

# Information Coordination:

## The Management of Information Models, Systems and Organizations

Richard Veryard

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### Chapter 4: Planning Techniques Part a: Architecture

## 4.1 Introduction

This document is one of a series of extracts from my 1994 book on Information Coordination, and contains the first half of Chapter 4.

Long-term plans for information systems development are increasingly based on some kind of high-level model of the business entities and functions (often referred to as a **Strategic Model** or **Information Architecture**).

In the previous chapter, we discussed different approaches to the planning of information systems. In this chapter, we shall discuss techniques that can be used in this planning. The techniques broadly apply to all three planning approaches, but with some differences in flavour.

The first step is to create a broad understanding of the business (or business area) for which information systems are required. This is achieved by a modelling exercise, producing a strategic information model known as an information architecture. In this document, we shall discuss the development, maintenance and use of strategic information models, known as information architectures, for the purposes of information systems planning.

Subsequently, we shall see how the scopes of projects, systems and data stores can be derived from these architectures, using techniques such as clustering. System development projects, scoped using these techniques, can progress in parallel with well-managed inter-project interactions; and the systems and data stores themselves, also scoped using these techniques, can be implemented and operated as integrated yet independent modules. The better the planning and scoping, the easier will this coordination be.

## 4.2 Example

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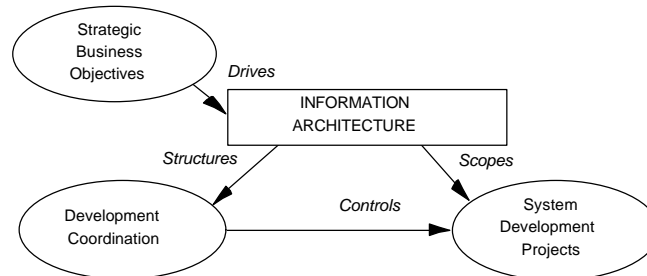
## 4.3 Architectures

All information models have scope, perspective and purpose. If the purpose of a model is planning and scoping, we call the model an **information architecture**. In this section, we discuss the main differences between an information architecture and other types of information model.

### 4.3.1. Purpose

First let us expand on the purpose of an information architecture.

One of the possible purposes of building an information model is to develop a strategy for the business. The Information Architecture may represent the principal activities or functions of the enterprise (structured hierarchically, or as a value chain) as well as its important entity types. A model of the whole enterprise can be clustered into sub-models or business areas, each of which is then the subject of detailed analysis and IS development projects.



**Figure 4.1** Purpose of Information Architecture

But the purpose of such strategic models need not be restricted to IS development plans. Strategic models can express the changing intentions and conceptual structures of the business, which may need to be reflected by new Information Systems, but which also may be communicated via Information Systems.

Thus an Information Architecture may have several related purposes:

- 1 To provide a framework for formulating opportunities to obtain direct competitive advantage from Information and Systems.
- 2 To establish and maintain the link between the strategic business objectives and the systems development projects.
- 3 To define the scope of business areas and of data analysis projects
- 4 To provide a framework for coordinating analysis and design projects
- 5 To provide a framework for planning and implementing the necessary technical and organizational infrastructures.

### 4.3.2 Perspective

The perspective of the information architecture is usually said to be 'strategic'. This is a somewhat abused word, and we shall need to clarify what it means in our context.

Computerized information systems have the power to change the way the members of the organization think about their work. The more the organization relies on computers, the more power the systems have. This is one of the reasons why the conceptual structure of the systems deserves serious attention from the management of the organization.

At the most general level, the kinds of questions raised by an information modelling exercise are of relevance to top management, in their formulation of the business strategy. Defining such entity types as customer, employee, competitor, market, product and organization, and determining their identity rules, can lead to significant strategic insights.

For example, high-street banks have traditionally equated customer with account holder. This means they have been unable to recognize when a person holds more than one account; each communication with a customer (including financial transactions and marketing promotions) relates to a single account; this is not only operationally inefficient, but may also reduce the quality of service perceived by the customer. Furthermore, customers without accounts (e.g. a person who buys travellers cheques for cash) are not recognized at all. Likewise, insurance companies have equated customer with policy holder.

Most financial services companies are now trying to change their perception of customer, to one that encompasses a whole spectrum of dealings with an individual. This requires a realignment of information systems, but goes further than this: it requires a realignment of the business itself.

Thus the questions addressed by an information modelling exercise - *who are our customers, what are our markets, who are our competitors, what are our products* - these are important strategic questions for an enterprise. The most important question of all (especially for publically owned or Not-For-Profit (NFP) organizations) may be: *how many organizations are we?* Thus in the 1960s and 1970s, many national PTTs (Post, Telephone and Telegraph companies) divided themselves into a separate telecommunications organization and mail organization. In the 1990s, the UK Central Electricity Generating Board divided into a power generation company and a power distribution network. A theatre may split into a company to run the building, and a separate company to produce plays. A charity may consist of a fund-raising organization and a fund-spending organization.

NFP organizations ought also to think strategically about the social need they are addressing, in the same way as a commercial enterprise thinks about its products. A social need will often have a life-cycle similar to a product. (Consider, for example, the changing needs associated with Polio or AIDS.)

Meanwhile, the question *how many organizations are we?* applies also to commercial enterprises. An oil company or chemical giant may divide itself into separate pieces; a tobacco giant may be forcibly attacked and dismembered; a computer manufacturer may fragment itself between numerous joint ventures.

These questions can be seen as questions about an intended future, rather than merely describing the present situation. The techniques and concepts of information modelling can be used to address these questions systematically, and to ensure correspondence between the business strategy (which may be fixed or dynamic, planned or emerging) and the information systems.

Another strategic question concerns the scope of the organization itself. One of the strategies for gaining competitive advantage is to change the information processing interface between the organization and the outside world. To analyse such opportunities, we need to define the information model independently of whether the underlying activities are done within the organization or outside.

For example, airlines may scope their models to include travel agents, regarding them not as external customers but as autonomous and unreliable departments. Wise manufacturing companies recognize that loyal customers make an excellent unpaid sales force, as do service engineers, whose continued employment depends on the continued purchase and use of the equipment they have been trained to maintain. As a more general rule, the strategic thinker always thinks twice where the boundaries of the organization lie. They may stretch outside the company's own offices, or outside the company's own employees, or into areas where the company has at best partial control.

Thus the perspective of an information architecture is the management of the unity, purpose and scope of the business.

### 4.3.3 Scope

The purpose of the information architecture includes the management of the scopes of projects and systems. The strategic perspective of the information architecture addresses such issues as the scope of the organization, particularly as this affects the organization's relationships with the outside world. But the information architecture itself has a scope, which is not quite the same thing.

The scope of the information architecture can be the entire enterprise or organization, together with its immediate environment (including customers, suppliers and other business partners). This enables a systems development plan for the entire enterprise to be drawn up, including opportunities to automate links with the computer systems of business partners.

In very large organizations, it may not be possible to create meaningful models for the entire enterprise. Instead, the scope for the information architecture may be a single operating division or business unit. If the enterprise has hierarchical management, and hierarchical business strategies, it may be thought appropriate to create a hierarchy of increasingly abstract information architectures, but this is seldom a realistic prospect.

In some situations, an architecture is created for a portion of the organization only. This allows the scope of a single project or system to be defined, by a consideration of its immediate neighbourhood (which may include objects inside the organization or outside).

This is frowned upon by top-down planners, but is considered useful by pragmatists.

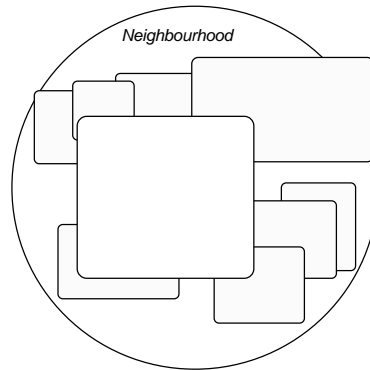


Figure 4.2 Information Architecture limited to neighbourhood

#### 4.3.4 Public and pivotal objects

Any object which is explicitly addressed by a major business strategy is likely to be needed within the Information Architecture. These may be referred to as **strategic** objects. Strategic objects may be either public (participating in all or many business areas) or pivotal (providing the strategic linkages between business areas). The strategy tells us which objects have to be shared or common.

##### Public objects

Public objects are those elevated for strategic purposes above the interests of a single project or system. This implies a distinction between **public objects** and **local** or **private objects**. Whereas private objects have an owner (the project or system or user), public objects have a **custodian**.

The following example is taken from a seminal paper by H-J Pels<sup>1</sup>.

System	Own	Foreign
Purchasing	ARTICLE, BACKORDER	ORDERLINE
Sales	CLIENT, ORDER, ORDERLINE	ARTICLE

Box 4.1 Entity types belonging to two systems

The entity type ARTICLE is public, under the custodianship of the Purchasing system/project. The entity type BACKORDER, on the other hand, is private to the Purchasing system/project, and is invisible to the Sales system/project.

<sup>1</sup> H-J Pels "Decentralized Organizations versus Integrated Information Systems" Proceedings of International Conference on Organization and Information Systems (Bled, September 1989) pp 177-190

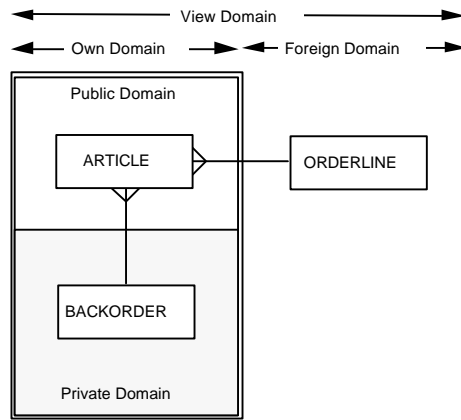


Figure 4.3 Separation of model into public and private

The distinction between public and private/local only works, of course, if there are some of each. It is usually advisable to ensure that only a minority of objects are public, unless you want to spend all your time managing public objects.

### Pivotal objects

A project should have a centre or focus: so should a plan or architecture. For example, if a business strategy revolves around the customer, then we should expect to find the entity type CUSTOMER at the centre of the Information Architecture. But consider which entity types you would expect to find in the centre of the Information Architecture, based on the following quotes from the CEO.

- *“We are a market-led company”*
- *“We need to become a market-led company.”*
- *“We are a quality-oriented company.”*

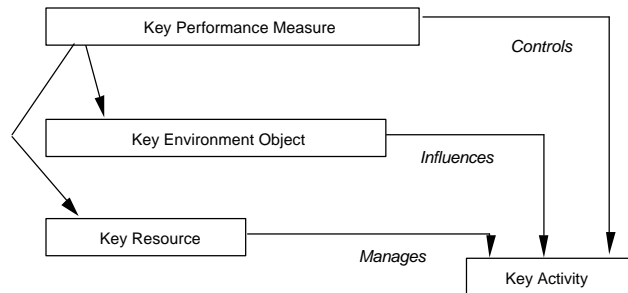
*Box 4.2 Focus of business strategy - how does this influence Information Architecture?*

Sometimes, if the Information Architecture has been produced directly from the strategic information needs of top managers, or with their active participation, it will reveal a contradiction between the stated mission of the enterprise and the actual management practice. For example, in many companies, despite paying lip service to marketing or quality, the actual centre turns out to be accounting entity types: COST CENTRE or ACCOUNT.

### 4.3.5 Modelling contents & constructs

An information architecture typically includes both the data objects (entities, relationships, attributes) and also the business activities (processes, inter-process dependencies).

Figure 4.4 shows what must be in the Information Architecture.



*Figure 4.4 Essential contents of information architecture*

- Key resources - physical and non-physical assets of the organization which may be used or reused, people inside and outside the organization who support the organization
- Key environment objects - things, people and bodies whose actions may affect the organization (including competitors)
- Key performance measures (KPM) - these will be attributes of key entity types - possibly one of the key resources or environment objects - they will almost certainly turn out to be derived from something else when we come to the detailed analysis. (Possible exception - when the KPM is measured for you by an outside agency, such as your market share).
- Key activities - a function usually manages a key resource and/or influences/monitors the environment and/or controls the business against a key measure.

### 4.3.6 Building the information architecture

What is the difference between building a strategic information architecture and a detailed analysis data model? Should the same techniques and standards apply? Some might argue that the attitudes required for detailed analysis and development are too pedantic for strategic planning. It all depends on what you think the information architecture is for. And what are the consequences of getting it wrong.

My argument here is that the techniques and attitudes are much the same. However, since the purpose and scope is different, the perspective should also be different. It is indeed necessary to be pedantic, but only about the strategic things. Part of the question is to identify what these strategic things are. This section provides some clues.



The Information Architecture should mostly eschew detail. We certainly do not want a model with more than 400 entity types. However, this is not an excuse for superficiality. There may be a few pivotal entity types and processes that deserve careful analysis, because they contain the germs of enormous strategic opportunities.

The Information Architecture does not normally include classification objects - it may therefore be less abstract than the information and activity models produced in detailed requirements analysis, in the sense that its entity types are more direct, albeit perhaps more generalized. For example, such classification as the demographic category of a customer would probably be left as an attribute in the Information Architecture, but could well become separate entity types in more detailed development models.

However, a strategic information architecture should at least identify opportunities for generalization and abstraction, so that projects can be given clear and minimally overlapping scope. This means that the definitions of the major entity types should be thought out fairly thoroughly. Even if the entity type has no formal identifier, it should at least have an identifying strategy. (In other words, some thought needs to have been given to the kind of identifier that would be appropriate.) However, the relationships and attributes need not be defined in detail.

Although the Information Architecture may be called a strategic model, it does not necessarily include all the information required by top management to make strategic decisions. Long-term market planning, capital planning and acquisition, and cultural change are all strategic issues - they could be suitable for business area analysis, perhaps resulting in the development of Executive Information Systems. So we may identify some broad Subject Areas, but the details of these areas will not be excluded from the Information Architecture, because they are not relevant to its purpose.

Thus the Information Architecture is not simply a top management model. It is focussed specifically on information systems strategies, and not on general business management.

There are several crucial things that must be addressed by the Information Architecture:

UNITY	How does the public object bring together different aspects of the business?
LEVERAGE	How pivotal is this object? Can small changes here have a large impact (positive or negative)?
INTENTION	What is the strategic intentions relating to this object? - In other words, what changes are foreseen for this object, what should it become?
MEANING	What is the object all about - what is its significance to the business? - In other words, what is it?
SOURCE	Where does the object originate?
DESTINATION	Does the object get exported?
STRUCTURE	What are the components and structure of the object?

Let us look at each of these in turn.

## Unity

The information architecture expresses the unity of public objects.

For example, a financial services company might want to issue a single telephone number to its customers, which can be used for any possible service the customer might require. (Instead of having to dial one number for account enquiries, a different number for reporting a stolen credit card, a different number for making an appointment to see the manager, and so on. Or imagine if the customer has to notify the same bank twice when s/he changes address, because the different departments don't talk to each other.) This is known as 'one-stop service' or 'one-call service'. It cannot be implemented without the information systems that support these services being somewhat integrated.

The first example can be satisfied by unity of the servicing process; the second example can be satisfied by unity of the customer address data. In both cases, we can fulfil the business strategy by elevating the process or data object to public status, which gives it global validity across the business.

A third example shows how the Information Architecture expresses changes in business thinking. A small financial company thought of itself as being in the loan business. It lent money to private individuals, which it raised through issuing bonds on the international markets. The people who received loans had always been regarded within the company as the customers, but the bond-holders had not been. It was realised by top management that there would be a strategic benefit to the company if the bond-holders were regarded as customers too. This would encourage the members of the organization to deal with the bond-holders in a more positive way, and encourage the development of profitable services aimed at the bond-holders. By building 'brand loyalty' among bond-holders, it would also protect the company from attack by large international predators.

This vision was reflected in the strategic information model by including both loan-holders and bond-holders in the entity type CUSTOMER, and including both loan-related services and bond-related services in the entity type PRODUCT. Some of the members of the organization could relate easily to these generalizations, but others found it difficult at first to see the implications of such abstract statements. But when these extended conceptions of CUSTOMER and PRODUCT were implemented in new computer systems and databases, this served to propagate and reinforce the new thinking through the organization.

## Leverage

When formulating a strategy, the idea is to identify pivotal objects that will have maximum impact on the health of the information systems, and on the business.

A business strategy based on organizational learning, or total quality management, will be usefully supported by information systems that cross through many areas of the business. These information systems will be based on pivotal entity types and processes.

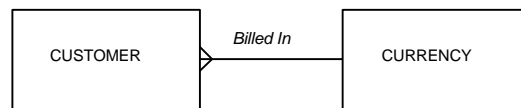
Pareto analysis is a useful technique, to find where the majority of the costs or risks or customer problems are being incurred, or where the opportunities are concentrated. For example, if we have received 500 occurrences of CUSTOMER COMPLAINT during a given period, and over 400 of them refer to late deliveries, while only 2 customers have complained that the documentation is only available in English, we might reasonably conclude that DELIVERY was strategically important, while DOCUMENTATION LANGUAGE was not.

The information architecture should support and be supported by this kind of business analysis.

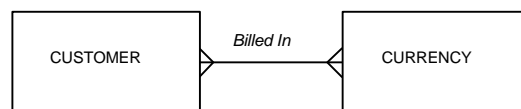
### Intention

Sometimes an enterprise will have two or more business concepts, with some similarities and some differences. A strategy may be declared, to bring these concepts closer together (or further apart). This strategy can be expressed and supported by modelling the two or more concepts within the Information Architecture, which is then used to plan information systems which will facilitate the intended changes.

Here is an example: Suppose the present computer systems only support a single trading currency, but the business strategy is to allow each customer to be billed in more than one currency. This strategy can be expressed as an intention to move from the top diagram to the bottom diagram. Such a change may have several direct and indirect effects on the business.



**Figure 4.5** *A single billing currency will be defined for each customer*



**Figure 4.6** *Each customer may be billed in more than one currency*

The information model shows clearly whether the customer may have only one billing currency, or may have many. If the customer may have many, then the data model contains a many-to-many relationship. Such a relationship automatically raises some data and process issues. The data and process models will be complete and consistent only when these issues have been settled.

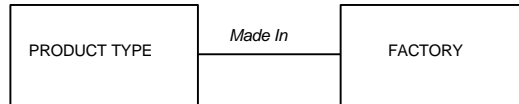
1. If the customer may be billed in more than one currency, then we need to know precisely which currency is to be (or was) used for which bill.
2. There may also be business rules demanding that certain transactions be in the same currency (e.g. bill and payment, or bill and chargeback).
3. A decision process is implied, to choose which currency is to be used for a given bill. Is this decided by a predefined algorithm, or by the customer, and how/when is this decision

communicated to the company? How much flexibility can be allowed for, what controls are required? Until what point in the process cycle can currency be changed?

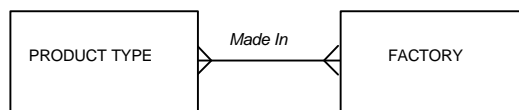
4. What are the consequences of making the system more flexible? What proportion of customers is likely to benefit, and is there any negative impact on the remainder? (E.g. extra information demanded from them.) What is the likely overall impact on profitability?

By exploring the data issues, the business issues can be addressed more systematically.

The same kind of situation can arise in a manufacturing environment.



**Figure 4.7** *Each factory makes a single type of product.  
Each type of product is made in only one factory.*



**Figure 4.8** *Factories will be equipped to make a variety of product types.*

Suppose the present factories only produce a single type of product, but the business strategy is to move to a more flexible manufacturing arrangement. This strategy can be expressed as an intention to move from the top diagram to the bottom diagram. Such a change may have several direct and indirect effects on the business.

- Manufacturing scheduling - may become more complex because there is now a choice of production location.
- Delivery of products to customers - may become simpler, because a single sales order may be supplied from a single factory.
- Engineering & production design - may be able to share components, skills, facilities and equipment between production of different types of product, wherever possible.
- If each type of product uses different raw materials, and if each factory must maintain separate stocks, inventory holdings may increase.

## Meaning

We could give many examples of inadequate thought about the meaning of strategic objects during the planning stage, causing project problems and/or coordination problems later. Here is one. In the oil business, petrol is sold, not directly to motorists but to petrol stations. Some departments refer to the petrol station as the customer, while others refer to the motorist as the customer. In one oil

company's Information Plan, however, there was a major entity type CUSTOMER, completely overlooking this ambiguity. This caused problems for several projects, and for Development Coordination. Such homonymy was too broad to be sorted out within a single development project, and needed to have been addressed at a strategic level.

The same confusion might arise in a manufacturing company, which might have conflicting understanding about who the customer is. Some managers may think of the distributor or retailer (who directly purchases the product) as the customer, while other managers may focus their attention on the end-consumer. Again, if this confusion is unresolved, and information data architecture includes a single entity type called CUSTOMER, the architecture may not provide an adequate framework for subsequent projects.

### **Source**

Where does the object come from? Suppose we have decided that the entity type MARKET is the strategic centre of everything. Who defines what the markets are? Does the organization create them itself, or does it wait until other (larger) organizations have created markets, and then seek to exploit them?

Where do new products and services come from? Are they copies of competitors' products and services, or do they spring fully-formed from the heads of the "boys in the back room"?

### **Destination**

If information is provided as a commercial service to external customers, or bundled into other commercial products or services, then it has a strategic significance for the enterprise, which can be recognized and analyzed within the Information Architecture. Taking account of the external destinations (usages) of such information objects can result in IS development plans that include 'strategic' systems to provide competitive advantage to the enterprise.

### **Structure**

The identification and content of major entity types can be important for an Information Systems Strategy Plan. The Information Architecture should reflect the structure of the 'real' world. Thus the structure of markets, the relationship between markets, products and customers, the internal organization structure of commercial or industrial customers, these are factors that should be considered.

## **4.3.7 Maintaining the information architecture**

If the architecture is to be a living object, it must change. Stability doesn't mean inability to change, it means that small changes are possible without destroying the whole.

There are several ways that the feedback from development projects to the architectures could be managed.

- 1 One option is not to allow any changes to the architecture to be carried out during on-going development projects, but to schedule a periodic replanning exercise, in which the architectures are entirely reformed to incorporate any new insights.
- 2 Architecture contains aggregates of business objects - this all changes are fed back. The components of the architectures are initially defined in vague and generic terms. As the detailed analysis is carried out, these definitions can be replaced by one that specifies the objects encompassed. Once a component of the architecture is so defined, any change to an object included in its definition automatically affects it.
- 3 “Panning for Gold” - The architecture coordinator dips a sieve into the torrent of detailed changes to the models - the trivial stuff passes through, and the large stuff remains. (Does he keep everything that remains in the sieve, or only if it glisters?)

There are of course costs associated with changes to the information architecture. These must be balanced against the benefits of having an accurate and up-to-date architecture.

<p><i>Need to analyze impact on current projects/systems</i></p> <p><i>Communication of new architecture to interested parties</i></p> <p><i>Risk of delay and changes in scope to current projects</i></p> <p><i>Risk of maintenance to current systems</i></p>
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*Box 4.3 Costs of changes to information architecture*

What we need is a measure of the scale of change- so that we can monitor and control the amount of change undergone by the architectures.

We have said that the Information Architecture documents the **meaning, source, destination, structure, unity, intention** and **leverage** of **public** and **pivotal** objects. Therefore, any insights affecting these points need to be fed back to the Information Architecture from the individual project models (requirements or design models).

In the organic planning approach, described in the previous chapter, each project is required to contribute to the architecture. Each project should therefore aim to do three things. First, it should help to complete at least one strategic object that is already clearly defined. Second, it should help to pin down some other, less clearly defined strategic object, previously only hinted at. (This may involve promoting an object from local to public status.) Third, it may hint at some entirely new object, of potential strategic/public interest, which will only clearly emerge with later projects. This itself implies feedback to the information architecture itself, which may grow organically as the projects build upon one another.

### 4.3.8 Summary

- *Avoid detail - but analyse the strategic 'pivots'*
- *Model should be generalized - but not too abstract*
- *To plan strategic systems, you don't need to specify strategic information requirements*
- *Document the meaning, source and structure of public and pivotal objects*

*Box 4.4 Summary of Information Architecture Guidelines*