Information Architecture Principles

Version Date

January 23, 2016

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1 Introduction:

1.1 Document description

This section presents a brief introduction of the intent and intended use of the principles. The second section describes the goals that the principles target to achieve. The third section describes the Principles themselves. Although the principles are described individually, in practice, they inter-relate significantly.

1.2 Background and Intent

Individual groups within organizations have diverse business objectives and priorities. These factors often adversely impact goals of organization wide information management. They typically have led to a wide variety of legacy information systems, which do not effectively share common data, and which overlap in some areas of functionality, while at the same time leaving gaps in others. The expressions “stove pipe” or “silo” mentality have been used to describe this common situation in many organizations today. Once this environment has been created, there is typically tremendous inertia to retain it, since individuals understand their individual solutions, and are reluctant to make significant changes for reasons of cost and comfort.

When new information systems delivery activities are inappropriately constrained by the priorities of individual groups, or limitations of legacy information systems, significant profitable opportunities (such as those enabled through fundamental business re-engineering) will not be realized. Instead of maximizing benefits of information technology investment, only incremental improvements will be realized.

The risk associated with delivering new information systems in a business environment undergoing fundamental changes is abnormally high since, in effect, we are asking business managers to define a future, optimal environment. No matter how bright or dedicated people are, it is not possible for them to clearly define things that they do not have experience with.

The risk associated with this uncertainty can be mitigated by relying on Information Architecture Principles discussed in this paper. Data bases and attendant information processing systems that have been designed according to these principles are able to survive significant changes in volatile business environments. In addition, the principles have proven to be very helpful in the creation of systems that are adaptable to support previously undefined information requirements, such as might arise during fundamental reassessment of existing business practices.

The principles are briefly presented in this document to provide a basic understanding of their meaning and intent. Full comprehension can only be gained through the application of the principles to specific situations.

2 Information Architecture Goals:

Information architecture models in themselves provide no tangible value. The knowledge contained in the models must be put to use before business benefit can be harvested. Information models must result in effective information systems, which in turn result in improved business effectiveness. Principles that influence the delivery of effective and timely information technology solutions will be perceived to be valuable. Principles which result in the creation of solutions that provide ineffective or untimely information will be perceived to be detrimental.

This section discusses the expected results of applying the Information Architecture Principles.

2.1 Shared Vision

A shared strategic vision that defines significant business simplification opportunity is required. The vision becomes the frame of reference for identifying business benefits, coordinating individual work activities, and assessing progress. Continued reference to the vision can avoid issues such as a natural human characteristic to drive for a specific solution to a problem at the first possible opportunity. Without a well defined vision, this tendency often leads to fragmented or sub optimal solutions. The Information Architecture Principles can be applied to protect the vision.

The real world typically disallows implementation of any vision in a single step. Tradeoffs and compromises must be made to move from the now to the future. Unless these required compromises are negotiated in reference to the future vision, there is no means of knowing whether short term actions are long term positive or negative. Application of the Information Architecture Principles will help ensure that all compromises are knowingly made against an optimal solution. This approach also ensures good positioning for continuous improvement, since specific compromise reasons can be documented as targets for future change.

2.2 Managed Redundancy

It is not possible to completely eliminate business data redundancy in today’s complex information processing environments. This is especially true considering the amount of common data exchanged with business partners such as suppliers and customers. At this level, it must be recognized that the target information processing environment consists of many independent organizations with a dependency for common information. As a result, data will be stored redundantly in different computer systems.

An appropriate business goal is to provide an overall information architecture that will allow necessary data redundancy to be managed with minimal administrative cost. The use of EDI, for example, will eliminate the costs of manually recapturing data. Probably more significant are the “hidden” costs associated with human errors and

associated error correction processes that result in environments which do not have a strategy for managing data redundancy.

2.3 No duplication

There are costs associated with the capture and storage of business information. Many current information processing environments bear excessive costs due to instances of recapture of information that is already available in computer form. Application of the Information Architecture Principles will focus attention on elimination of duplicate and redundant work, especially duplicate recording of the same data in different processes.

2.4 Stability, Flexibility, Extensibility

Limitations in hardware and software during evolution of information processing systems has led to rigid, special purpose, “stovepipe” applications that impose high maintenance and replacement costs. As technology limits continue to be reduced, isolated applications are increasingly seen as bearing unnecessary costs. The principles specifically target the “stovepipe” syndrome

2.5 Information Quality (Timely, Accurate & Complete)

The principles have been established to focus on information quality as a priority. Improved quality will lead to reduced costs due to avoided re-work, reduced delays in information availability, and tighter feedback loops in error reporting and correction. The principles target quality problems such as lack of timely information as well as inaccurate and incomplete data.

2.6 No boundaries to information flow

Technical limitations of the past that created labour intensive boundaries to the flow of information are becoming less and less of a factor in information system designs today. Maximum business benefits are achieved by considering information usage end to end, independent of organizational or technological boundaries. The desirable goal of single source computer capture of data and effective flow to authorized parties will not be optimally reached through small incremental improvements to existing information exchange mechanisms. An “end to end” perspective will ensure that significant opportunities are not discarded in favor of short term, sub optimal improvements. The principles specifically address opportunities for eliminating boundaries to the flow of information across different technical platforms and among organizations. Applying the principles also promotes elimination of boundaries among different applications systems solutions.

2.7 Effective Communication and Common Understanding

The prime purpose of any model is to communicate common understanding of opportunities and related problems. All models are intended to be simplified perspectives of more complex realities.

The focus of models developed according to the principles is to present a simplified view of the complex information sharing among people and organizations. Within this environment the models address two prime audiences:

- the people who understand the nature and needs of the business
- information systems professionals who must understand the business needs in order to deliver effective information technology solutions

Application of the principles help ensure that information models capture the required significant facts to direct implementation of effective information systems. Proper application of the principles also ensure that models will be understandable with a reasonable amount of effort and education.

2.8 Consistent principles across stakeholders

A consistent set of understood principles can facilitate communication among diverse stakeholders. Although communications could be further improved with adoption of complete and consistent standards, tools and practices, agreement to principles is a more easily achieved first step.

3 Information Architecture Principles:

The principles documented in this section are intended to be methodology and technology neutral. This recognizes the fact that there are many different viable approaches that various organizations endorse for the delivery of information technology solutions. When reference is made to terms which may be perceived to be specific to an individual approach, the intent is to clarify the meaning of the underlying principle. The principle itself should be applicable within any information systems delivery methodology.

In summary, these principles are intended to be independent from:

- modeling approaches
- information systems delivery methodologies
- diagramming techniques
- CASE (Computer Assisted Software Engineering) tools
- target information technology hardware and/or software platforms (e.g. DBMS, client/server, mainframe, etc.)

3.1 Multiple Business Uses

Information and communications technology (ICT) based solutions will support All business uses of information.

The end to end objective - optimization of information use - is to be considered the driving force for any models, and any potential solutions. Seek out approaches which do not constrain future optimization of information use. The perspective used in the creation of information solutions is therefore not to be influenced or constrained by any single business use or by any individual application perspective.

This principle will lead to the direct benefit of optimal information use across both organizational and technological boundaries. It will also ensure that solutions can be incrementally adapted to support future, unspecified business purposes by any stakeholder.

This principle dictates that models are not to be distorted by the organization structure currently in place to conduct business, or by the automated or manual systems which currently provide information support. This principle emphasizes fundamental requirements for business information by focusing on "What" the business must accomplish.

Application of this principle will cause models to be extended to define information at the lowest level of detail that meets the cumulative business requirements of all stakeholders. This “lowest level of disaggregation” view can always be rolled up or aggregated to meet the needs of individual stakeholders. The fully disaggregate view is the only level at which effective communication is assured across all stakeholders.

3.2 Legacy Constraints

ICT solution designs are Not constrained by currently employed technology or existing solution designs

The definition of fundamental business information requirements, without distortion due to current systems will provide a foundation for levering new technologies and new business opportunities in the future.

One of the most significant and common traps that constrain flexible and extensible solutions is allowing legacy information systems to influence future designs. This most commonly results from a natural human tendency to produce models that reflect the current methods since it is easier to describe what is than conceive what might be. In many organizations, this is further complicated by the large and diverse stakeholder community. Each stakeholder will naturally try to influence solutions to comply with their existing environments. Unless resisted, this pressure could lead to the worst form of "lowest common denominator solution", combining the limitations of information environments of every participant. This could lead to the situation described by the adage "camels are race horses designed by committee".

When it is an objective to eliminate unnecessary legacy processes through business simplification, information models will not be influenced by current constraints in either information technology or current business practices. The rate of change in both of these areas results in a rapidly moving target for information systems solutions. For example, many current system solutions tend to be focused on capturing data for paper based information support systems. Maximum business benefits will not result by simply converting paper to EDI. The validity of all existing input forms and reports should be questioned when modeling future solutions. Forms and reports are artifacts of information systems, and are not fundamental to achieving business goals. The information conveyed on these instruments may indeed be business critical, but optimal use of technology could well mandate complete elimination of the conveyance mechanism itself.

Realities imposed by legacy systems must be considered to ensure that information technology solutions are truly workable. The harsh realities of current technology limitations, and deeply ingrained business practices, cannot be ignored in any viable systems solution. The challenge is to avoid distortion of the logical design to comply with perceived physical constraints. The time to apply current constraints is after the models have solidified the logical vision of an optimal information processing environment.

Limitations imposed by legacy systems are recognized by ensuring that a clear distinction is made between logical and physical solution designs. Compromises to meet current limitations are established in the physical design. It is important that these compromises be documented in reference to the logical vision, as opposed to overwriting or displacing the logical vision. The major business advantage of this approach is that documented tradeoffs can be continually tested against advances in technology. This leads to an environment that directly fosters continuous improvement. Knowing where compromises are made can also beneficially influence more effective design of individual systems. A system that is designed to be changed in areas of known compromise should be more easily maintained, thereby avoiding future costs.

One technique that is used in the application of this principle is to model the business use of information independent of how that information might be processed. This is often referred to as modeling “what” vs. modeling “how”. The distinction between these two concepts is not readily perceived by the uninitiated. Simply stated, “what” refers to something that must be accomplished to achieve business success, whereas “how” refers to the process or means of accomplishment. “What” is the business need, “how” is the systems solution.

3.3 Fundamental Physical Reality

ICT based information solutions reflect Fundamental Physical Reality underlying the business

The most stable information system solutions have their design based on the underlying physical reality that the business deals with. The principles ensure that information models reflect and are biased towards this physical reality.

This principle requires a distinction between fundamental physical reality, and other things which are unarguably physical. For example, input documents or output reports are not allowed to influence the basic structure of information models of the business. Forms and reports are artifacts created to facilitate information management (they are simply conveyance mechanisms for data). Physical objects created solely to support data capture or information reporting need to be analyzed to determine the underlying business purpose that they enable. The fundamental business requirements for data will not change over time, but the way that information is reported will almost certainly change. Answers to questions such as “what is the information conveyed by this document”, or “what business purpose does the information conveyed serve” typically lead to the discovery of a more fundamental physical reality.

One of the major benefits of applying this principle is that the fundamental physical reality of any business is common for all stakeholders. The fundamental physical reality becomes a solid and effective “common denominator” that each user references as a foundation for their own information usage.

Many legacy information systems contain distortions of physical reality which have crept into the design for a whole host of reasons (technical limitations, economic limitations, patchwork enhancements, designer ignorance, etc.) These pseudo reality concepts can take several forms:

- creating things that do not exist to represent aggregate information (e.g. a coding classification scheme)
- creating fictitious occurrences of data (e.g. a “dummy employee”) in order to comply with a system design
- pretending that some physical reality is something other than what it truly is (e.g. treating an employee as a vendor so that expense accounts can be paid through accounts payable).
- creation of two occurrences of a single physical thing to avoid existing system limitations (e.g. same business partner as both a vendor and a customer).

In general, the existence of any “dummy” entry in a data base is an indication that the physical reality principle has been violated. All such “pseudo” concepts are therefore eliminated in information models.

A technique associated with this principle that assists in definition of compliant models is to ensure that any information transaction accurately reflect a singular physical business event. For example, in a case where a sale event occurs, there may be an accompanying product movement. On the other hand, in some sale situations, a movement is not necessary.

The movement and the sale are therefore two quite distinct events, and should be represented as such in information models.

This principle also implies that information technology solutions must support reporting of data that accurately represents the reality of a business transaction. Data about a business transaction should not be distorted in any manner prior to capture. External pressures, such as limitations in existing systems or “opportunities” to take short cuts in reporting should be recognized as such and not be allowed to influence the solution. For example, one should not have to report a value added service provided to a customer as a product to meet the limitations of a computer billing system. Products and services are distinct concepts, with different attribute sets and relationships.

3.4 Stability

The core aspects of ICT based information systems are based on business activities which are stable over time.

Observation of business activities reveals that some are more stable over time than others. If information system designs can be tightly coupled to the more stable functions, the systems will inherit stability. Analysis efforts carried out according to the principles focus on driving out the most stable business activities to form the best foundation for information processing environments.

Successful application of this principle therefore relies on the ability to assess the stability of required business functions, and to segregate the functions and related information usage into more stable and less stable categories. The following discussion elaborates concepts that are applied in this categorization process.

From a stability perspective, the required business activities of every viable organization may be classified into three distinct types:

- "Do" business functions

  These activities are selected as the most stable functions over time. They typically relate directly to the fundamental reasons for existence of the enterprise.

  Other characteristics that may be used to identify these stable **Do** functions are:

  ⇒ they are typically associated with line as opposed to staff activities

  ⇒ they tend to be associated with physical operations as opposed to administrative activities

  ⇒ they are often identified as core or key competence areas

- "Keep Track" business functions

All successful enterprises invest considerable time and resources in activities that support management processes. It is a management

task to assess how well the business is performing the fundamental **Do** functions and take corrective action as required. The methods used to keep track, monitor, and control the business are inherently less stable than the fundamental functions. In fact, **Keep Track** activities are constantly undergoing change as management tunes the organizational structure and associated control mechanisms to react to changes in the business environment. Information systems that are aligned to **Keep Track** functions will inherit the same instability.

Recognizing certain sub categories of the keep track perspective have been found to be useful when deciding which business functions should influence stable information models.

⇒ Financial tracking and control.

Every thing that is done in business has a financial implication, and since financial resources are typically limited in an enterprise, they are heavily tracked, monitored and controlled. Systems supporting these activities are volatile.

⇒ Regulatory reporting

All organizations are subject to legislated reporting requirements. These requirements may be viewed as externally imposed keep track functions. This perspective is inherently unstable since regulatory rules are constantly evolving.

⇒ Management Control

Information systems that support management control typically require unstructured access to a wide variety of data. New management reports on existing data is the constant theme for systems enhancement. This perspective has historically been very unstable and with the ever changing theories of effective management will probably become more volatile.

⇒ Project Control

A project is a technique used to muster financial, human, and physical resources to address particular problems in a business. Since a project is a means to an end, not an end in itself, any information used or generated by the project should have residual value after the project completes. If information support systems are designed so that the information used and accumulated during the project is only accessible from the project perspective, access to information from the "do" perspective will be complicated by project control data structures and systems.

- "Plan" business functions

Successful organizations also are concerned with activities that direct the effective execution of the core business activities. These functions are very similar to keep track functions. In fact,

from an information support perspective, the only significant differences are the time element, and the level of detail involved. Planning is done for the future, and generally is concerned with aggregate data as opposed to individual transactions. Keep track looks to the past, and relies on the lowest possible levels of data aggregation for “fine tuning” purposes. Therefore systems tightly aligned with planning functions will suffer the same problems and weaknesses as those aligned to keep track functions.

Since processes that support planning and control are inherently less stable than the core business activities, information technology designs which are primarily influenced by Keep Track or Planning perspectives will be subject to frequent and often major disruption. This is not to say that Plan and Keep Track activities are of secondary importance to the business. From an information architecture perspective it simply suggests that information requirements for these essential functions should be “overlaid” on information systems that directly support the **Do** activities.

Several analysis techniques that have been found useful in the application of this principle are worthy of note. The first is to distinguish information reporting processes from the total set of business processes. Since information reporting processes and associated objects are created as components of an information system, they will not be stable over time. This is especially the case when business process re-engineering concepts are applied.

One particular construct to look for in data models that adhere to this principle is data relationships that depict unstable transitive dependencies. Unstable transitive dependencies arise when modeled data relationships depict non-fundamental entities (such as a source document) in a central role in the data design. A quality check for unstable transitive dependencies is to differentiate between what exists in the physical reality and what has been created to document or track the physical world. Data models that adhere to the Stability principle emphasize relationships between fundamental or **Do** entities. Relationships required to support **Plan** and **Keep Track** perspectives are added after fundamental (inherently more stable) relationships are defined.

3.5 Logical Source Data Capture

Data will be captured once and only once at its logical source

Optimal timeliness and accuracy of information is achieved when data is captured at the location and point in time where it comes into existence. Adherence to this principle therefore results in the creation of information technology solutions that promote efficiencies of direct computer to computer exchange of data. Costs associated with human handling (data input errors, administrative time, delayed access to information) can be minimized.

In some instances today, it may not be feasible to capture the data in computer form at the source point. However, the direction indicated by improvements in information technology clearly points to increasing viability of this principle. Adherents to the principles will therefore strive to define the actual source data capture points for information technology solutions.

In application of this principle, it is important to identify the fundamental business event that causes the data to come into existence. For example, recording data on an input form is not a fundamental business event. The fundamental event can often be discovered by identifying the physical place where the data truly originated. This could be from a SCADA (System Control and Data Acquisition) system, or from some type of measurement device that monitors a physical process. Once the source point has been identified, the fundamental event and all relevant business data associated with the event can be defined. This knowledge can then be used to drive appropriate systems design, including forms and reports. This approach is contrasted to one which establishes a form as the first step, and then examines business events to test and validate the form.

An extension of this concept is that solutions will be sought that do not prescribe time lags in data capture. Further, situations where information is withheld pending the arrival of other data will be evaluated to determine alternate solutions that allow reporting of what is known, when it is known. An important implication of this principle is that data integrity must be established at the source, or at minimum attendant processes will be applied subsequent to capture to ensure that data integrity is established as early in time as possible. Under no circumstances is it acceptable to delay the capture of data at the source due to perceived problems with ensuring data integrity. The source of data **is** the only source. Ensuring high quality of source data is a matter of systems design.

Application of this principle also implies looking across organizational boundaries. The most effective information technology solutions promote correct reporting of what is known by whom it is known when it first becomes known, independent of organizational boundaries.

3.6 Disaggregate Data

Data will be defined in disaggregate form

Paper based systems tend to work with data in summary form. Both aggregate data (e.g., total production) and intermediate calculations (e.g., commission share for a sale) are commonly recorded. In a paper based system, this makes some sense, since repetitive calculations can be avoided, and volumes of data to be handled are smaller. Unfortunately, our history with paper based systems, coupled with historical limitations with information technology have proliferated the practice of storing aggregate data in computerized data bases.

In an optimized and integrated information environment, storing aggregate data at the expense of the more elemental forms severely restricts potential uses of the data. Aggregations can always be performed on elemental data, however aggregate data cannot be broken down. This leads to situations where it is not possible to “drill down” into the data to address valid business needs for information. Ensure that solution designs support data defined at a lowest level of need for all stakeholders by disaggregating data definitions to reflect the lowest level of physical reality of significance to the business.

Several techniques may be used to ensure that this principle is properly applied. Analysis must determine that any individual data element has only a single meaning. Analysis efforts should also ensure that each unique data element is decomposed to the elemental level.

The formalized data normalization techniques as practiced by data modeling professionals over the past few decades can also be used to check for violations of this principle.

Occasionally, the identification of embedded meaning within the structure of an individual data element can also indicate some form of aggregation has been defined. From a systems maintainability perspective as well, it is good practice to ensure that data elements, (especially those used as unique identifiers) contain no embedded meaning.

Another situation to look for in the application of this principle is the existence of classification attributes. Classification attributes are derived from more fundamental attributes. For example, the classification of a customer as “prime” is dependent on other more fundamental pieces of data. A special case associated with classification attributes must be considered. In some instances, a classification may be designated rather than derived. These classifications are typically imposed by authorities outside of an organization, such as regulatory bodies. Information systems need to recognize that data which is deemed to exist by legislation or legal agreement does need to be recorded and processed. However, this “deemed” data should not be allowed to override or otherwise replace more fundamental data.

Flags , switches and codes should also be recognized as a form of derived data. These attributes are by definition set and reset based on other more fundamental data. These may have a place in a physical design optimized for performance, but can be very misleading when the goal is to establish a fundamental perspective of information that supports the business.

Derived data also arises from legacy systems where technical limitations required a proliferation of tables and attributes for holding interim calculations. In order to break from the current paradigm, the analyst must ask the correct questions in order to determine whether a piece of business information is a logical source fact as opposed to an answer

determined through derivation. Calculated data should not be modeled in place of the fundamental attributes that are used in the derivation.

One exception for derived data should be noted. Derived data will be required in most enterprises where financial data is involved. Such items as a Charge (unit cost multiplied by number of units) which are derived from other data but which are documented on an invoice have legal contract and regulatory reporting implications. In these cases it may be appropriate to depict this data in a logical data model.