)
  - IEPF - Industrial Engineering & Projects Follow-up (D)
  - ISP - Industrial Support and Promotion (D)
- ISS - Industrial Specifications and Service (S)

- QCL - Quality Control Labs (D)
- SS - Specifications and Standards (D)
- ISE - Industrial Safety and Environment Control (D)
- TS - Technical Services (D)
- WCS - Water Cooling Stations (D)
- AFA - Administrative and Financial Affairs (S)
  - AA - Administrative Affairs (D)
  - AD - Administrative Development (D)
  - FA - Financial Affairs (D)
  - SST - Supplies and Stores (D)
- OD - Other Departments (S)
  - LA - Legal Affairs (D)
  - IP - Industrial Planning (D)
  - IDS - Information and Decision Support (D)
  - IAP - Internal Audit and Performance (D)

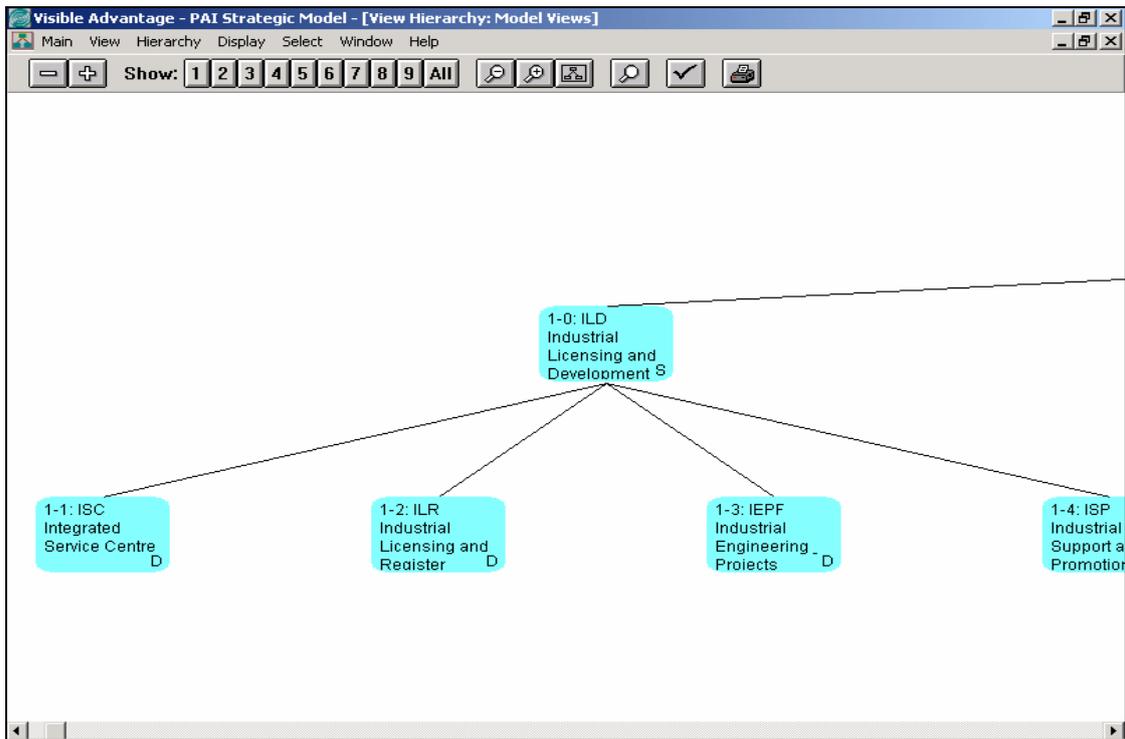


Figure 4: Sectors and Departments of PAI defined as Model Views

### 3.4 Sector Responsibility for Articles of Law

Figure 5 is a matrix illustrating Sectors that are responsible for specific articles of the PAI Law. (This matrix can also be extended to show Departments within each Sector that have responsibility for each article of law.) Additionally it can be used to assign strategic planning statements to different Sectors and Departments responsible for implementation of the plan. This enables Tactical Business Plans to be extracted for each Sector, and also Operational Business Plans to be extracted for each Department. The definition of these business plans is discussed at the end of this section.

Reading down a Sector column in Figure 5, the specific articles that a Sector is responsible for are indicated by a tick in the relevant cell. For example, the *Industrial Specifications and Service* Sector column shows ticks for Article 1 (A01) and Article 7 (A07). The Planning Outline for this Sector in the right window lists only those two articles, plus a subset of other articles that could be seen ticked in lower rows by scrolling down the matrix.

Reading across an Article row, each Sector participating in the article is ticked. This illustrates articles that require collaboration across several Sectors. For example, Figure 5 shows that

Article 7 “A07: METHOD FOR SUBMITTING THE APPLICATION” has a tick in each Sector column except for the *Administrative and Financial Affairs* column. (Of course, in practice this Sector may also be involved in this article; an additional tick for that sector column can indicate such involvement. This example was used only to illustrate collaboration across several Sectors.) This planning matrix shows relationships between the WHY (Motivation) and the WHO (people) columns in the Planner row of the Enterprise Architecture.

Model Views	1-0: ILD Industrial Licensing and Development	2-0: ISS Industrial Specifications and Service	3-0: AFA Administrative and Financial Affairs	4-0: OD Other Departments
Statements				
A01: APPLICATION OF LAW TO INDUSTRIAL ENTITY (Article of Law)	✓	✓	✓	✓
A02: MEANING OF INDUSTRIAL FIRM (Article of Law)	✓			
A03: MEANING OF INDUSTRIAL WORKSHOP (Article of Law)	✓			
A04: GRANTING OF INDUSTRIAL LICENSES (Article of Law)	✓			
A05: MODIFICATIONS TO AN INDUSTRIAL ENTITY (Article of Law)	✓			
A06: TO WHOM LICENSES ARE GRANTED (Article of Law)	✓			
A07: METHOD FOR SUBMITTING THE APPLICATION (Article of Law)	✓	✓		✓
A08: DECISION REGARDING LICENSE APPLICATION (Article of Law)	✓			✓

**Figure 5: Article by Sector Matrix, showing Sectors Responsible for Specific Articles**

Figure 5 is an example that uses the Visible Advantage *Planning Statement – Model View Matrix*. This is more typically used to allocate responsibility for strategic planning statements to different parts of an enterprise. For example, the *Mission* and *Vision* statement for PAI would be assigned to all Sectors and Departments: all managers and staff must be aware of these. But only Policies, Goals and Strategies that relate to Licensing might be allocated to the *Industrial Licensing and Development* column, and also (where relevant) to the *Industrial Specifications and Service* column. This planning matrix also shows relationships between the WHY (Motivation) and the WHO (people) columns in the Planner row of the Enterprise Architecture. It helps define Strategic Planning detail at the Owner row in the WHY column.

By reading down each column, the subset of the strategic plan that has been allocated to each Sector column is defined by ticks in relevant planning statement rows. This subset plan represents the Tactical Business Plan for each Sector. A similar allocation of more detailed planning statements – such as Objectives, Tactics and KPIs – can also be allocated by ticks in each Department column, so defining the Operational Business Plan for each Department.

Each Sector and Department that must participate jointly in the relevant statement has that statement included as part of its business plan. This ensures that required collaboration occurs between participating Sectors and Departments.

### 3.5 Data Supporting Articles of Law

Figures 2 and 3 include model links that show the data entities that support each article. For example, Figure 2 shows that “A04: GRANTING OF INDUSTRIAL LICENSES”, is supported

by ENTERPRISE, INDUSTRIAL FIRM, INDUSTRIAL WORKSHOP, INDUSTRY, INDUSTRY CONTROL, LICENSE, PROJECT, PROJECT ACTIVITY, PROJECT CONTROL and PUBLIC AUTHORITY. This matrix addresses relationships between the WHY (Motivation) and WHAT (Data) columns in the Planner row of the Enterprise Architecture.

Statements	PROGRAM PLAN	PROJECT	PROJECT ACTIVITY	PROJECT APPLICANT	PROJECT CONTROL	PROJECT RULE	PROPOSAL	PUBLIC AUTHORITY	PUBLIC AUTHORITY/LAW	PUBLIC AUTHORITY/PRODUCT OR SERVICE	QUALIFICATION CONDITION	RAW MATERIAL RESOURCE
A01: APPLICATION OF LAW TO INDUSTRIAL ENTITY												
A02: MEANING OF INDUSTRIAL FIRM (Article of Law)												
A03: MEANING OF INDUSTRIAL WORKSHOP (Article of Law)												
A04: GRANTING OF INDUSTRIAL LICENSES (Article of Law)		✓	✓		✓			✓				
A05: MODIFICATIONS TO AN INDUSTRIAL ENTITY								✓				
A06: TO WHOM LICENSES ARE GRANTED (Article of Law)												
A07: METHOD FOR SUBMITTING THE APPLICATION		✓										
A08: DECISION REGARDING LICENSE APPLICATION												

Figure 6: Article by Data Matrix, showing the Data that Supports Specific Articles

These model links were defined using the *Statement – Data Matrix* in Figure 6. For example, the Article A04 row shows ticks in the columns for the last four entities above: PROJECT, PROJECT ACTIVITY, PROJECT CONTROL and PUBLIC AUTHORITY, while Article A07 only has a tick in the PROJECT column in this window showing a subset of all data entities.

### 3.6 PAI Strategic Data Map

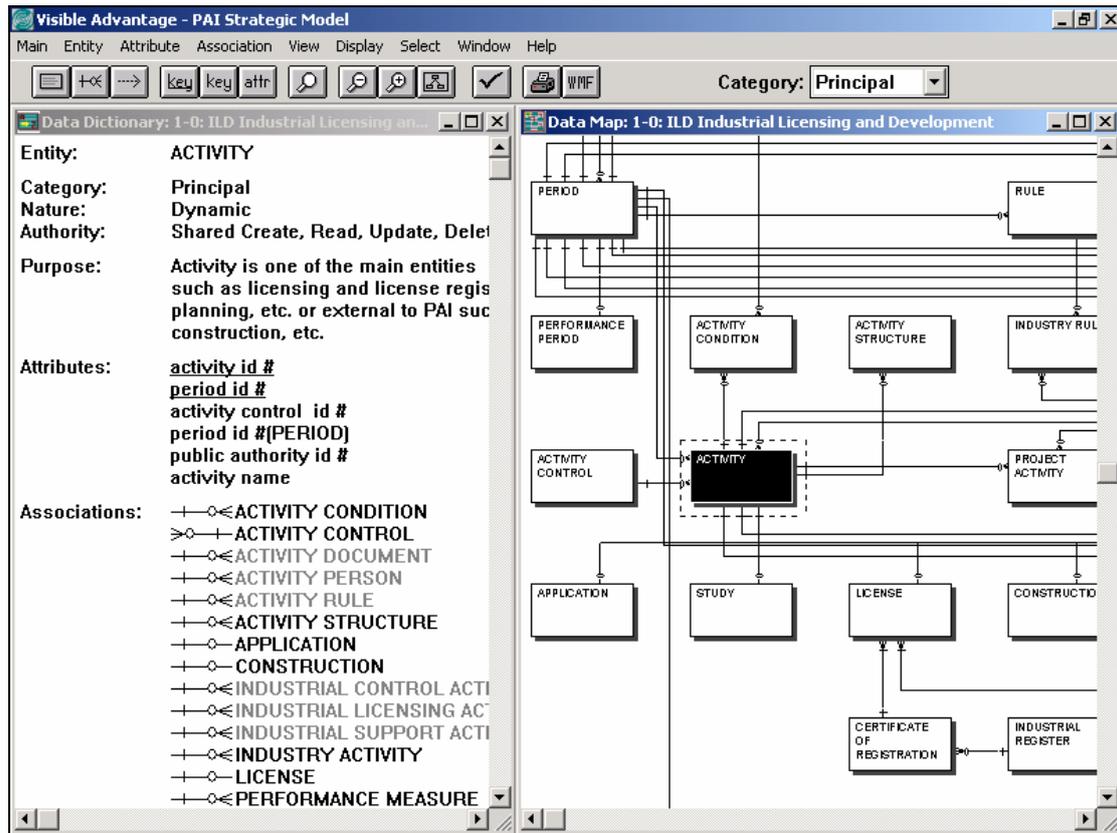
A subset of the Strategic Data Map that was defined during the facilitated Strategic Modeling session is illustrated in Figure 7 for the *Industrial Licensing and Development Sector*. This data map indicates data (the WHAT column) of interest to PAI (the Owner row), based on the PAI Law at the Planner row and the WHY column of the Enterprise Architecture.

The plans of a building enable the location and proximity of various rooms to be assessed, to determine whether the building design meets certain needs. Similarly a Data Map shows the data that is needed to support various business requirements. For example, Figures 7 and 9 show some of the data used by PAI project activities. These data entities are used to assess whether a license can be approved for an industrial firm or industrial workshop, from all of the applicants for a project. The data map shows detail in the WHAT column from the Owner perspective, defined from the list of entities in the Planner row as discussed for Figure 6.

Figure 7 shows the ACTIVITY entity selected in the right Data Map window. Details for this entity are shown in the left Data Dictionary window. The Purpose description of this entity is shown along with some defined attributes, and associations between ACTIVITY and other entities. The associations that are dimmed exist in the Strategic Data Map, but are currently outside the scope of the *Industrial Licensing and Development Sector* as presently defined.

In the Data Map window on the right, we can see entities defined below ACTIVITY for some of the licensing activities related to a project. These are APPLICATION, STUDY, LICENSE and CONSTRUCTION. Various conditions must be satisfied for these detailed activities, as indicated by ACTIVITY CONDITION above ACTIVITY. Following these activities, eventually a

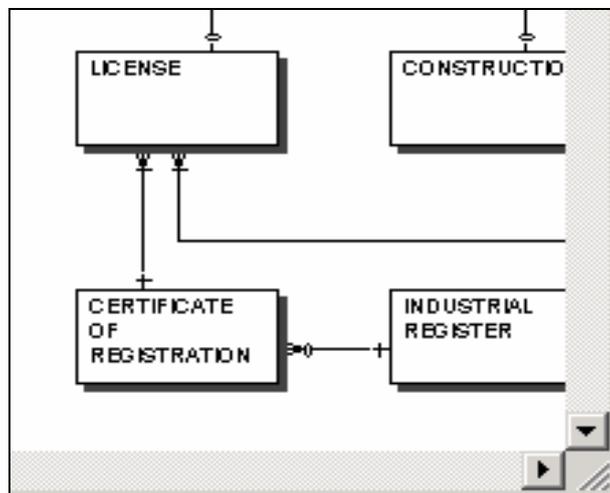
CERTIFICATE OF REGISTRATION must be recorded in the INDUSTRIAL REGISTER for an approved LICENSE.



**Figure 7: Subset of Strategic Data Map for Industrial Licensing and Development**

Part of the Data Map window in Figure 7 has been extracted as Figure 8. This extract includes LICENSE, INDUSTRIAL REGISTER and CERTIFICATE OF REGISTRATION. It shows the line joining the last two entities with symbols at each end as follows: INDUSTRIAL REGISTER —|—○< CERTIFICATE OF REGISTRATION.

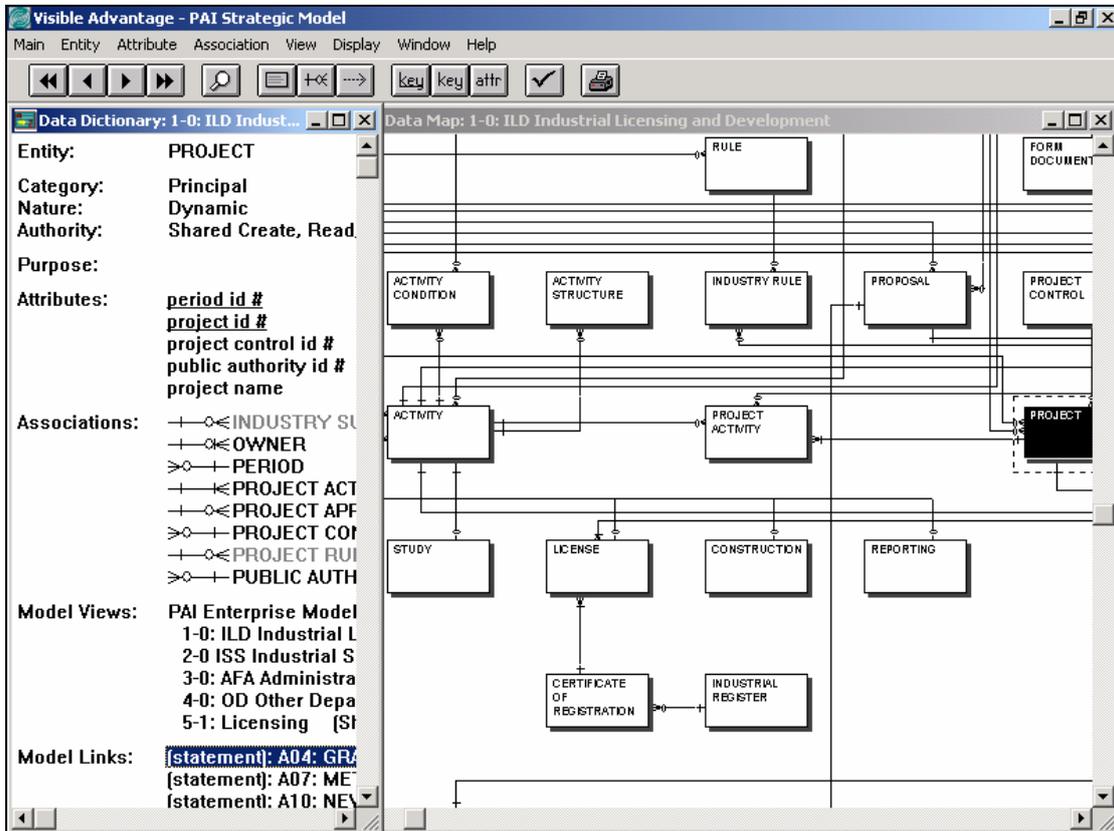
The symbols at each end of this association line provide information about business rules that apply to the association. An association with a “crow’s foot” (—<) indicates *many*, whilst the absence of a crow’s foot (—) indicates *one*. A zero on the line (—○—) indicates *optional* or “*may*”, a vertical bar (—|—) indicates *mandatory* or “*must*”, while a zero and a vertical bar together (—○|—) indicate *optional becoming mandatory* or “*will*”. We will discuss the symbol meanings after Figure 8.



**Figure 8: Extract from Data Map in Figure 7 Relating to Licensing**

The association of INDUSTRIAL REGISTER —|—○< CERTIFICATE OF REGISTRATION in Figure 8 expresses the business rule that the INDUSTRIAL REGISTER has *one or many* [*optional many* —○<] CERTIFICATE OF REGISTRATION. It also shows each CERTIFICATE OF REGISTRATION *must* be recorded in INDUSTRIAL REGISTER [*mandatory one* —|—].

The association defined as CERTIFICATE OF REGISTRATION —|—|< LICENSE in Figure 8 indicates that a CERTIFICATE OF REGISTRATION *must* have *at least one* LICENSE, but after each four yearly license renewal there will be *many* renewed licenses (—|<). From the other direction, the association shows LICENSE *must* have *only one* (—|—) CERTIFICATE OF REGISTRATION.

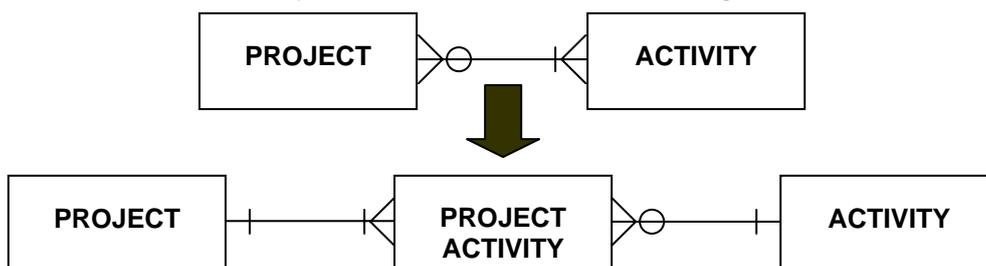


**Figure 9: Strategic Data Map Showing PROJECT, PROJECT ACTIVITY and ACTIVITY**

We discussed in Figure 7 that each type of activity is carried out for many projects, as shown by PROJECT ACTIVITY. This also appears in Figure 9, where we can see the association ACTIVITY —|—○< PROJECT ACTIVITY *is mandatory one to optional many*: an ACTIVITY may apply to one or many PROJECT ACTIVITY.

We can also see that the association of PROJECT —|—|< PROJECT ACTIVITY is defined as *mandatory one to mandatory many*: a PROJECT must have *at least one* ACTIVITY (an APPLICATION); as the PROJECT progresses it *must have many* other activities. Some are shown here in Figure 9 as STUDY, LICENSE, CONSTRUCTION – and later – REPORTING).

PROJECT ACTIVITY was formed by decomposing the *many to many* association originally shown as PROJECT >○—|< ACTIVITY. This is illustrated in Figure 10.



**Figure 10: PROJECT ACTIVITY represents Project Activity Management**

The intermediate entity PROJECT ACTIVITY in Figure 10 is also shown in Figure 9 between PROJECT and ACTIVITY. It is called an **intersecting entity and represents a Business Activity in the Strategic Model**. This is a very important principle: the decomposition of *many to many* associations between two entities identifies Business Activities.

In this example, the intersecting entity PROJECT ACTIVITY represents the Business Activity of *Project Activity Management*. We will see in the following section 3.7 *Strategic Analysis of the PAI Strategic Model* that identification of business activities can be automated. We will return to this *Project Activity Management* example in that section.

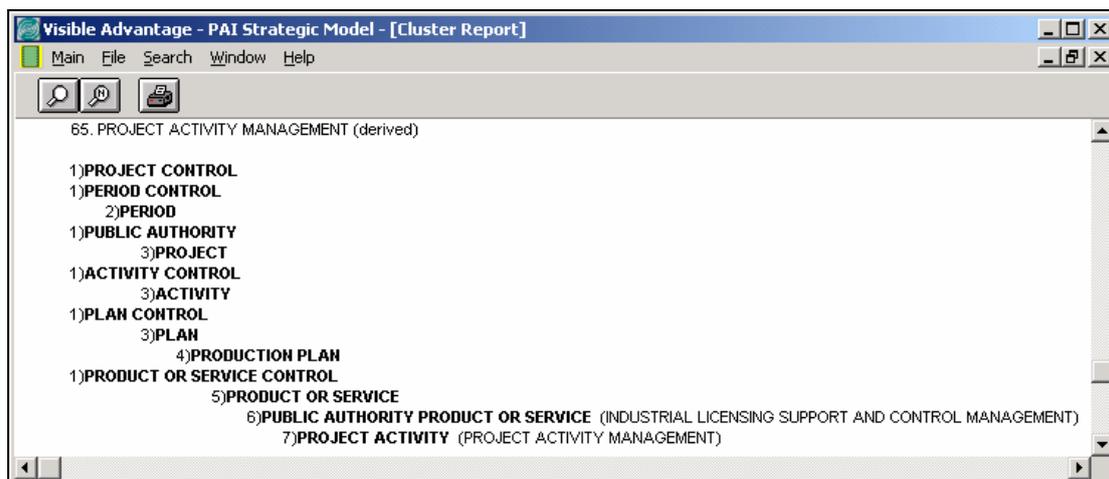
The left window of Figure 9 also lists a number of Model Links at the bottom. They are planning statements of the articles that were linked to data entities in Figure 6 and listed with those articles in Figure 2, and Figure 3 in the Planning Statement Report. The corresponding links for each entity in the Data Dictionary window point to relevant planning statements that need the data from these linked entities as data attributes. In the PAI Enterprise Architecture, this relates *PAI Law* in the WHY column of the Planner row to the WHAT column of the Owner row.

We will now use the PAI Strategic Model (at the Owner row and WHAT column) to determine how the priority information needs of PAI management are used to define the greater level of data model and process model detail that is needed at the Builder row in the WHAT (Data) and HOW (Function) columns of the Enterprise Architecture. We use Entity Dependency Analysis of the Strategic Model, automated as discussed next.

### 3.7 Entity Dependency Analysis of the PAI Strategic Model

Visible Advantage was used to analyze the Strategic Model: to identify *Business Activities*; and to derive *Project Plans*. This analysis enables priority information that is needed by PAI managers to be developed early in the IIW and IISB Corporate Portal projects, so that it can be delivered to management first. The software uses *Entity Dependency Analysis*, automated by using *Entity Dependency Cluster Analysis*. This is described in the book: *“Information Engineering: Strategic Systems Development”*, by Clive Finkelstein (Addison-Wesley, 1992) and in Part 1 of the book: *“Building Corporate Portals with XML”*, by Clive Finkelstein and Peter Aiken (McGraw-Hill, 2000). This analysis identifies management activities of priority interest to PAI, and the databases that will be implemented in the IIW and IISB Corporate Portal.

Figure 11 shows part of a Cluster Report generated by Visible Advantage from the Strategic Model using Entity Dependency Cluster Analysis as discussed above. It is a derived Project Plan: it lists data entities presently included in the Strategic Model that are needed for *Project Activity Management* as shown on the last line.



**Figure 11: Cluster Analysis of PROJECT ACTIVITY**

The last line of Figure 11 is PROJECT ACTIVITY. It is an intersecting entity, discussed in the previous section, formed from the *many to many* association PROJECT >O—|< ACTIVITY in Figure 10. It is displayed as follows:

**7) PROJECT ACTIVITY (PROJECT ACTIVITY MANAGEMENT)**

This indicates that the entity **PROJECT ACTIVITY** represents the Business Activity called *Project Activity Management*. The number 7) preceding this line indicates that attribute details in this entity will be defined in project phase 7 of the *Project Activity Management Subproject*, during the Tactical Data Modeling phase of the EA/EIA Project. The last line displayed in Figure 11 is called the *Cluster End-Point* of the Project Activity Management cluster.

Reading up from the bottom of Figure 11, we can develop a Business Activity description from this cluster as discussed next. We see that the preceding line is:

**6) PUBLIC AUTHORITY PRODUCT OR SERVICE  
(INDUSTRIAL LICENSE, SUPPORT AND CONTROL MANAGEMENT)**

This line is the Business Activity called *Industrial License, Support and Control Management*, which is the main focus of the Industrial Licensing and Development Sector of PAI. The last two lines in Figure 11 indicate that PROJECT ACTIVITY in phase 7 is dependent on PUBLIC AUTHORITY PRODUCT OR SERVICE, which is in phase 6. They are both shown in **bold**. Each entity listed in **bold** – above the Cluster End-Point entity on the last line – means that the last line is directly dependent on those bold entities above it and of a lower phase number.

The cluster in Figure 11 shows the project phase for each entity that the Cluster End-Point entity is dependent on. It can be used to define a Business Activity description for *Project Activity Management* as follows (reading up from the bottom of Figure 11):

**Business Activity Description: Project Activity Management**

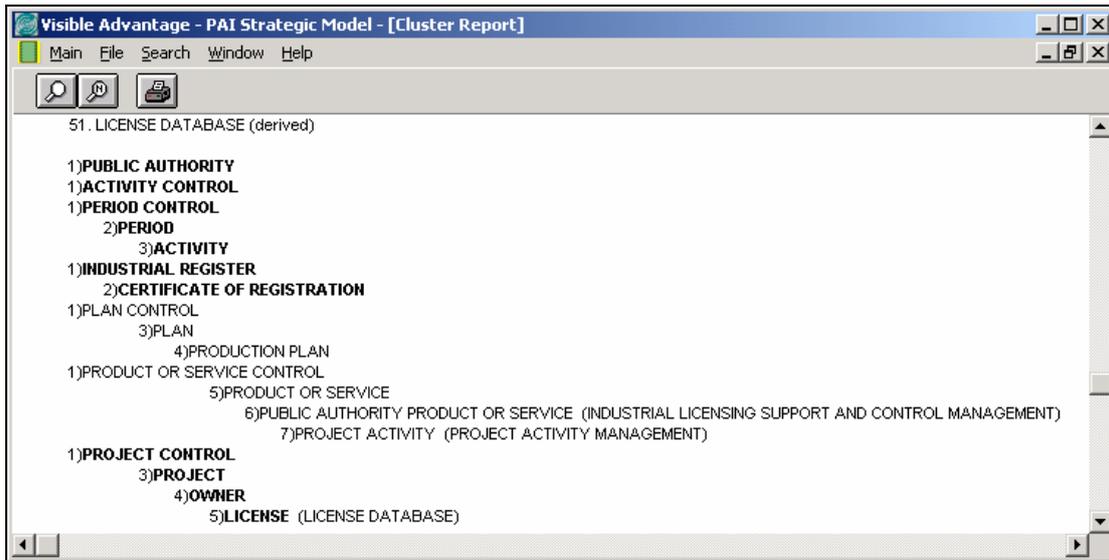
*Project Activities are Services that are carried out by PAI, based on defined Product or Service Controls, in support of a Production Plan – part of overall Plans for Kuwait (Economic, Manpower, Social and Production Plans). These Activities for Projects include Application, Study, License and Construction and are completed in a required Period.*

These entities in Figure 11 will be defined in attribute detail in the Tactical Data Modeling phase of the EA/EIA Project. The complete cluster can also be shown for Project Planning purposes as a Gantt Chart as illustrated in Figure 12.

<b>65. PROJECT ACTIVITY MANAGEMENT (derived)</b>	<b>Phase:</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
1) PROJECT CONTROL								
1) PERIOD CONTROL								
2) PERIOD								
1) PUBLIC AUTHORITY								
3) PROJECT								
1) ACTIVITY CONTROL								
3) ACTIVITY								
1) PLAN CONTROL								
3) PLAN								
4) PRODUCTION PLAN								
1) PRODUCT OR SERVICE CONTROL								
5) PRODUCT OR SERVICE								
6) PUBLIC AUTHORITY PRODUCT OR SERVICE								
7) PROJECT ACTIVITY (PROJECT ACTIVITY MANAGEMENT)								

**Figure 12: Gantt Chart for the Project Activity Management Cluster in Figure 11**

All entities in the Project Activity Management cluster of Figure 11 are displayed in bold. This shows that Project Activity Management does not directly depend on other Business Activities at PAI. Project Activity Management can be implemented first, as part of a larger project. Once implemented, all Sectors and Departments can share common data and information from Project Activity Management throughout PAI.



**Figure 13: Cluster Analysis of the LICENSE Database**

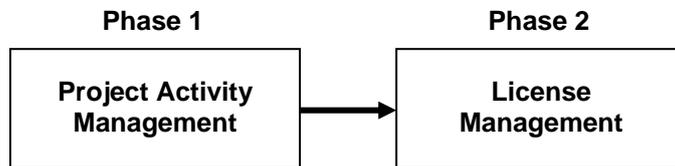
Consider now Figure 13, which shows a cluster that represents the PAI License Database at this stage of the EA/EIA Project. During Tactical and Operational Data Modeling it will be defined in more detail and will represent License Management processes. We will therefore refer to it in this discussion as *License Management*.

Figure 13 indicates the Cluster End-Point for *License Management* of the License Database (LICENSE in project phase 5) directly depends on those entities above it in **bold**, and with a lower phase number. It reflects business rules in the Strategic Model that were defined during the facilitated Strategic Modeling session. Figure 13 indicates a Business Activity description for *License Management* (reading up from the last line, for each project phase) that:

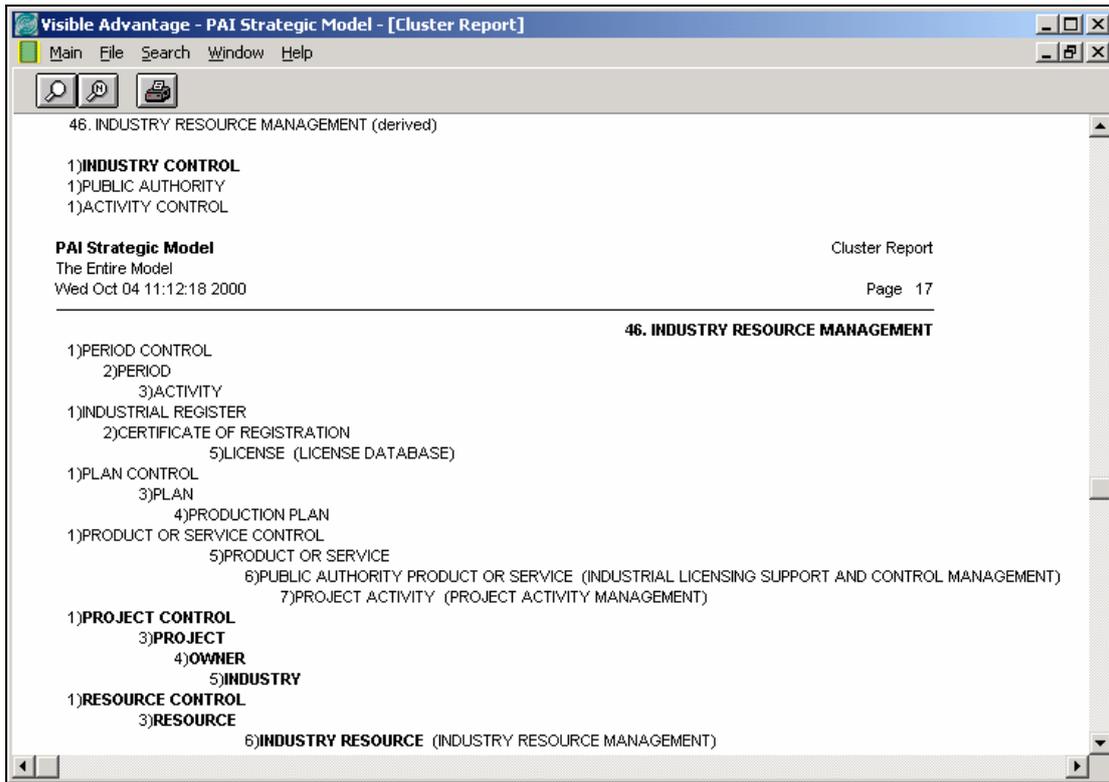
**Business Activity Description: License Management**

*License (phase 5) requires an Owner (phase 4), following approval of a license for a Project (phase 3), according to controls defined by PAI in Project Control (phase 1). For approved licenses, a Certification Of Registration (phase 2) is recorded in the Industrial Register (phase 1). Licensing is an Activity (phase 3) for Activity Control (phase 1) of PAI (Public Authority – phase 1) carried out over a Period (phase 2) of time for Project Activity Management.*

We can see in Figure 13 that Project Activity Management (discussed in relation to Figure 11) is shown with all entities in plain text (not bold). This indicates that *License Management* is dependent on *Project Activity Management* as a prerequisite activity. The project sequence for implementation of these two projects is shown as a *Project Map* in Figure 14.



**Figure 14: Project Activity Management is a Prerequisite of License Management**



**Figure 15: Cluster Analysis for Industry Resource Management**

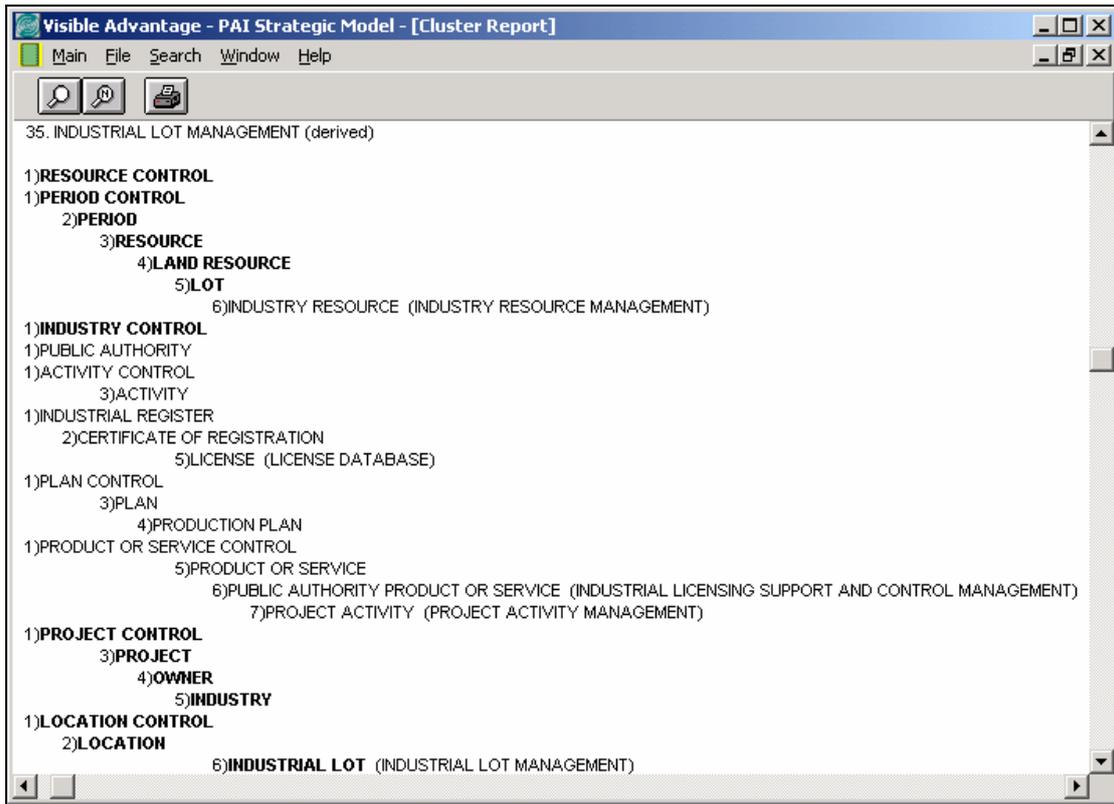
Figure 15 next shows the cluster for *Industry Resource Management*. Once again, reading from the bottom, the Business Activity description can be documented as:

**Business Activity Description: *Industry Resource Management***

*An Industry (Industrial Firm, Workshop or Enterprise) may request certain Resources (Land, Funds, Equipment, Personnel or Raw Material resources) in the proposal that was submitted by the Owner for the Project. Based on Project Controls and Resource Controls defined by PAI, these resources may be allocated to the Industry (by Project Activity Management) once a License has been approved (License Management)*

Notice in Figure 15 that the previous clusters (*Project Activity Management* in Figure 11 and *License Management* in Figure 13) are shown in plain text (not **bold**). They are prerequisite Business Activities for *Industry Resource Management*. A reference to these clusters was included in the above description of the Business Activity for *Industry Resource Management*.

We will now look at the cluster for *Industrial Lot Management* in Figure 16.



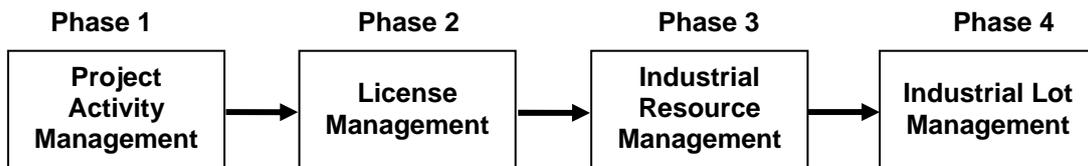
**Figure 16: Cluster Analysis for Industrial Resource Management**

The Business Activity for *Industrial Lot Management* in Figure 16 can now be stated as:

**Business Activity Description: Industrial Lot Management**

*An Industrial Lot may be allocated to an Industry in a required Location (specified in Location Control as available for allocation), to satisfy a proposal request submitted by the Owner for the Project – carried out according to Project Activity Management, License Management and Industry Resource Management.*

The Business Activities in Figures 11, 13, 15 and 16 indicate a specific project sequence, illustrated by the Project Map in Figure 17.

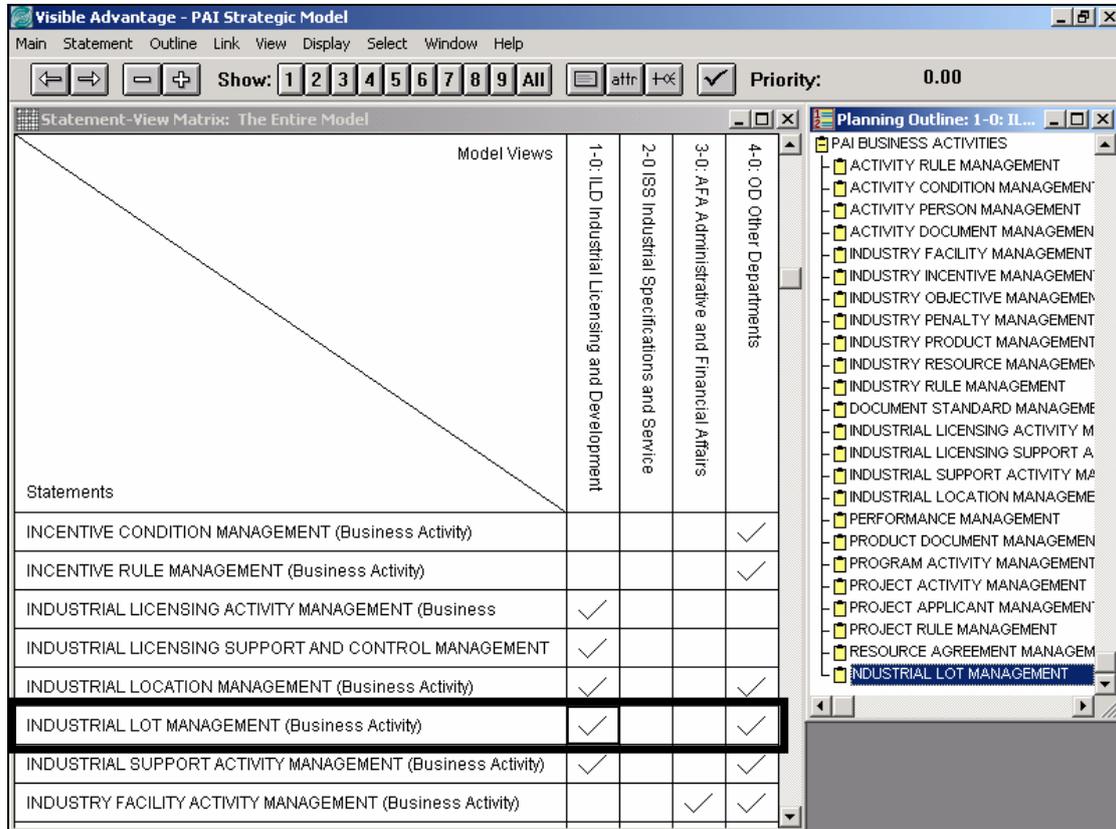


**Figure 17: Project Map for Industrial Lot Management**

### 3.8 PAI Business Activities from the Strategic Model

A Business Activity is a unit of work that can be performed, managed, or monitored by a business function or organization unit. We saw that Entity Dependency Analysis derives the required activities from the Strategic Model. The entities in the data model are grouped together based on the relationships that must exist between data to support the *PAI Law* (see Appendix 2 - Cluster Report). This group of data model entities is referred to as a cluster. As the contents of each cluster are analyzed, a meaningful business name is assigned to the business activity represented by the contents of entities of the cluster. In conjunction with this name, a brief description of the activity is created. We discussed this in conjunction with Figures 11 – 17.

As the clusters were analyzed, named and described, they were each classified into Business Activities and Databases of information for use by PAI. Business Activities indicate relatively high-volume business transaction processing, whereas Databases indicate business data stored for later reference. Business Activities are typically derived from intersecting entities, while Databases are derived from secondary (subtype) entities. Names and descriptions were provided for all clusters, whether they are representative of Business Activities or Databases. As a description is developed for each cluster, the name of the cluster may need to be changed to more accurately represent the description.



**Figure 18: Business Activities by Sector Matrix**

Figure 18 shows Business Activities (documented in Appendix 2) allocated to the PAI Sectors responsible for, or involved in, the implementation and execution of those activities. For example, the *Industrial Lot Management* activity row in the left window shows ticks for the PAI Sectors that have major responsibility for that activity. The right window shows the activities that the *Industrial Licensing and Development* Sector is responsible for, or involved in, as a subset of all of the business activities in Appendix 2. The complete Activities by Sector Matrix Report is included as Appendix 5.

### 3.9 Detailed Report Appendices

Following development of the Strategic Model from the PAI Law by the EA/EIA Project Team, Visible Advantage produced detailed reports that are included as Appendices as follows.

- Appendix 1: Model Views and Strategic Data Maps
- Appendix 2: Cluster Reports of Activities and Databases
- Appendix 3: Planning Statement Reports for PAI Law
- Appendix 4: Article of Law by PAI Sector Matrix
- Appendix 5: Business Activity by PAI Sector Matrix
- Appendix 6: PAI Article of Law by Strategic Data Matrix
- Appendix 7: PAI Strategic Model Entity Report
- Appendix 8: Zachman Framework for Enterprise Architecture
- Appendix 9: Visible Universal Model Business Plans
- Appendix 10: Visible Universal Model Business Objects

Each Appendix is discussed in the relevant Appendix Cover Page, which also describes the content and meaning of each of the enclosed reports.

## 4. RECOMMENDATIONS

This *Enterprise Architecture Portfolio Plan (EAPP) Report* documents results of the Strategic Modeling phase of the Enterprise Architecture/Enterprise Information Architecture (EA/EIA) subproject. This phase and the EAPP Report enable priority business activities and associated databases to be used for early delivery of the relevant data and information by the later Industrial Information Warehouse (IIW) and the IISB Corporate Portal projects.

Recommendations arising from this EAPP Report are discussed next. Some are general recommendations, while other recommendations are for PAI Management. Further recommendations apply to the EA/EIA Project Team.

### 4.1 General Recommendations

- PAI management identified the following Business Activities as their highest priority, for early delivery of priority information by the IIW and IISB Corporate Portal:
  - Licensing Management
  - Industrial Lot Management
  - Industrial Service Management
  - Industrial Control Management

These priority activities are documented in the Appendix 2 Cluster Report. The data needed by these activities are defined in the relevant clusters, named as listed above.

- Before required data and information can be delivered to PAI managers by the IIW and IISB Corporate Portal projects, the Strategic Model must be expanded to greater detail for these priority activities in terms of the data and activities it contains. This is defined using *Tactical Data Modeling*, then *Operational Data Modeling* methods.
- *Activity Modeling* will also need to be used to define the priority business activities in greater activity detail. Activity Modeling documents the resources required by, and the costs associated with, component activities. These costs are defined using Visible Advantage for *Activity Based Costing* (ABC). This will enable PAI to determine the most cost-effective approach to be used to implement defined activities.

## 4.2 PAI Management Recommendations

- The above modeling is completed in the *Tactical, Operational and Activity Modeling* phase of the EA/EIA project. To ensure that the information needs of each Sector and Department of PAI are identified, **it is vital that PAI managers make their most experienced business experts available to the EA/EIA Project Team.**
- Business experts will participate in scheduled meetings (typically half-day or full-day duration) when their detailed knowledge is required. These meetings will be facilitated modeling sessions conducted by the EA/EIA Project Team. This will enable their PAI knowledge to be included in relevant Sector and Department data models and activity models, as the *Tactical, Operational and Activity Modeling* phase progresses.
- This data and activity modeling is time-consuming, but it is **absolutely essential** to ensure PAI information needs are addressed by the IIW and IISB Corporate Portal.
- To reduce the time involved (and hence the cost) – and also increase the final quality of the IIW and IISB – predefined Tactical and Operational *Business Objects* can be selected that address specific needs of PAI. These Business Objects comprise data and business processes for major PAI activities, such as PAI Resource Management: a part of *Industrial Lot Management*.
- These Business Objects can be rapidly tailored to unique PAI needs and terminology. They comprise part of the Visible Universal Model. The EA/EAI Project Team will evaluate these Business Objects. They can then advise whether selected objects can be used to achieve time and cost savings for PAI in *Tactical, Operational and Activity Modeling*; with later quality improvements from the IIW and IISB Corporate Portal.

## 4.3 EA/EIA Project Team Recommendations

- The EA/EAI Project Team will evaluate the Visible Universal Model Business Objects in relation to the Strategic Model. They will advise PAI Management whether selected objects can be used to achieve time and cost savings in the next EA/EIA phase, with later quality improvements from the IIW and IISB Corporate Portal.
- Project Maps and Project Plans for the priority business activities listed above will be developed by the EA/EIA Project Team, to schedule participation by Sector and Department business experts. The project maps and clusters in Appendix 2 will be used for project planning of the detailed modeling that will be carried out, to include expert PAI knowledge.
- Reports in the Appendices for this Strategic Model will be replaced by the relevant Tactical Data Model reports, Operational Data Model reports and Activity Model reports as the *Tactical, Operational and Activity Modeling* phase progresses. This will evolve this document to an *Enterprise Information Architecture Portfolio Plan Report*.
- The *Enterprise Architecture Portfolio Plan Report* with key reports from the Appendix, document high-level PAI information needs. It should be supplied to potential vendors of software products for the IIW and IISB Corporate Portal.
- The vendor(s) selected to implement the Industrial Information Warehouse (IIW) and IISB Corporate Portal will use the final *Enterprise Information Architecture Report* as PAI data and information requirements for implementation in those phases.

# **ENTERPRISE ARCHITECTURE PORTFOLIO PLAN (EAPP) APPENDICES**

**Appendix 1: Model Views and Strategic Data Maps**

**Appendix 2: Cluster Reports of Activities and Databases**

**Appendix 3: Planning Statement Reports for PAI Law**

**Appendix 4: Article of Law by PAI Sector Matrix**

**Appendix 5: Business Activity by PAI Sector Matrix**

**Appendix 6: PAI Article of Law by Strategic Data Matrix**

**Appendix 7: PAI Strategic Model Entity Report**

**Appendix 8: Zachman Framework for Enterprise Architecture**

**Appendix 9: Visible Universal Model Business Plans**

**Appendix 10: Visible Universal Model Business Objects**

## Appendix 1: Model Views and Strategic Data Maps

A strategic data map shows the data and information needed by management to support the strategic plan. The data entities needed to support PAI were initially identified in the Strategic Model by reviewing the PAI Articles of Law to isolate major data subjects and their inter-relationships. This resulted in a strategic data model of approximately 140 data entities. The links between each entity and the relevant articles of law that they support were documented. Finally, the data entities of the strategic model were linked to the PAI organizational structure of Sectors and Departments, allowing subsets of the model to be generated from *Visible Advantage* for any area of interest.

The data maps in this Appendix document different model views of the PAI Strategic Model. Each includes the data required by a number of Business Activities (documented in Appendix 2) and illustrates data entities and relationships needed to support these Business Activities. A line drawn between two entities indicates that a relationship exists between them. This relationship is called an *association*. At a strategic level, associations represent reporting paths, communication paths, management controls, security controls, governance controls, audit controls, or other coordination that is required to manage the operation of the areas of the business that refer to entities joined in the association. At a tactical or operational level, these associations represent business rules that guide implementation of PAI strategies.

The symbols at each end of an association line provide further information about business rules that apply to the association. An association with a “crow’s foot” (—<) indicates *many*, whilst the absence of a crow’s foot indicates *one* (—). A zero on the line (—○—) indicates *optional* or “*may*”; a vertical bar (—|—) indicates *mandatory* or “*must*”, while a zero and a vertical bar together (—○|—) indicate *optional becoming mandatory* or “*will*”. For example, the association between PROJECT and ACTIVITY is an *optional many to mandatory many* association (>○—|<). This shows that a PROJECT that has been formed by PAI for establishment of an industrial enterprise, industrial firm or industrial workshop *must* have at least one ACTIVITY. It also indicates that each ACTIVITY *may* be used in zero, one or many PROJECT.

(Several activities are involved in a project: from initial application by applicants for the project; through a study to assess the eligibility of each project applicant; followed by the approval or rejection of a license for the relevant enterprise, firm or workshop that is the focus of the project; and finally for the successful applicant, the later construction activities that must be undertaken. These are shown as more detailed secondary (subtype) entities – APPLICATION, STUDY, LICENSE and CONSTRUCTION – under the principal (supertype) entity: ACTIVITY.)

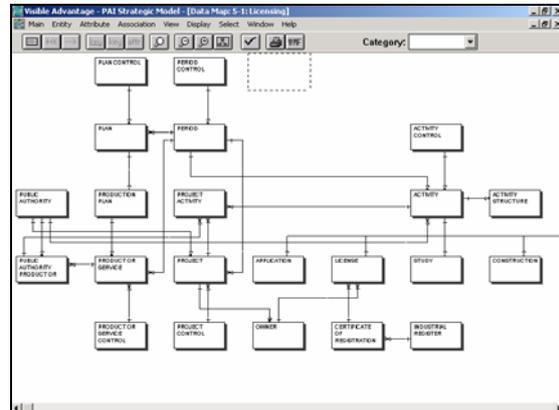
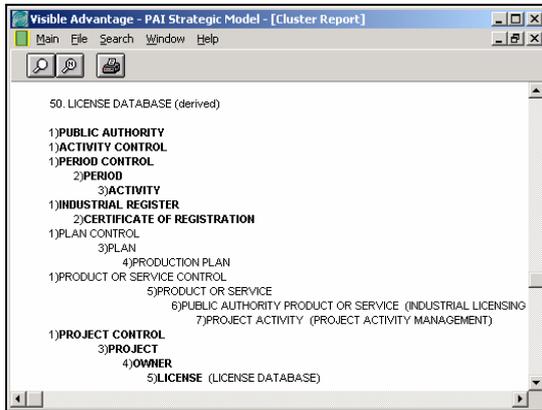
Some data maps have been expanded to show the names of the *attributes* within each of the entities. Attributes indicate specific details stored in entities. In these data maps, the majority of the attributes are being used as *keys* to uniquely identify a real-world occurrence of an entity, or to support the relationships between entities. Keys can be quickly identified in the list of attributes for each entity, since they are followed by the “#” symbol (e.g. the attribute *project id #* in the entity PROJECT is a unique identifier for each project). Attributes that contain additional information about an entity are called *non-key attributes* (e.g. the attribute *activity name* in the entity ACTIVITY).

As is often the case in a strategic data model, many non-key attributes are not documented as yet. Only those necessary to uniquely identify entities and their relationships, or to clarify the meaning of the model and ensure its completeness, are modeled. For example, to ensure that the strategic model later contains the entities necessary to accurately model PAI’s Goals, Objectives and Key Performance Indicators (KPIs), it will be necessary to identify the non-key attributes required for calculation of each of these performance measures. It is also necessary to ensure that the appropriate entities exist within the strategic model to contain these attributes. But it is not necessary to identify other non-key attributes within the strategic model at this stage; these will be defined during the Tactical and Operational Data Modeling phase of priority activities in PAI, selected from this Enterprise Architecture Plan Report. The Model Views and Data Maps that follow in this Appendix include the following:

- Model View Hierarchy Diagram, showing the Sectors of PAI. The *Industrial Licensing and Development* Sector has been expanded to show its Departments, with priority activities shown below the *Industrial Licensing and Register* Department.
- Data Maps for Tactical Modeling follow, of priority activities discussed in this Report:
  - *Project Activity Management*
  - *License Management*
  - *Industry Resource Management*
  - *Industry Lot Management*
- The *PAI Enterprise Model Data Map* is included, followed by Sector Data Maps:
  - *Industrial Licensing and Development*
  - *Industrial Specifications and Service*
  - *Administrative and Financial Affairs*
  - *Other Departments*

## Appendix 2: Cluster Reports of Activities and Databases

Clusters are sets of highly cohesive data, information or knowledge. Each cluster is a subset of the data model that can be separately implemented. It represents the related data entities needed by each business activity or database. An analysis of the data entities contained in the cluster objectively and precisely identifies subsets of the data model for which organizational or functional responsibility can be determined. It also identifies data frequently shared by multiple activities and people. The Cluster Report included in this Appendix shows the result of cluster analysis for all entities in the Strategic Model. A sample cluster from the Strategic Model is shown below.



This cluster was derived by Visible Advantage based on the relationships established between entities needed for *Licensing*, as shown in the Strategic Model at right. It addresses the data required for the License Database at PAI for the *License Management* business activity.

Clusters can have both **bold** and non-bold entities. The entities in bold indicate that data represented by these entities is required to implement this business activity. The entities not in bold represent other clusters of information that are required for implementation of the bold entities. These non-bold “embedded” clusters represent prerequisite cross-functional activities. Each group of non-bold entities of a cluster also exists as an independent cluster with its entities all in bold and are typically reusable activities.

To read, or analyze a cluster, begin with the last line in the cluster. This last entity is referred to as the *Cluster End-Point* entity.

Read the purpose of the entity from Appendix 6 - Entity Report. Do the same for each entity above the end-point entity. This will result in each cluster of entities being given a name representing an activity of the business. In this example, the name of the cluster is License Database for the business activity of *License Management*. If we provide a narrative about the cluster as a business activity, it is defined as shown at right.

Once all clusters have been named and described, the activities and databases of PAI are represented in the data model based on PAI Law. As you read this Appendix, note several of the entities shown in a cluster will be seen to exist in other clusters as well. This indicates the overlap of information needs reusable activities have with shared data, shared activities, or both. This shows a need for communication between activities and organizational units.

The data map above illustrates the data in the figure at left. It is the Business Activity for *License Management* of the License Database. The last line in the cluster at left is LICENSE – with a prefix 5). This indicates it is in project phase 5. It depends on those entities above it in **bold** and with a lower phase number. The Business Activity for *License Management* (reading up from the last line) follows:

### Activity: License Management

*License (phase 5) requires an Owner (phase 4), following approval of a license for a Project (phase 3), according to controls defined by PAI in Project Control (phase 1). For approved licenses, a Certification Of Registration (phase 2) is recorded in the Industrial Register (phase 1). Licensing is an Activity (phase 3) for Activity Control (phase 1) of PAI (Public Authority – phase 1) carried out over a Period (phase 2) of time for Project Activity Management.*

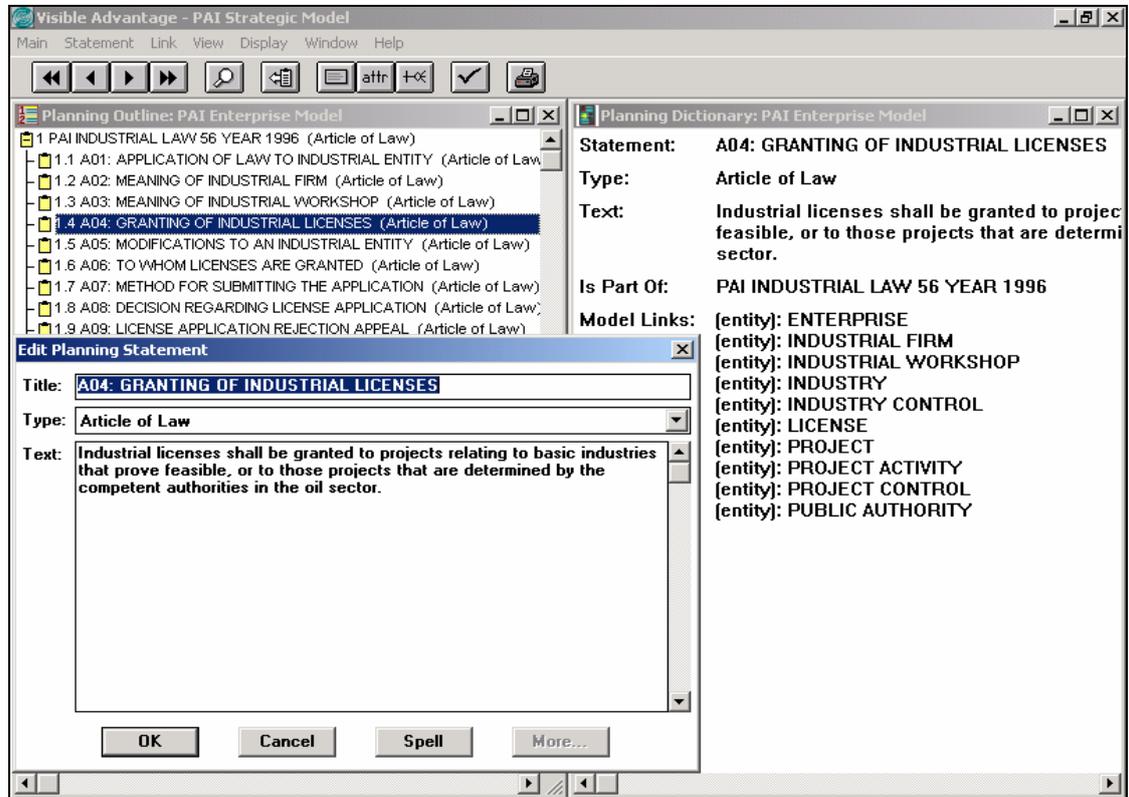
Entities that are not bold are for *Project Activity Management*, which is a prerequisite activity of *License Management*, described as follows:

### Activity: Project Activity Management

*Project Activities are Services that are carried out by PAI, based on defined Product or Service Controls, in support of a Production Plan – part of overall Plans for Kuwait (Economic, Manpower, Social and Production Plans). These Activities for Projects include Application, Study, License and Construction and are completed in a required Period.*

### Appendix 3: Planning Statement Reports for PAI Law

The PAI Law comprises 55 Articles of Law. All were entered into the Planning Dictionary. Each article was then allocated to the PAI Sectors and Departments within those sectors that are responsible for that article. It was also linked in the Data Dictionary to data entities that are used to implement the Article of Law at PAI, in the right window of the figure below. This shows Article 4 “A04: GRANTING OF INDUSTRIAL LICENSES” with the data entities supporting that article listed below as Model Links.



The first Planning Statement Report in this Appendix lists all *PAI Articles of Law*. The title of each article defines its focus, as described in detail in the associated article text. The data that support each article are listed below the relevant article as “Model Links” to the Data Dictionary in the right window. These links were defined using the Statement – Data Matrix of Visible Advantage, as shown in the *PAI Article of Law by Strategic Data Matrix* report in Appendix 6. All articles that each relevant entity supports are listed as “Model Links” under that entity, in the *PAI Strategic Model Entity Report* in Appendix 7.

The second Planning Statement Report in this Appendix lists the *PAI Business Activities*, derived by Cluster Analysis of the Strategic Model. These business activities were indicated by intersecting entities, formed by decomposing *many to many* associations between entities in the Strategic Model. The title of each activity defines its focus, as described in associated activity text. Not all activities have been defined as yet in descriptive text. Only those activities have been described that are associated with priority areas identified by PAI management, as discussed elsewhere in this report and included as Data Maps in Appendix 1.

## Appendix 4: Article of Law by PAI Sector Matrix

The Articles of Law were assigned to each Sector in PAI responsible for, or involved in, implementing that article. The *Article by Sector Matrix* below illustrates this.

Model Views	1-0: IID Industrial Licensing and Development	2-0 ISS Industrial Specifications and Service	3-0: AFA Administrative and Financial Affairs	4-0: OD Other Departments
Statements				
A01: APPLICATION OF LAW TO INDUSTRIAL ENTITY (Article of Law)	✓	✓	✓	✓
A02: MEANING OF INDUSTRIAL FIRM (Article of Law)	✓			
A03: MEANING OF INDUSTRIAL WORKSHOP (Article of Law)	✓			
A04: GRANTING OF INDUSTRIAL LICENSES (Article of Law)	✓			
A05: MODIFICATIONS TO AN INDUSTRIAL ENTITY (Article of Law)	✓			
A06: TO WHOM LICENSES ARE GRANTED (Article of Law)	✓			
A07: METHOD FOR SUBMITTING THE APPLICATION (Article of Law)	✓	✓		✓
A08: DECISION REGARDING LICENSE APPLICATION (Article of Law)	✓			✓

Reading across an Article row, all of the Sectors involved in that article are ticked. It indicates the need for their collaboration in relation to that article. Reading down a column for a Sector shows the subset of articles the Sector is responsible for, or is involved in. For example, the Sector column for *Industrial Specifications and Service* has only Articles A01 and A07 ticked. The subset of articles for this Sector is shown in the right window above.

This appendix provides a Matrix Report showing all articles allocated across the PAI Sectors. Within each Sector, the responsibility or involvement of different Departments in various articles can also be allocated.

These matrices are used to allocate Strategic Plan statements to Sectors and Departments that will be responsible for implementing parts of the Strategic Business Plan as Tactical and Operational Business Plans. Reading across a row for a Goal, Objective, Strategy, Tactic or KPI indicates collaboration that is needed for achievement of the strategic plan. Reading down a column for a Sector indicates the subset of the PAI Strategic Business Plan that represents the specific Sector Tactical Business Plan. Similarly reading down a Department's column indicates the specific Department's Operational Business Plan.

The *Article of Law by PAI Sector Matrix* follows as a matrix report in this Appendix.

## Appendix 5: Business Activity by PAI Sector Matrix

A Business Activity is a unit of work that can be performed, managed, or monitored by a business function or organization unit. Business activities are determined by performing an analysis of the Strategic Model. Entities in the strategic model are grouped together based on the relationships that must exist between data to support the plans (see Appendix 2 - Cluster Report). This group of related data model entities is referred to as a cluster. As the contents of each cluster are analyzed, a meaningful business name is assigned to the business activity represented by the contents of entities of the cluster. In conjunction with this name, a brief description of the activity is created.

As the clusters were analyzed, named and described, they were informally classified into Business Activities and Databases of information for use by the business. Business Activities indicate relatively high-volume business transaction processing, whereas Databases indicate business data stored for later reference. Business Activities are typically derived from intersecting entities, while Databases are derived from secondary (subtype) entities. Names and descriptions are provided for all clusters, whether they are representative of Business Activities or Databases. As a description is developed for each cluster, the name of the cluster may need to be changed to more accurately represent the description.

Model Views	1-0: ILD Industrial Licensing and Development	2-0: ISS Industrial Specifications and Service	3-0: AFA Administrative and Financial Affairs	4-0: OD Other Departments
INCENTIVE CONDITION MANAGEMENT (Business Activity)				✓
INCENTIVE RULE MANAGEMENT (Business Activity)				✓
INDUSTRIAL LICENSING ACTIVITY MANAGEMENT (Business Activity)	✓			
INDUSTRIAL LICENSING SUPPORT AND CONTROL MANAGEMENT	✓			
INDUSTRIAL LOCATION MANAGEMENT (Business Activity)	✓			✓
<b>INDUSTRIAL LOT MANAGEMENT (Business Activity)</b>	<b>✓</b>			<b>✓</b>
INDUSTRIAL SUPPORT ACTIVITY MANAGEMENT (Business Activity)	✓			✓
INDUSTRY FACILITY ACTIVITY MANAGEMENT (Business Activity)			✓	✓

The above figure shows Business Activities (documented in the Cluster Report in Appendix 2) allocated to the PAI Sectors responsible for, or involved in, the implementation and execution of those activities. For example, the *Industrial Lot Management* activity row in the left window shows ticks for PAI Sectors that have major responsibility for that activity. The right window shows the activities that *Industrial Licensing and Development* Sector is responsible for, or involved in, as a subset of all of the business activities in Appendix 2.

The *Business Activity by PAI Sector Matrix* follows as a matrix report in this Appendix.

## Appendix 6: PAI Article of Law by Strategic Data Matrix

The PAI Articles of Law were used during Strategic Modeling to identify strategic data entities that are used by PAI to implement the law. These strategic data entities were then related back to each relevant article by using the Visible Advantage Statement – Data Matrix. This produces an *Article of Law by Strategic Data Matrix*, as shown in the figure below and printed in this Appendix.

Statements	Data Objects	PROGRAM PLAN	PROJECT	PROJECT ACTIVITY	PROJECT APPLICANT	PROJECT CONTROL	PROJECT RULE	PROPOSAL	PUBLIC AUTHORITY	PUBLIC AUTHORITY LAW	PUBLIC AUTHORITY PRODUCT OR SERVICE	QUALIFICATION CONDITION	RAW MATERIAL RESOURCE
A01: APPLICATION OF LAW TO INDUSTRIAL ENTITY													
A02: MEANING OF INDUSTRIAL FIRM (Article of Law)													
A03: MEANING OF INDUSTRIAL WORKSHOP (Article													
A04: GRANTING OF INDUSTRIAL LICENSES (Article			✓	✓		✓			✓				
A05: MODIFICATIONS TO AN INDUSTRIAL ENTITY									✓				
A06: TO WHOM LICENSES ARE GRANTED (Article of													
A07: METHOD FOR SUBMITTING THE APPLICATION			✓										
A08: DECISION REGARDING LICENSE APPLICATION													

The Article of Law “A04: GRANTING OF INDUSTRIAL LICENSES”, is supported by a number of data entities: ENTERPRISE, INDUSTRIAL FIRM, INDUSTRIAL WORKSHOP, INDUSTRY, INDUSTRY CONTROL, LICENSE, PROJECT, PROJECT ACTIVITY, PROJECT CONTROL and PUBLIC AUTHORITY. These model links are shown as ticks under each entity column, moving across a relevant article row. For example, the Article A04 row above shows ticks in the columns for the last four of these entities: PROJECT, PROJECT ACTIVITY, PROJECT CONTROL and PUBLIC AUTHORITY. Article A07 only has a tick in the PROJECT column in this window, which shows only a subset of all data entities.

This matrix defines model links to indicate data entities that support each article. These are printed in the Statement Report in Appendix 3 as “Model Links” of data entities listed under each article that they support. A data entity can be used to support more than one article, and so will appear multiple times under all relevant articles. Similar Model Links are shown in the PAI Strategic Model Entity Report printed in Appendix 7. These Model Links appear under each data entity, and show the Articles of Law that the entity supports.

The *PAI Article of Law by Strategic Data Matrix* for the PAI Strategic Model is printed as a matrix report in this Appendix.

## Appendix 7: PAI Strategic Model Entity Report

The entity report in this Appendix documents every entity in the Strategic Model, listed in alphabetical order. This report has been formatted to show fundamental details of each entity (name, type, phase and purpose) along with a list of the attributes, associations and planning statements linked to the entity.

The entity name is supplemented by the *purpose*, which provides a narrative description of the entity and often provides examples of what values a real-world occurrence of an entity may contain. *Notes* are comments that can be attached to an entity, which often record issues awaiting resolution.

The entity *category* is a way of categorizing entities, based upon their function as a component of the strategic data model.

Attributes indicate specific details stored in entities. In a Strategic Data Model, the majority of the attributes are used as *keys* to uniquely identify a real-world occurrence of an entity, or to support associations between entities. Keys can be quickly identified in the list of attributes for each entity, since they are followed by the “#” symbol (e.g. the attribute *project id #* in the entity PROJECT is a unique identifier for each project). Attributes that contain additional information about an entity are known as *non-key attributes* (e.g. the attribute *activity name* in the entity ACTIVITY).

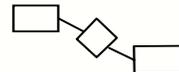
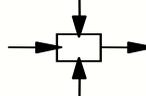
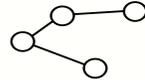
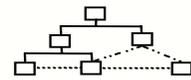
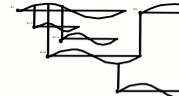
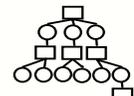
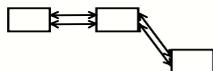
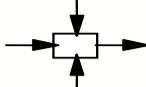
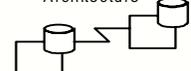
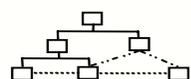
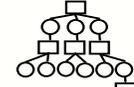
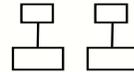
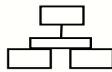
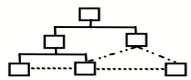
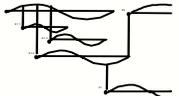
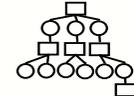
Symbols are used to provide additional information about an association between two entities. An association with a “crows foot” (—<) indicates *many*, whilst the absence of a crows foot indicates *one* (—). A zero on the line (—○—) indicates *optional* or “*may*”; a vertical bar (—|—) indicates *mandatory* or “*must*”; while a zero and a vertical bar together (—○|—) indicate *optional becoming mandatory* or “*will*”. For example, the association between PROJECT and ACTIVITY is an *optional many to mandatory many* association (>○—|<). This shows that a Project *must* have at least one Activity, but can have many; while an Activity *may* be used for no Projects, or for many Projects. A *many to many* association such as this will typically be decomposed through further data modeling into an intermediate entity (called an “intersecting” entity) and two, *one to many* associations.

In this example, the intersecting entity formed by decomposing the *many to many* association between PROJECT and ACTIVITY is PROJECT ACTIVITY, which represents *Project Activity Management* at PAI.

The complete *PAI Strategic Model Entity Report* is printed in this Appendix. It shows Model Links under each relevant entity for all the Articles of Law that the entity supports, as defined in the *PAI Article of Law by Strategic Data Matrix* report in Appendix 6.

## Appendix 8: Zachman Framework for Enterprise Architecture

# A FRAMEWORK FOR ENTERPRISE ARCHITECTURE™

	DATA <i>What</i>	FUNCTION <i>How</i>	NETWORK <i>Where</i>	PEOPLE <i>Who</i>	TIME <i>When</i>	MOTIVATION <i>Why</i>	
OBJECTIVES/ SCOPE (CONTEXTUAL)  <i>Planner</i>	List of Things Important to the Business  Entity = Class of Business Thing	List of Processes the Business Performs  Function = Class of Business Process	List of Locations in Which the Business Operates  Node = Major Business Location	List of Organizations Important to the Business  People = Class of Agent	List of Events Significant to the Business  Time = Major Business Event	List of Business Goals/Strat.  Ends/Means = Major Bus. Goal/ Critical Success Factor	OBJECTIVES/ SCOPE (CONTEXTUAL)  <i>Planner</i>
ENTERPRISE MODEL (CONCEPTUAL)  <i>Owner</i>	e.g. Semantic Model  Ent. = Business Entity Rein. = Business Relationship	e.g. Business Process Model  Proc. = Business Process I/O = Business Resources	e.g. Logistics Network  Node = Business Location Link = Business Linkage	e.g. Work Flow Model  People = Organization Unit Work = Work Product	e.g. Master Schedule  Time = Business Event Cycle = Business Cycle	e.g. Business Plan  End = Business Objective Means = Business Strategy	ENTERPRISE MODEL (CONCEPTUAL)  <i>Owner</i>
SYSTEM MODEL (LOGICAL)  <i>Designer</i>	e.g. Logical Data Model  Ent. = Data Entity Rein. = Data Relationship	e.g. Application Architecture  Proc. = Application Function I/O = User Views	e.g. Distributed System Architecture  Node = I/S Function (Processor, Storage, etc.) Link = Line Characteristics	e.g. Human Interface Architecture  People = Role Work = Deliverable	e.g. Processing Structure  Time = System Event Cycle = Processing Cycle	e.g. Business Rule Model  End = Structural Assertion Means = Action Assertion	SYSTEM MODEL (LOGICAL)  <i>Designer</i>
TECHNOLOGY MODEL (PHYSICAL)  <i>Builder</i>	e.g. Physical Data Model  Ent. = Table/Segment, etc. Rein. = Key/Pointer, etc.	e.g. System Design  Proc. = Computer Function I/O = Data Elements/Sets	e.g. Technology Architecture  Node = Hardware/System Software Link = Line Specifications	e.g. Presentation Architecture  People = User Work = Screen Format	e.g. Control Structure  Time = Execute Cycle = Component Cycle	e.g. Rule Design  End = Condition Means = Action	TECHNOLOGY CONSTRAINED MODEL (PHYSICAL)  <i>Builder</i>
DETAILED REPRESENTATIONS (OUT-OF-CONTEXT)  <i>Sub-Contractor</i>	e.g. Data Definition  Ent. = Field Rein. = Address	e.g. Program  Proc. = Language Stmt I/O = Control Block	e.g. Network Architecture  Node = Addresses Link = Protocols	e.g. Security Architecture  People = Identity Work = Job	e.g. Timing Definition  Time = Interrupt Cycle = Machine Cycle	e.g. Rule Specification  End = Sub-condition Means = Step	DETAILED REPRESENTATIONS (OUT-OF-CONTEXT)  <i>Sub-Contractor</i>
FUNCTIONING ENTERPRISE	e.g. DATA	e.g. FUNCTION	e.g. NETWORK	e.g. ORGANIZATION	e.g. SCHEDULE	e.g. STRATEGY	FUNCTIONING ENTERPRISE

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## Appendix 9: Visible Universal Model Business Plans

The Visible Universal Model provides an Enterprise Architecture and Enterprise Information Architecture to build integrated data models and databases for Data Warehouses, Information Warehouses and Corporate Portals. The premise of the Visible Universal Model is that:

1. All businesses, even diverse businesses, perform a set of common functions that include Planning, Marketing, Sales, Research, Resource Management, Production, Purchasing, Finance, Human Resources, etc.,
2. Each business function performs many of the same activities, e.g. Contract Management, Contact Management, Project Management, Document Management, Inventory Control, Hiring, Training, Budgeting, Accounting, etc.,
3. Many of the activities act on similar data, e.g. organizations, people, skills, products, services, facilities, locations, assets, liabilities, accounts, documents, etc.,
4. In many cases the similar data is in fact the same data, e.g. Mr. Jones, Ms. Smith, Washington DC, Dallas, etc.,

Strategic Business Plans document strategic directions of an enterprise, in terms of Mission, Policies, Goals, Objectives, Strategies and Activities. The Visible Universal Model includes a complete set of Strategic Business Plans that apply to many different enterprises, both Government and Commercial. It defines Business Plans for an Enterprise Architecture that can be tailored to incorporate specific strategic directions for precise strategic management.

These Strategic Business Plans become the basis for Tactical Business Plans, and then Operational Business Plans. Strategic plans for common functions are often the hardest to develop; these difficult plans are supplied as part of the Visible Universal Model. From these, through methods such as Goal Analysis, Tactical and Operational Business Plans can be developed for each Sector and Department throughout an Organization.

The Strategic Business Plans provided by the Visible Universal Model are documented in this Appendix as groups of related planning statements. This includes 8 Mission Statements for different functions of the enterprise, 31 Goals, 157 Strategies, 85 Objectives and 65 Activities – for a total of nearly 350 planning statements.

Relevant statements are allocated to different Model Views of the Universal Model, and were used to identify the data needed to support specific business areas as Business Objects. The different Business Objects are discussed in Appendix 10. The actual planning statements supplied depend on the Model Views of Business Objects selected in Appendix 10 based on PAI needs.

Two Planning Statement reports are included in this Appendix:

- The first report provides a high-level perspective to senior management of Mission and Goal Statements for 8 major Functional Areas that apply to all enterprises. These address: Asset Management, Product and Service Management; Financial Strategic Direction; Operating Plan; Management Accounting; Risk Analysis; Relationship Management; and Market Analysis.
- The second report includes all Planning Statements: the Mission and Goals from the first report, together with Objective, Assumption, Strategy and Activity statements. These subordinate statements are defined to support achievement of the major Goal and Mission statements.

The two Planning Statement reports in this Appendix apply to all enterprises. They are used as a basis for strategic, tactical and operational plans in these 8 functional areas, and can be easily tailored to address the unique strategic needs of PAI. These statements were used to define the Business Objects that are described in Appendix 10.

## Appendix 10: Visible Universal Model Business Objects

In the Visible Universal Model, closely related data are grouped by subject area (Business Objects). This data was directly identified from the Strategic Business Planning statements in Appendix 9. While many business activities can be supported by data from a single subject area, other activities need data from several subject areas. The Visible Universal Model shows the interdependency of the subject areas. By grouping activities performed by business function; the subject areas, hence the data, needed to support the business function are determined.

The Visible Universal Model is the collective result of hundreds of person years of experience; gained by Visible’s consultants in many projects throughout the world, for Government and Commercial enterprises. In addition, the model provides the basic data relationships that often are not stated during the “system requirements gathering” phase of major projects. It reflects the data and business activities needed to support the Business Plans in Appendix 9.

The Visible Universal Model contains common object classes that support multiple activities; rather than activity-specific object classes often developed over and over again in different guises. Recognition of repeating business patterns during the development of business models over the years has permitted Visible to establish these object classes.

The Visible Universal Model is an enterprise-wide data model containing over 45 business subject areas, as Business Objects encompassing over 600 entities with many attributes. The model is fully normalized with a high level of abstraction making the model highly reusable. Each object class is centered on a “kernel” entity. The kernel entities were established based on their relevance in the business environment. The object classes constructed around the kernel entity vary in complexity. The object class PERIOD, for example, consists of only 3 data entities. Others, such as PERFORMANCE are very complex and consist of between 30 and 40 different data entities.

### The Visible Universal Model Business Objects

The following table presents a list of some of the object classes used in the construction of the Visible Universal Model. These were defined from the Business Plans in Appendix 9.

➤ ACTIVITY	➤ GENERAL LEDGER ACCOUNT	➤ PERIOD
➤ ASSET	➤ GENERIC RESOURCE	➤ PERSON
➤ CHECK	➤ INTERNAL ORGANIZATION	➤ PHYSICAL ASSET
➤ CONTACT	➤ INTERNAL POSITION	➤ PRICE
➤ CONTACT TOPIC	➤ LAWSUIT	➤ PRODUCT
➤ CONTRACT	➤ LEGAL ENTITY	➤ PRODUCT OR SERVICE
➤ COST CENTER	➤ LOCATION	➤ PROJECT
➤ CURRENCY	➤ MARKET OFFERING	➤ QUALIFICATION
➤ DELIVERY COMMITMENT	➤ MARKET SEGMENT	➤ SERVICE
➤ DISPUTE	➤ MARKET SEGMENT CRITERIA	➤ SPECIFIC RESOURCE
➤ DOCUMENT	➤ ORGANIZATION	➤ SPECIFICATION
➤ FACILITY	➤ PERFORMANCE	➤ STATEMENT ACCOUNT
➤ FINANCIAL PRODUCT	➤ PERFORMANCE SUBJECT	
➤ FINANCIAL TRANSACTION	➤ PERFORMANCE SUBJECT MEASUREMENT RULE	

This Appendix documents each Business Object as a Model View, with its Definition and Purpose. All entities that comprise the Business Object are listed for each Model View. Each Business Object is selected based on its relevance to the PAI Enterprise Architecture and Enterprise Information Architecture documented in this report.