Using GIS to develop an integrated land records management system

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Paper Abstract

GIS integration is a loosely used term to describe a feature of many land records management solutions. The definitions and limitations placed on this term vary as greatly as the levels of integration their definer achieves between GIS and other land records systems. Using real case studies as examples, this paper will detail how to set and meet goals for integration of GIS and land records management systems. Attendees will leave with a better understanding of the different levels of integration between GIS and other land records systems, and strategies they can employ to achieve or enhance integration.

Introduction

Many local governments are retooling their computer systems. The retooling is often simply a result of aging systems. However, looking closely at existing systems usually reveals several key missing ingredients that would significantly enhance the day-to-day business operations of the organization. The flaws are generally characterized as:

1) Lack of GIS integration
2) Lack of general systems integration
3) Lack of Workflow tools to automate business processes and eliminate paper pushing
4) Lack of tools to customize the system using in-house resources

Governments have made significant and sometimes huge investment in GIS, but GIS has rarely reached the core business processes and remains more of a novelty. Government automation is also characterized by departmental systems that are often not integrated. The lack of integration is evident when end-to-end business processes are studied and the level of interaction between departments is discovered. The lack of integration between systems is often made worse because of reliance on paperwork for inter-departmental workflow. It is usually an interesting, yet disappointing study to document the number of places in the organization that are making 5, 8 or 12 copies of something to pass to other departments to either notify them of something being accomplished or a requirement for them to do something. Finally, although the base services provided by local governments is in essence similar, the manner in which they are provided varies from site to site. The least expensive and often times the best way to handle the challenges of variance are to provide tools to customize the environment using in-house resources.

As the retooling occurs, forward-looking organizations are taking advantage of several important characteristics found in some of today's software. In looking at the four aforementioned flaws in many of today's systems, the first three are basically integration issues. The fourth provides enhanced abilities to develop integration. The bottom line is that integration is the key to meeting these challenges. Modern software provides an environment to address these challenges completely.

If integration is the key, then having some definition for what integration means is essential. Interestingly enough, there are not really any definitions to assist organizations in categorizing the types of integration that exist from various vendors offering solutions for local governments. If you attend a conference, you will hear descriptions such as "fully GIS integrated," "unmatched levels of integration," "integration of all systems" without really having a measurement system for assessing exactly what these statements mean. It takes clever questioning and some real Information Technology background to ascertain what, if anything, these claims provided to a user of the system.

This paper attempts to help organizations ascertain the level of integration achieved by the various vendors by defining levels of integration and providing examples and questions to assist in determining where a particular vendor is in the pursuit of "full" integration.

To begin, here is a simple definition of integration.

Integration: The capability for two or more separate systems to operate in conjunction with each other.

The notion to author this paper was driven in large part to the challenge associated with this definition of integration. The challenge associated with this definition is to determine from such a vague statement exactly what integration means. Because integration can exist at many levels, the word gets tossed around in many discussions. The person who hears the word, integration, immediately makes assumptions about the system being described based on that listeners definition of integration.

In substantiating the need for this paper, the web-site **http://whatis.com** was consulted. A definition of integration from an IT perspective was found on that site. The following section was copied directly from the definition of integration from **http://whatis.com**.

> Integration (from the Latin *integer*, meaning whole or entire) generally means combining parts so that they work together or form a whole. In information technology, there are several common usages:
>
> 1) Integration during product development is a process in which separately produced components or subsystems are combined and problems in their interactions are addressed.
>
> 2) Integration is an activity by companies that specialize in bringing different manufacturers' products together into a smoothly working system.

> 3) In marketing usage, products or components said to be integrated appear to meet one or more of the following conditions:
>
> A) They share a common purpose or set of objectives. (This is the loosest form of integration.)
>
> B) They all observe the same standard or set of standard protocol or they share a mediating capability, such the Object Request Broker (ORB) in the Common Object Request Broker Architecture (CORBA).
>
> C) They were all designed together at the same time with a unifying purpose and/or architecture. (They may be sold as piece-parts but they were designed with the same larger objectives and/or architecture.)
>
> D) They share some of the same programming code.
>
> E) They share some special knowledge of code (such as a lower-level program interface) that may or may not be publicly available. (If not publicly available, companies have been known to sue to make it available in order to make competition fair.)
>
> In describing its Internet Information Manager (IIS), Microsoft says that it is "tightly integrated," apparently meaning that it meets conditions (A), (B), to some extent (C), possibly a bit of (D), and, if any, an unstated amount of (E).

In reading the description of integration from **http://whatis.com**, the reader discovers the need for further definitions of integration when exploring specific technologies. Of course, the usage in the marketing sense is where the confusion begins. The final words describing Microsoft's IIS is a perfect example of why people looking at systems need to ask questions when someone uses a term like "tightly integrated," "fully integrated," or "provides unmatched integration."

The levels and definitions discussed in this paper can be applied to all land records oriented applications like permitting, inspections, code enforcement, parcel maintenance, addressing, computer assisted mass appraisal, land registry, public works, zoning case management, sub-division approval and others. Many of the examples relate to GIS integration with appraisal systems, but the concept of the level of interaction between systems may be carried to other functions. The focus of the definitions is on the interaction of these technologies and others.

The Seven Levels of Integration to be defined are:

1. Hardware
2. Data Duplication
3. Data Access
4. Data Sharing
5. Functional
6. Workflow
7. Inter-Departmental

The seven levels of integration are defined in order of incremental improvement. Level 1 is the lowest level of integration while level 7 represents the highest level of integration. Higher levels of integration provide for improved efficiencies in business processes, reduced costs in on-going monitoring or maintenance of the various systems, easier access to the technologies or data and generally a more functional implementation.

Level 1: Hardware

Hardware integration describes the ability for various types of devices to communicate with each other. Hardware integration is a requirement for the variety of devices that might be used in a complete permitting, inspection, code enforcement, public works or CAMA implementation. Hardware integration almost always requires one of the other 7 levels of integration to handle the functionality and data issues associated with an implementation that includes several hardware platforms.

Opportunities for integration between hardware devices include laptops used in the field, server based systems, Personal Data Assistants (PDAs), Global Positioning System (GPS) devices, digital camera's or Interactive Voice Recognition (IVR) technology. This is not an exhaustive list but should provide some help in defining hardware integration.

Virtually all governmental systems exist primarily as a traditional server or host based system that is accessed by Personal Computer's (PCs) or terminal devices through a network. The need to understand hardware integration has been triggered by the extension of technology into smaller, more mobile devices and the new ability to collect traditional information in a digital manner.

The utilization of laptops and PDAs has provided the worker in the field with the ability to collect information while out of the office. The connection of digital cameras or GPS devices to the field devices has provided opportunities for collecting location or picture data in digital form. IVR technology has allowed data access through traditional phone lines or through cellular connections providing the public or other users new methodologies to access corporate data. All of these improvements or new technologies have created the need to understand hardware integration.

As mentioned before, hardware integration most likely requires one of the subsequent levels of integration to handle the functionality or data requirements for having these disparate devices communicate with the office based system. The following questions will provide a basis for determining the use of hardware integration in a particular vendors technology.

- Do you support the collection of data using a PDA/laptop?
- What functionality do you provide on the PDA/laptop to facilitate the collection of that data?
- How is the data collected in the field uploaded to the corporate database?
- What type of connection is maintained between the PDA/laptop and the corporate system?
- Is the connection web-based, wireless, disconnected in the field but then connected on the network in the office or some other physical connection?
- Do you provide the tools to automatically load the data from the field device?
- Do the tools detect changes and manage the fact that users could have changed the same data on the server that was being worked on in the field?
- What operating systems do you support on the PDA/laptop?

If field devices are supported in some manner by the vendor, then there is also the opportunity to begin using technologies like digital cameras and GPS devices. The hardware vendors would handle most of the responsibility for the connection between a digital camera or GPS device and the field data collection device. The key questions for the system vendor for supporting this hardware integration would be as follows.

- Do you support the use of pictures in your system?
- What technology attaches them to the respective parcel, address, account, building or land component?
- What format is used to store the pictures?

- Do you support coordinate location data in your system?
- How are the parcel, address, account, building or land components connected to the coordinate data?
- What format is used to store the coordinate data?

Other technologies requiring special hardware are also being incorporated into a comprehensive permitting, inspection, code enforcement, or other implementation. One such technology is IVR. Good questions to ask related to IVR include the following.

- Does your system support IVR?
- What type of interface is used to access the corporate database from the IVR technology?

Hardware integration is important to a many system implementations because of the additional functionality and change in data collection processes that will hopefully improve the overall business processes of the organization. The use of laptops or PDAs allows the employee to collect data while in the field. Field data collection should improve data accuracy. The data is entered directly by the employee while on-site. Field data collection eliminates the need for clerks or other personnel to enter the data collected as hand-written notes from the field workers.

Additional hardware integration with digital cameras or GPS units allows the appraiser to collect other types of information while in the field. Pictures of structures are becoming an increasingly important piece of information in implementations. Having a picture of the structure, violation, emergency, condition or status of the situation helps reduce the number of visits to the site, which should help reduce overall costs to the department. GPS integration enables the field personnel to collect location data about structures, land use, natural features or other important components on a property with good positional accuracy. The location data may have an important role in further spatial analysis required by the situation.

As organizations try to provide easier and better ways to access the corporate information, IVR has become a popular method for data access. Because of the accessibility of phones to virtually everyone, IVR represents an efficient manner to access information about permit status, inspection schedules, violation resolution, project status, property values or any other information in corporate databases.

Even at the first level of integration, the benefits from a business process standpoint can begin to be realized. Saving time and money, providing a mechanism to streamline the collection of data, improving the quality of the data collected, gaining access to a greater variety of data and making it easier for the public to access information are all potential benefits of hardware integration.

Level 2: Data Duplication

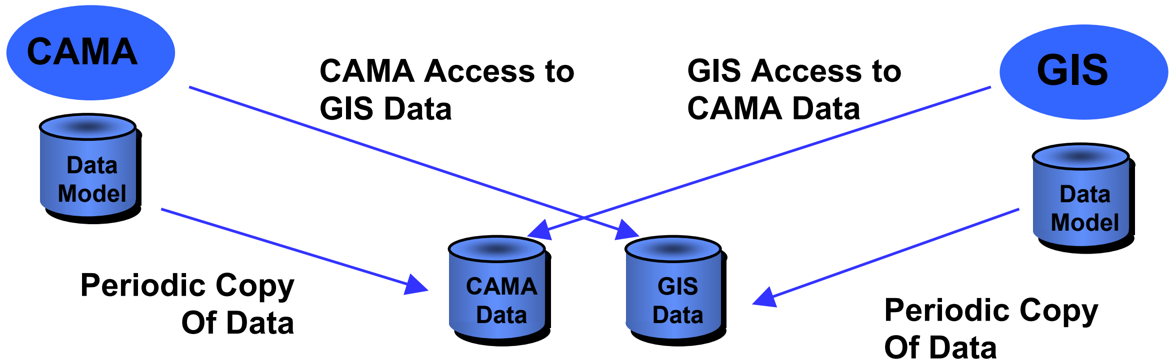
The next 4 levels of integration specifically address the interaction of distinct corporate systems. These integration levels define the types of interaction of data and functions between the systems. They really define the overall effectiveness in the use of combined functionality for building more highly integrated corporate solutions.

Most of the following examples involve GIS because GIS is one of the most easily understood typically external systems in use in local governments today. The reference to other corporate, land records systems include areas such as permitting, code enforcement, inspections, sub-division approval, addressing, parcel maintenance, land registry, computer assisted mass appraisal (CAMA), and public works.

Data duplication is the simplest form of integration between systems. Data duplication is defined by the following.

Data Duplication: Copying data from one system into another format to allow the other system to utilize the data.

Below is a diagram illustrating data duplication for CAMA/GIS integration:



Data duplication can occur in either or both directions. GIS data may be moved from its normal data store into a different format so that the GIS data may be viewed in the other system. Likewise, and probably more commonly, data is moved from its normal data format into a different format so that the data may be viewed in the GIS environment.

Examples of this type of integration are copying data from ESRI's ArcSDE layers into a shape file for access by the other system. This level of integration could also copy Oracle's Spatial data to GeoMedia's native format. The purpose of copying this data would be to get the information into a format supported by the other system.

The reciprocating movement of data duplication is to copy the other systems data from its current data store into some other format. This might be the copying of Oracle or SQL/Server files into dBASE (.dbf) or Access (.mdb) files. This might be copying DB2, VSAM or simply flat files from the other systems environment into some other GIS supported data structure.

Every GIS and governmental system vendor should be able to support this type of integration in at least one direction. The GIS vendors should be able to specify a file format for the attribute data that can be related to the spatial information. The other system vendor may have more trouble supporting the alternative because there has to be some type of GIS viewing capabilities in the system in order to even support copying data from the GIS so that it might be viewed.

This level of integration is typically what starts the difficulty in determining just how integrated the GIS and other systems are. Data duplication potentially allows either system to see data from the other. Users can touch a parcel and see typical data such as permits issued, violations reported, assessed values, numbers of bedrooms, square footage or any data item that has been copied out of the systems database into a GIS-readable format. Likewise, system users may be able to see the selected record on a map. Data duplication provides the appearance of "full" integration.

Data duplication provides a basic ability to see GIS and other data together from one or the other system. While there are benefits to this level of integration, there are also limitations. The benefit has been defined above: users can view GIS and tabular data together in one system.

The drawbacks to this level of integration require further questioning. The limitations begin to arise with timeliness and functionality requirements beyond simply viewing data in a single environment.

By copying the data from one system into a supported format required by the other system, the issue of timeliness of the copied data comes to the forefront. The data is potentially out-of-date, the moment it is copied to the other format. Changes can occur on the system from which the data is copied. Most organizations that are integrated at the data duplication level have established time frames for "refreshing" the data. Data is copied monthly, yearly or in good situations maybe weekly or even nightly.

Users should be aware of the continued time and effort required to sustain a data duplication integration level. This requires constant monitoring of systems to ensure that the data indeed moved successfully between the two systems. Users should also be aware of the age of the data and the potential for providing wrong information because of subsequent changes made since the last copy was made.

Data duplication integration really simply provides a read-only method for sharing information. Because the data resides in two places, the integrated system cannot support updating information in both places. The synchronization of data at this level of integration is typically done at the file level and not the transaction level. The synchronization of this data also creates potential data integrity issues if users begin to update the data on both sides. With data duplication, a parcel mapping user would not be able to enter the ownership data into the GIS and have that data also entered into the CAMA. That is a transaction level update. The GIS user would get a refresh of the CAMA data with the new ownership information at some later date when the entire file was copied out of the CAMA system into the GIS supported format. This same description could apply to GIS based addressing tools attempting to feed systems reliant on address information. Users will continue to have considerable redundancy in business processes because of the amount of data that is required to be entered in both systems.

One other potential struggle exists at this level of integration. Who is going to perform the integration? Some system vendors do not provide information about how the data is stored at a level that would allow the user organization to extract the information for use in the GIS. Some vendors would require that the vendor perform all of this type of integration because they maintain such proprietary data structures that the end users are helpless in copying the data out of its environment. Each and every modification or additional field of information desired to be viewed through GIS would require services and most likely payment to the system vendor. Basically, the user is hostage to the system vendor to manipulate their own data. This can also be true, although less likely, from the GIS side.

In accomplishing integration between systems that were not designed to be or initially integrated with each other, the end users must be able to have access to a variety of the components of the system. The data model and functions are essential to performing integration. The systems must be customizable by the end users to achieve many of the levels of integration. Having access to the data model is essential for this level of integration.

The following question should help ascertain if this is the level of integration achieved by a vendor.

- Do you copy data from one format to another in order to provide access from either GIS or the other systems information?

If the answer to this question is “no,” then the vendor either supports another level of integration or does not support integration at all. If the answer to this question is “yes,” then more questioning should follow.

- What frequency do you copy the data?
- What format is the data stored in the your system?
- What format is the data stored in the GIS?
- What direction do you copy the data? Other system to GIS supported files or GIS to othere system supported files?
- What formats do you copy the data into?
- Do you publish enough of the data structure so that we can write our own data copy routines?
- Do you have GIS viewing capabilities inside your system?

As stated earlier, data duplication should be achievable by virtually every vendor. It may require that the vendor do the work, but they should at least be able to provide the user with a routine to copy data from their system to a GIS supported data structure. This level of integration will provide the ability to see other system data on a map. However, this level of integration will create timeliness and functionality limitations as well as introduce potential for data integrity issues because of data duplication. Data duplication provides a read-only view of the integrated data.

The single biggest reason for being limited to this level of integration is the storage of data in formats that are old, not open nor widely supported by the GIS community.

Data duplication should enable several types of functions to be performed. Data duplication will typically allow users to view and query the provided data elements from the GIS. It is extremely important to realize that the capabilities provided by this level of integration are driven by the amount of data that is copied into the target environment. GIS views of all permits, violations, zoning cases, sub-division applications, proposed plats, sales by dollar amount, comparable properties, location of appeals, finding agricultural properties and so on are made possible only if the appropriate data is copied into a GIS supported format.

Data duplication will not allow for automated analysis or updating of information to be shared between the systems. Users will not be able to calculate soil composition and automatically update the CAMA database. Users will not be able to update ownership information on the GIS side and see the changes immediately on the CAMA side. Basically, data duplication means there are still 2 sides or 2 systems.

Level 3: Data Access

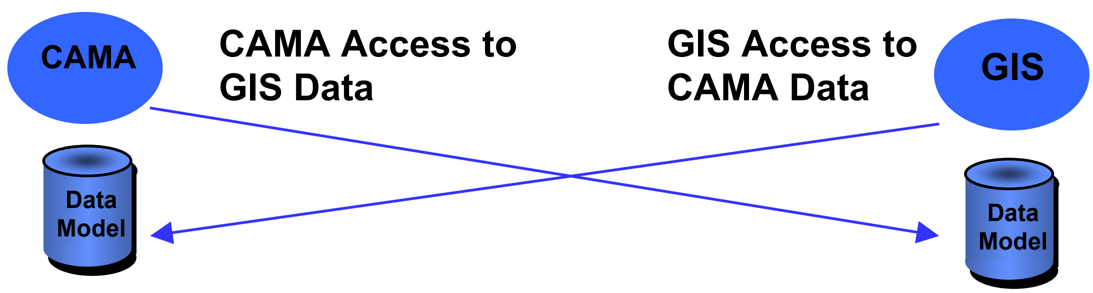
Data access improves the level of integration between GIS and other systems by eliminating the need to copy information to external formats required by the other environment. Data access means the vendor supports newer, more open data structures that are already supported natively by the other environment.

Data Access: Connecting directly to the data structures from either system without the need to duplicate data into a different format.

Data access eliminates the continued overhead of constantly moving data between systems through the use of external supported data structures. The information is accessible between GIS and the other system by simply pointing to the native data stores used by either environment.

Data access also eliminates the concerns over data timeliness and data integrity by allowing the data to be maintained in only one place and viewed by the other system. The moment an update is made in one system, it is accessible to the other system because the two environments are pointing to the same data.

Below is a diagram of data access integration in a CAMA/GIS environment:



This level of integration is not necessarily achievable by all vendors. Data access typically requires that the other system data stores be in an Open DataBase Connectivity (ODBC) compliant data structure or stored natively in the more common Relational DataBase Management Systems (RDBMS's) like DB2, Informix, SQL-Server, Access, dBASE or Oracle. This level of integration requires support from the GIS vendor for ODBC compliant or RDBMS products.

For integration from the other system to the GIS, the vendor must provide GIS viewing capabilities that can read the native GIS format. If the map viewer in the other system can support the native GIS format, then data access is possible. Typical supported GIS formats for map viewers are Shapefiles and Oracle Spatial. There are other GIS formats that can be supported.

The main benefit of achieving a data access level of integration is the ability to see updates on a transactional rather than on a batch or file transfer basis. Data duplication provided access to changing information, but only on the frequency of when the entire file was duplicated. Data access provides the users with an interactive view to the live data being updated in the 2 environments. Other system users can see map updates as they occur and GIS users can see attribute changes as they occur.

An important designation in supporting data access that provides for this transaction level viewing of updates is to ensure that the vendor is supporting a multi-user data store for the other environment. A common misunderstanding related to this occurs when vendors state that they support Shapefiles for achieving this level of integration. Supporting Shapefiles achieves this level of integration for direct access to the GIS data store but only supports transaction level updates, as long as the GIS environment is not multi-user. Shapefiles are a single user GIS format. They do not support a multi-user editing environment. Given that limitation, a vendor who only supports Shapefiles, cannot be achieving the transactional access desired by data access unless there is only one person making spatial updates. They are most likely back at data duplication and copying data from ESRI's Librarian or ArcSDE or Oracle Spatial into a shape file for integration purposes.

Likewise, the GIS vendor must be able to support changes being made dynamically to the underlying tabular data structures. If the GIS can access tables through ODBC, but accomplishes this by taking a snapshot of the data and using a temporary file, then the GIS falls short of data access also. The internal workings of the GIS are basically prohibiting the transactional level data access. This limitation again basically puts the GIS vendor back to data duplication. It does, however, mean that the periodic nature of the data refreshes occurs with each initiation of the GIS to tabular data connection.

Some of the same limitations exist in data access as in data duplication. Data access integration is also limited to read-only type interaction. Data access is also limited to editing data in only one environment. These limitations are somewhat a by-product of this definition as the ability to extend beyond read-only to write operations in either environment are included in subsequent integration levels.

A common misunderstanding with data access occurs with the assumption that because a system uses a standard relational database, the integration between GIS and the other system should be fully functional and easy. The misunderstanding occurs because users know that the GIS environment they have chosen supports the RDBMS that is the same as the other system. Why shouldn't the integration between the systems be easy and fully functional? The GIS can write to RDBMS tables and so can the other system.
The answer lies in the functions that are processed as part of the update routines. There are typically many functions that are executed when a new account is added to a CAMA system or a change is made to the CAMA database. For instance, splitting a parcel on the CAMA side may require functions to establish a parent/child relationships between the original parcel and the 2 or more parcels being created. It may also require account numbers to be generated. It may also require that the names and/or addresses be

validated. It may initiate a valuation routine. These are all functions that are written in and executed by the CAMA product. If the GIS writes data into the CAMA tables that are accessible to the GIS, these important CAMA functions are not initiated and cause potential for data integrity issues.

Assuming that because the GIS and the other system can support the same tables makes complete integration easy and accomplished is a really bad assumption.

Determining the vendor's ability to achieve the data access level of integration requires some questioning.

- Can a GIS product directly access the tabular data in your system?
- Does the GIS access provide the ability to see changes made to the tabular data immediately?
- What format is the tabular data stored in that allows the GIS to see that data?
- Does your system directly access GIS data?
- What format is required of the GIS data to support that functionality?
- Is that GIS format a multi-user environment?
- What updates do you allow to occur in each environment? Can I update address information in the GIS and have it reflected in the other system? Can I update Parcel Identification Number's (PIN's) in the other environment and see the updates on the GIS side?

Understanding the answers related to updating information in a data access environment requires some skillful discerning of the answers provided. The answers are based on the data model used by the two systems. Because data access really only provides a single point of editing data, the system responsible for the update must include all necessary functions be initiated during the update process. Many vendors would answer that you can update the information from either system. What the users must ascertain is if that is really possible because of the functional requirements mandated by the data updates. Subsequent questions that will most likely lead to one of the next levels of integration would include the following.

- When I add a new parcel through the GIS, is it the same as when I add a new parcel through the CAMA?
- When I update data in the permitting system, is it the same as when I update the data in the GIS?

If the answers to these questions is "no," then the vendor probably supports data access, but not the next two levels of integration.

It is possible to support data access from one direction and not the other. A permitting system may be able to read the GIS data directly but not vice versa. A particular permitting vendor may support data access in only one direction.

Data access provides a slightly higher level of integration than data duplication. The biggest benefits are that the data no longer needs to be copied from one format to another and the data is as timely as the last transaction.

Data access does not solve the challenges related to moving beyond a read-only environment during integration. Data access provides for the addition, deletion or change of information only in one or the other system. The system allowing write access must be the system that controls all necessary additional functions or processes required for data integrity.

Data access provides for the same functional capabilities as data duplication. Data access will typically allow users to view and query tabular data elements from the GIS. Unlike data duplication, the GIS users are typically able to utilize most or all of the tabular data elements because they have direct access to the tabular data and are not relegated to the information that is copied over. GIS views of all permit locations, code enforcement violation details, sales by dollar amount, comparable properties, location of appeals, finding agricultural properties and so on are made more readily available because of direct access to the tabular data.

Data access will not allow for automated analysis or updating of information to be shared between the systems. Users will not be able to calculate soil composition and automatically update the CAMA database. Users will not be able to update address information on the GIS side and see the changes immediately on the permitting side. Even though the two systems are pointing at the same data, the functional requirements of the other system during update processes are not accessible. Basically, data access means there are still two sides or two systems but they are able to utilize the same data for read-only purposes.

Level 4: Data Sharing

Data sharing improves the level of integration between GIS and other systems most significantly by allowing the systems to begin sharing data beyond a simple read-only environment. Data sharing requires the same technical environment as data access. GIS and tabular systems must be able to access each other’s default data stores in their native environments. GIS products typically need ODBC or RDBMS data stores. Other products need standard, multi-user GIS data stores.

Data sharing and the next level of integration, functional, combine to provide a system where data and functionality are utilized in a single, seamless environment between GIS and the other system. It is difficult to separate the two levels, but they are described individually because data sharing deals with the data side of integration while functional deals with the functional side of integration.

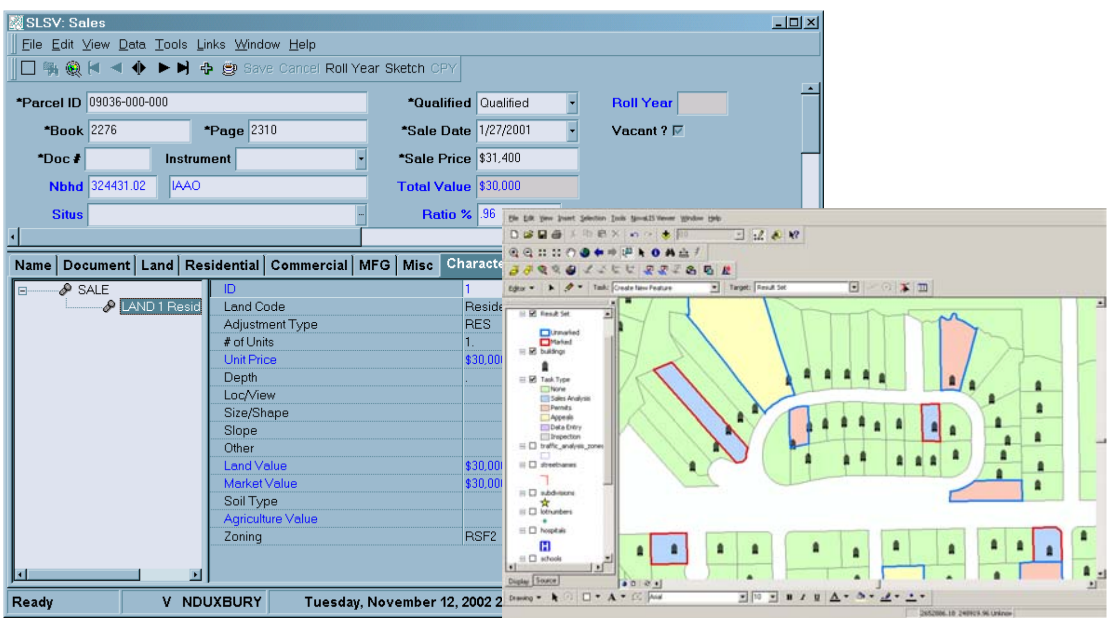
Data Sharing: Connecting directly to the data structures from either system in a bi-directional methodology and providing an integrated set of tools for selection of data with a shared data model.

The single defining difference between this level of integration and the previous levels is the concept of a shared data model. A shared data model means that information is not repeated between the GIS and the other system. The databases are linked through key values to establish relationships between tables containing spatial and tabular data.

The key benefit of the single data model is the provision for selection of parcels on the GIS side resulting in the same parcels being selected on the other side and vice versa. A user can combine tabular and GIS selections to create a result set to be used by either program. There are some very compelling functions provided through data sharing.

Take comparable sales, for instance. Data sharing means that returning 10 properties that are comparable to a subject property in CAMA can be used to see which three are closest to the subject in GIS and then run the typical statistics for sales ratio, coefficient of dispersion and so on from the CAMA. This is all accomplished without having to re-key information. The 10 record result set is viewed in the GIS by the fact that the GIS and CAMA share a data model. The three closest comps are then chosen by selection in the GIS environment. Again because of the shared data model, the CAMA now has the same three properties as a selected set. The user then clicks the button to generate statistical calculations. Data sharing integration makes this process require about five clicks of the mouse.

Below is an example of a comparable sales selection using GIS after the attribute query has returned a list of potential candidate properties.



Neighborhood delineation is another good example.   Data sharing integration provides for the spatial selection of a neighborhood and the immediate coding of those parcels in the CAMA database to reflect the new neighborhood designation. This is all accomplished without re-keying any data. The user utilizes the GIS tool to draw one or more polygons around the selected parcels for the new neighborhood. Because the

CAMA now has the same selected set of records, the user then utilizes the CAMA function to mass update the neighborhood value to the new designation. The user has basically redefined a neighborhood with about four clicks of the mouse and has been able to use the map as the key methodology for selecting the neighborhood.

There are several important questions in determining if a vendor provides data sharing.

- Does your system use a single, integrated, shared data model for both spatial and attribute information?
- Are the only linkages between the GIS data and the tables maintained by the other system the key fields in each table?
- Is the connection between the systems more than read-only?
- If I select records on the GIS side are they also selected on the tabular side?
- If I select records on the tabular side are they also selected on the GIS side?

Data sharing is an important step in the integration hierarchy because when coupled with the next level creates the highest level that can be achieved between GIS and another system. It is difficult to provide additional levels of functionality provided through this level of integration until coupled with the next level of integration. Data sharing is a prerequisite for the next level of integration.

Level 5: Functional

Functional integration changes the way that an organization can utilize technology. Functional integration enables users to combine the capabilities of separate systems into a single, integrated program. It also enables users to access functions from the separate systems together as though they are one system.

Functional: The utilization of separate technologies in a single system.

Functional integration requires the technologies to be integrated to be of specific types of architecture. During functional integration, the architecture of the technology must support the ability for outside programs to access its functionality. In other words, the GIS product must be able to initiate functions in the other system and the other system must be able to initiate GIS functions. The architecture of both systems must be engineered to allow this type of interaction.

Without an adequate technical architecture and achievement of at least a level of integration of data sharing, functional integration is impossible. Some samples of technical architectures that provide for functional integration include Microsoft's Component Object Model (COM), Common Object Request Broker Architecture (CORBA), Application Programming Interface (API) or simply having the source code to the underlying product.

Having access to a COM layer, CORBA, database triggers or API for a system provides the opportunity for a more open type of integration because these access methods to a system's internal functions are often published and accessible by a wide range of users. If the vendor is the only organization with access to the source code of a product, only the vendor can perform the integration. Organizations that have the source code to their systems can build in integration. Many vendors do not publish their interfaces, which puts the burden of integration on the vendor.

This highlights the need for chosen systems to provide access for modification of the system to the end-user organization. If the vendor does not integrate with the chosen systems, then integration must be physically performed by someone. Without the ability to access functions through external application development, this level of integration is simply not possible.

Some firms that specialize in systems integration will use other architectures to access the functionality of disparate systems. Technologies based on something like a bus architecture or Simple Object Access Protocol (SOAP) to provide integration between disparate systems. Either of these integration methodologies or standards, however, requires access to the underlying technology to accomplish integration. In other words, the GIS functions must be exposed to an outside program and the other systems functions must be exposed to an outside program.

The benefits of functional integration are almost immeasurable because the flexibility to combine separate technologies creates a near infinite possibility of approaches to business challenges. In terms of system integration, functional integration provides a nice set of functional capabilities that simply cannot be reached with each system operating at the previous levels of integration.

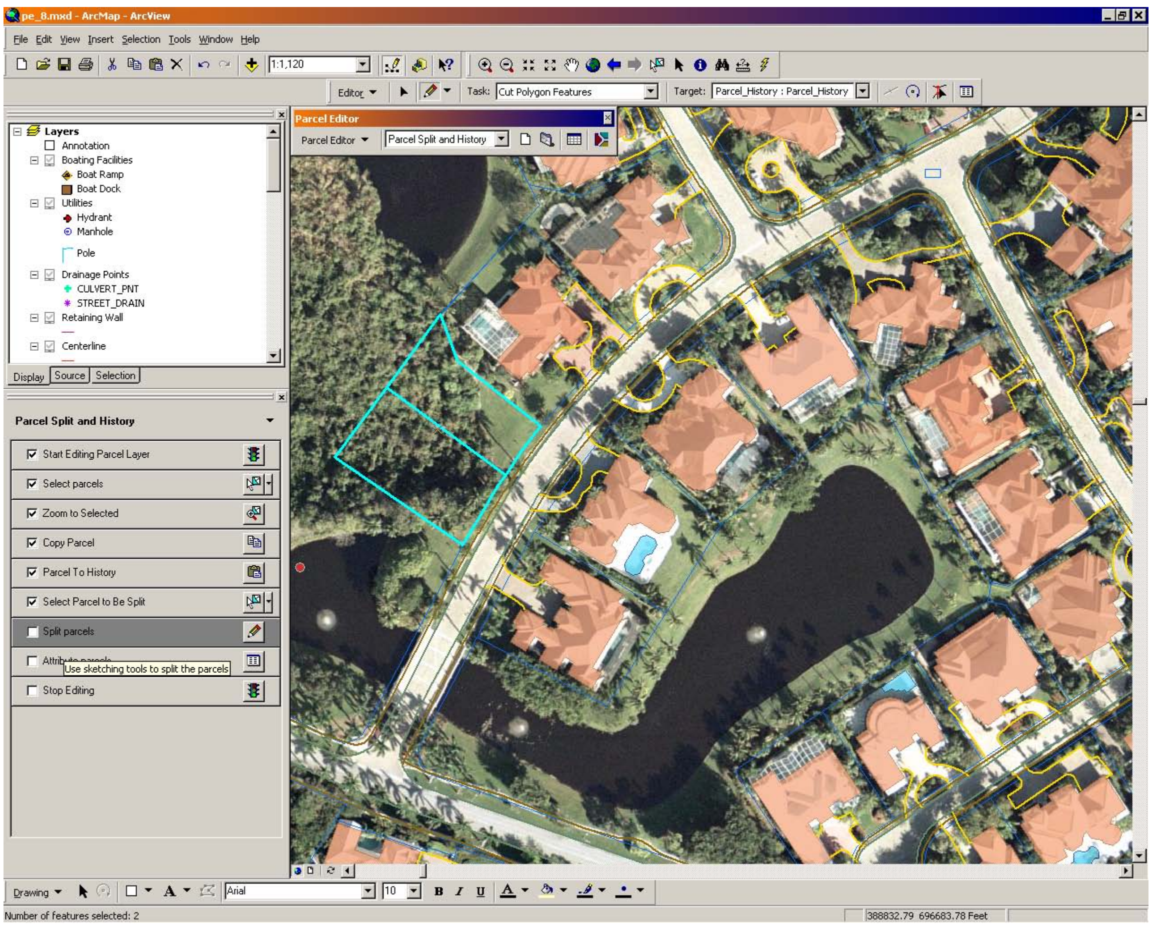
Functional integration between systems means that users in either environment can enjoy combining functions from both systems to make business processes easier and more efficient. Functional integration allows for tasks like the following to be accomplished:

1) Any analysis performed on the GIS side can be passed back to the other side.
2) The other system can write data into the GIS.
3) The GIS can write data into the other system.
4) Functions in other system can be initiated by the GIS.
5) Functions in the GIS can be initiated by the other system.

These very broad statements contain the capabilities to achieve some very specific functionality that most users would appreciate. The benefits of these broad statements can be demonstrated by studying just a couple of simple, everyday business processes.

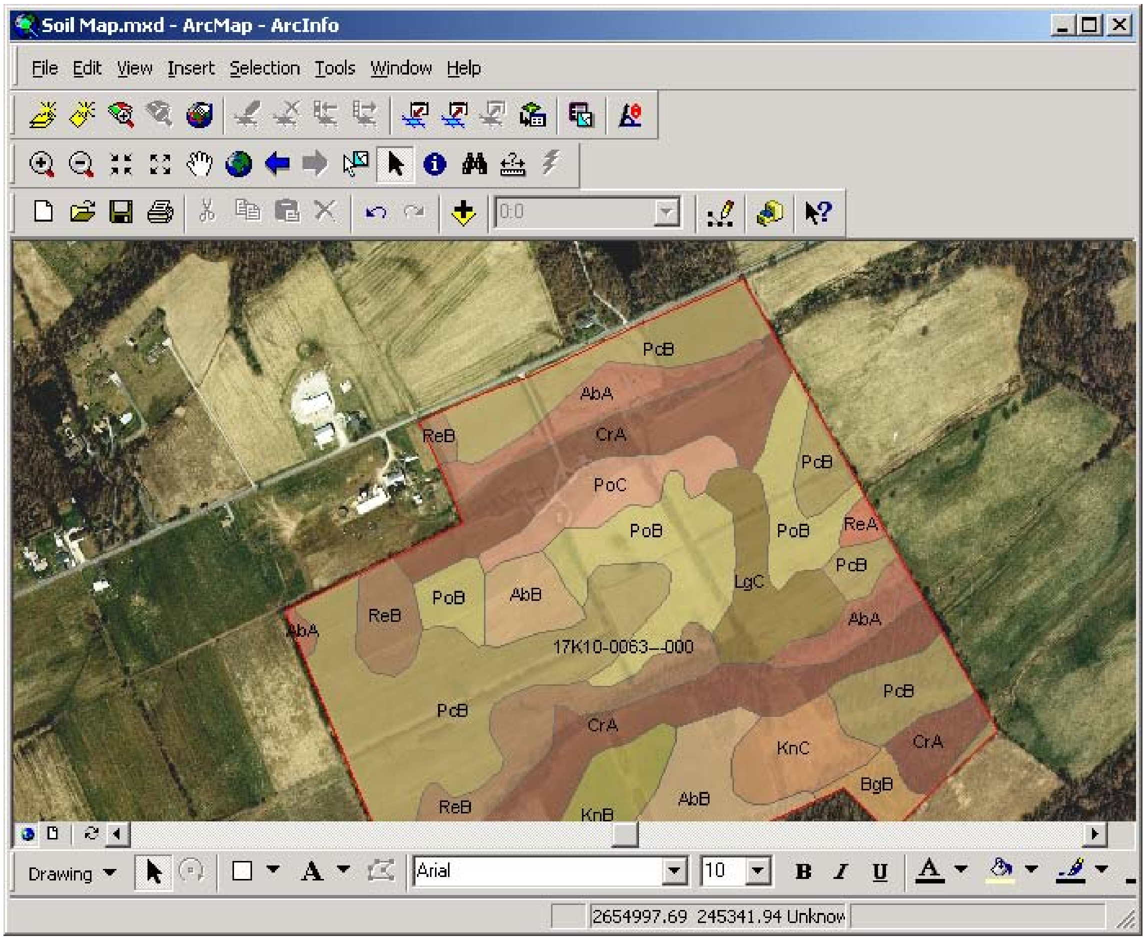
Take splitting a parcel as another example. Functional integration means performing an update in the GIS to split a parcel into two and having the parent parcel retired on the CAMA side with two new child related accounts populated with the ownership information entered during the split operation in the GIS all performed by the mapping professional. This is also all accomplished without having to re-key information. The split is accomplished using the tools in the GIS. The parent parcel number is stored and the GIS initiates the CAMA function to retire that parcel. The GIS then passes the data entered on the GIS side to the CAMA system to populate new records. The GIS initiates the appropriate CAMA functions used when entering data to ensure proper processing and data integrity. Those functions might include establishing the relationship to the retired parcel, assigning account numbers and putting the ownership data into the appropriate place. The appraiser is now able to simply enter the remaining required data for that account instead of having to type in all of the same information entered by the GIS mapping person.

The following is a screenshot from a parcel maintenance environment that automatically updates the CAMA database:



Determining the soil composition of an agricultural piece of land is another good example. A query in CAMA returns the requested Ag land, which is passed to the GIS. The GIS performs the overlay calculation between the parcel and soils layers to determine the acreage of each soil type on the parcel. The soil types and associated acreage are then linked to the parcel in CAMA. All of this is performed with about four mouse clicks as functional integration provides the communication between GIS and CAMA to create, link and enter the electronically generated information.

The following screenshot illustrates the use of GIS functionality for calculating soil types. This information is passed directly to the CAMA environment through a COM interface:

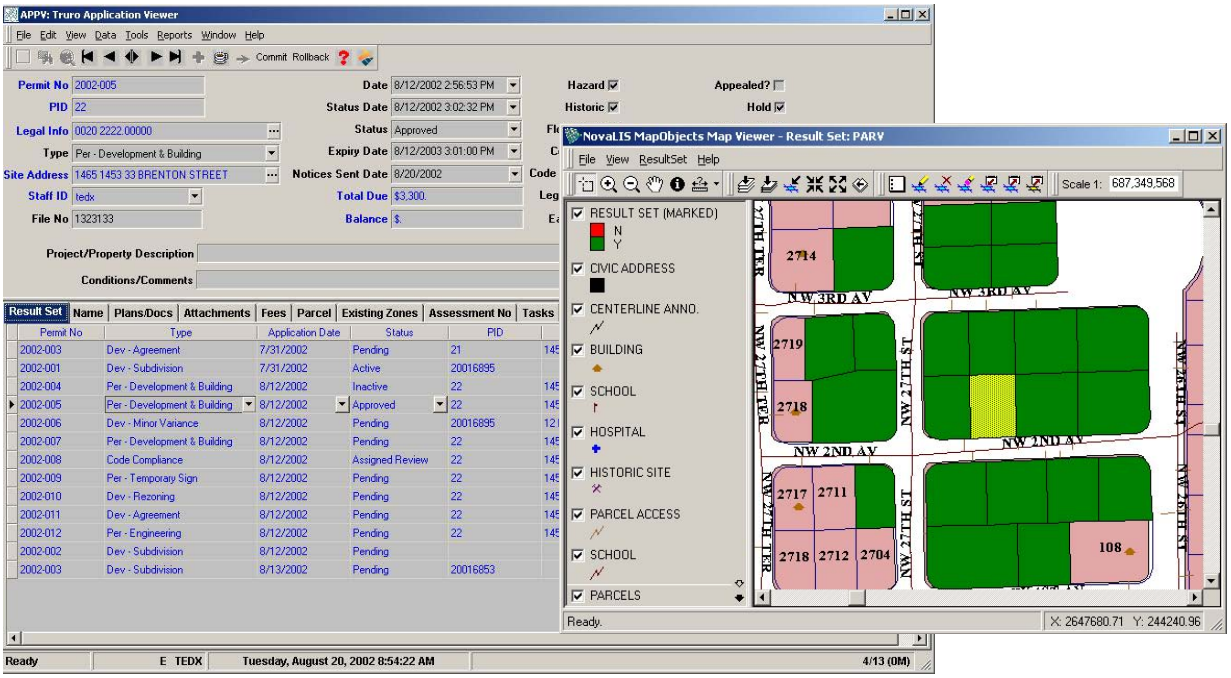


Functional integration goes well beyond capabilities for integrating just two systems. A permitting product whose architecture provides for functional integration can also be integrated with other technologies. Those technologies might include a sketch program, statistical package, word processing system, spreadsheet product, document management system, CAMA, addressing or any other technology that would enhance the user's work experience. Of course, these other technologies must also be capable of functional integration.

A good example of this integration is between something like SPSS and CAMA. Records selected in CAMA for comparable sales can be utilized in SPSS for running a regression model to assign a new market value for the selected properties based on sales information. Much the same as in the descriptions of GIS and CAMA integration the capability for SPSS to initiate CAMA functions and the ability for CAMA to initiate SPSS functions is required. These products must also, remember, be able to support at least data sharing as well.

Another example would be the integration of permitting and Microsoft Word. Records could be selected in the permitting based on some criteria for permit type information and merged with a document. Pieces of another related database might include names, addresses and previously submitted information. Each letter would be printed with personalized information without having to re-key any of the information. This functional integration might produce 50 letters with about five mouse clicks.

Below is an example of integrating the buffer process within a zoning case application for notification using Microsoft Word:



Discerning a vendor’s ability to meet the requirements of functional integration requires a little knowledge into the Information Technology (IT) realm.

- What component of the architecture of your system allows functions to be accessed from an outside program?

The answer could be the source code, meaning the vendor will be the only source of integration. The answer could be through an API, COM, SOAP, database triggers or CORBA, which might allow a user organization to perform some of the integration. The answer might be that no component of the architecture provides functional access to outside programs, meaning that the vendor cannot support functional integration.

- Which functions in your system might be accessed by an outside program using your architecture?

It is critical that the vendor be questioned on the types of functions in the system that are exposed to the outside programs. Vendors that have accomplished some level of functional integration at the source code level are going to potentially require significant levels of effort to add other functions.

The functional level of integration provides for making a single system from 2 completely distinct technologies. Functional integration provides for the ability for a user to perform business processes without having to retype data or transfer information from one format to another. Functional integration provides the opportunity for users to experience all of the technologies required to perform their jobs in a seemingly single system.

Functional integration makes the disparate technologies much easier to use. In fact, many users who do not have access to a system that provides this level of integration will simply choose not to use any technology outside of that departments system. It simply becomes too hard to make use of the GIS when they are not integrated at a functional level. Without functional integration the user who wants to actually do some analysis work in the GIS must often spend tremendous amounts of time and effort making the connection between the systems through manual means.

The most common reasons for many vendors not supporting functional integration stem from either:

1) An architecture that makes it impossible.
2) Not understanding or having expertise in the other technology, making it impossible to perform the integration.
3) Not understanding or focusing on the benefits of integration.

Choosing vendors that supports functional integration provides an environment to create a more productive, easier to use system.

Level 6: Workflow

The next two levels of integration begin to study the entire business process from start to finish and provide new methods for making those processes more efficient. Information technology is touted inside an organization to save time and money. It is amazing, however, how many times systems fall short of reaching their full potential for savings. In many cases, integration is the missing component to reaching these goals.

Workflow integration provides an opportunity to automate the typical paper based workflow systems that move tasks from one individual within an organization to another.

Workflow: Automation of the transitioning of work tasks from one individual to another that provides for the tracking and measurement of task performance.

If you were to study most organizations, you would find that the movement of work that represents the many steps of a single business process is typically perpetuated by a paper system. Most business processes require permission, approval, review, assignment, collection of tasks, input of data and so forth. These activities are usually carried out by a group of people within the organization.

One of the biggest challenges in recognizing the need for workflow integration is getting people to look at the big picture. The big picture is considering the automation of the entire business process and not just automating one or more steps along the way.

For instance, take the business process of processing an appeal. A typical workflow in an organization would have a citizen communicate to a clerk at the counter the desire to appeal her property value. The clerk would collect some information on a piece of paper and give it to the appeal supervisor. The appeal supervisor would apply some known rules and ascertain that a site visit is called for. She would assign the site visit to one of the appraiser's. He would go into the field and collect some pertinent data. He would schedule a hearing with the Board of Equalization. The Board would hear the case and recommend changing the value. The appraiser would be notified of the new value and update the system. The appraiser would notify the Tax Collector to reissue the tax bill.

Most people in the organization do not think about the entire process. Their job is only one piece of that process and that is where they stay focused.

What is interesting about the process described above is that there were probably six or seven forms that were filled out to move the appeal along in the process. The clerk filled out a form to give to the supervisor so she would know she had a task to perform. The supervisor probably filled out a form so the appraiser knew he had a task to perform. He probably filled out a form to schedule the hearing. There was probably another form reminding him to show up at the hearing. There was another form that initiated the task of changing the value. And yet another form to notify the Tax Collector on her task.

These forms may have been handled impeccably, efficiently and without fail. However, there is usually no way to monitor where something is in the process. How do you know where the appeal is in the process once the appeal has been requested? What happens if the appraiser loses the piece of paper requiring him to do a site visit? What if you wanted to have all appeals scheduled within four days of receipt? How would you measure the efficiency of this process? How could you measure the balance of workload? Having a paper workflow system does not provide many tools for managing and monitoring an entire business process.

Workflow integration automates the business process. Workflow integration allows the business process to be modeled in an electronic environment. The modeling of the business process involves not only the steps required to perform the business process but should also model some or all of the logic used in moving through the process. The logic to move through the process usually is defined by business rules. Workflow integration combines the task lists with the business rules to initiate the appropriate steps to be performed by the appropriate people in an automated fashion.

Workflow integration eliminates the need for the user to check her in-basket for a piece of paper that initiates a job function. Using workflow integration, the user would find her tasks in a task list generated and maintained on the system. The user might log on at any time and request a new task list. The workflow integration could initiate an email for immediate notification of the assignment of a task.

Once workflow integration is in place, most job functions are subsequently tagged with begin and end time stamps. These time stamps can then be used to measure performance, monitor completion or establish the current step being processed in the whole business process. The time stamps help improve customer service through performance measurement and knowledge of where in the business process a request might be.

Implementing workflow requires organizations to study their business processes. The studies performed and knowledge gained during workflow integration provides the organization with opportunity to evaluate and potentially improve business processes while being automated.

There are numerous business processes that operate between other systems and GIS technology. Tasks such as handling a new building permit, assigning addresses, processing complaints, notifying people within a certain distance of a rezoning case, establishing splits, merges or subdivisions in CAMA or GIS, processing sales information, scheduling field work, assigning revaluation tasks, processing income data from commercial properties and so on. The biggest challenge to the organization is to begin thinking of these processes in their entirety and not simply focusing on the individual task that a person in a specific department is responsible for.

The following questions will help discern the vendor's ability to provide workflow integration.

- How does your system support workflow?
- Can you establish business rules that direct the flow of tasks?
- What different methods do you have for initiating a task?
- What tools are present for measuring the efficiency of a business process?
- What tools are present for establishing the status of a request in the entire business process?
- How are the business rules stored?
- How do the users create and maintain the process?

Workflow integration is a significant step for an organization. It initiates the study, subsequent automation and eventual improvement of business processes within an organization. This level of integration begins to provide the payback typically sought through technology.

Level 7: Inter-departmental

Inter-departmental integration builds on the concepts of workflow to extend beyond the walls of a single department. Inter-departmental integration begins to look at business processes throughout the entire organization. Many business processes involve multiple departments or groups within an organization. This level of integration transcends these boundaries.

Inter-departmental integration also requires some other levels of integration to be present. In crossing departmental boundaries, integration between departmental systems also becomes a requirement. Inter-departmental integration helps break down the barriers that exist between departments because of turf battles or technology silos.

Inter-departmental: Building connections between the people and technologies across departmental boundaries in an organization.

Many departments struggle to understand their own internal processes. The first challenge with inter-departmental integration is that people must now consider business processes that cross department boundaries. The subsequent challenge is applying other levels of integration between the technologies in place in the various departments.

Take processing building permits as an example. Studying the entire inter-departmental process for building permits will highlight the successes that can be achieved through this level of integration. There is an entire business process typically found outside of the departments that may need the resulting information. Without even going into modeling that entire business process through workflow, the result of that process is the issuance of a building permit. Assessment organizations handle permits differently. Inspections departments need that information. Public safety groups may need the information. Code enforcement groups may need the information. Public works may need the information. The beauty inter-departmental integration is that the business rules governing the process and the connection between permitting and these other parts of the organization are established.

For instance, an assessment jurisdiction may perform several tasks during the construction phase that is monitored by the permitting business process. There may be the initial entering of data, a percent complete appraisal performed and a final appraisal upon the issuance of the Certificate of Occupancy (CO). This business process is intertwined with the building permit process. This is a perfect opportunity for inter-departmental integration.

Workflow tools are used to initiate tasks between the departments. Business rules model when the appraisers are notified in the permitting process of their own tasks. An initiation task can be created upon issuance of the permit. A site inspection task might be issued upon the electrical inspection or any other point in the permitting process. A final appraisal might be initiated as a result of the CO being issued. A percent completion task might be generated nearing the end of the roll year.

The workflow tasks are only part of the inter-departmental integration. The data about the permit must be somehow attached and accessible to the other system user. This is accomplished by establishing one of the other levels of integration between the other system and permitting systems. The higher the level of integration that exists between these systems the better. In effect, the integration of permitting and CAMA can be studied like the integration of GIS and CAMA.

There are many opportunities for inter-departmental integration. Tasks such as processing deeds or plat maps, zoning changes, utility improvements, road construction, annexation, school construction or redistricting are all samples of tasks that involve multiple departments.

Figuring out the extent to which a vendor supports inter-departmental integration involves asking some important questions.

- How does your system support the initiation of tasks across departmental boundaries?
- What events can be utilized to provide for the initiation of these tasks?
- What other departmental systems is your system or GIS already integrated with?
- What level of integration is achieved between those systems?
- Who owns the business process that crosses departmental boundaries?

Inter-departmental integration studies the reality that in an organization, many business processes cross-departmental boundaries. To allow technology to provide maximum benefit to the organization, inter-departmental integration is a necessity. Without inter-departmental integration, an organization cannot truly streamline or automate an entire business process.

Conclusion

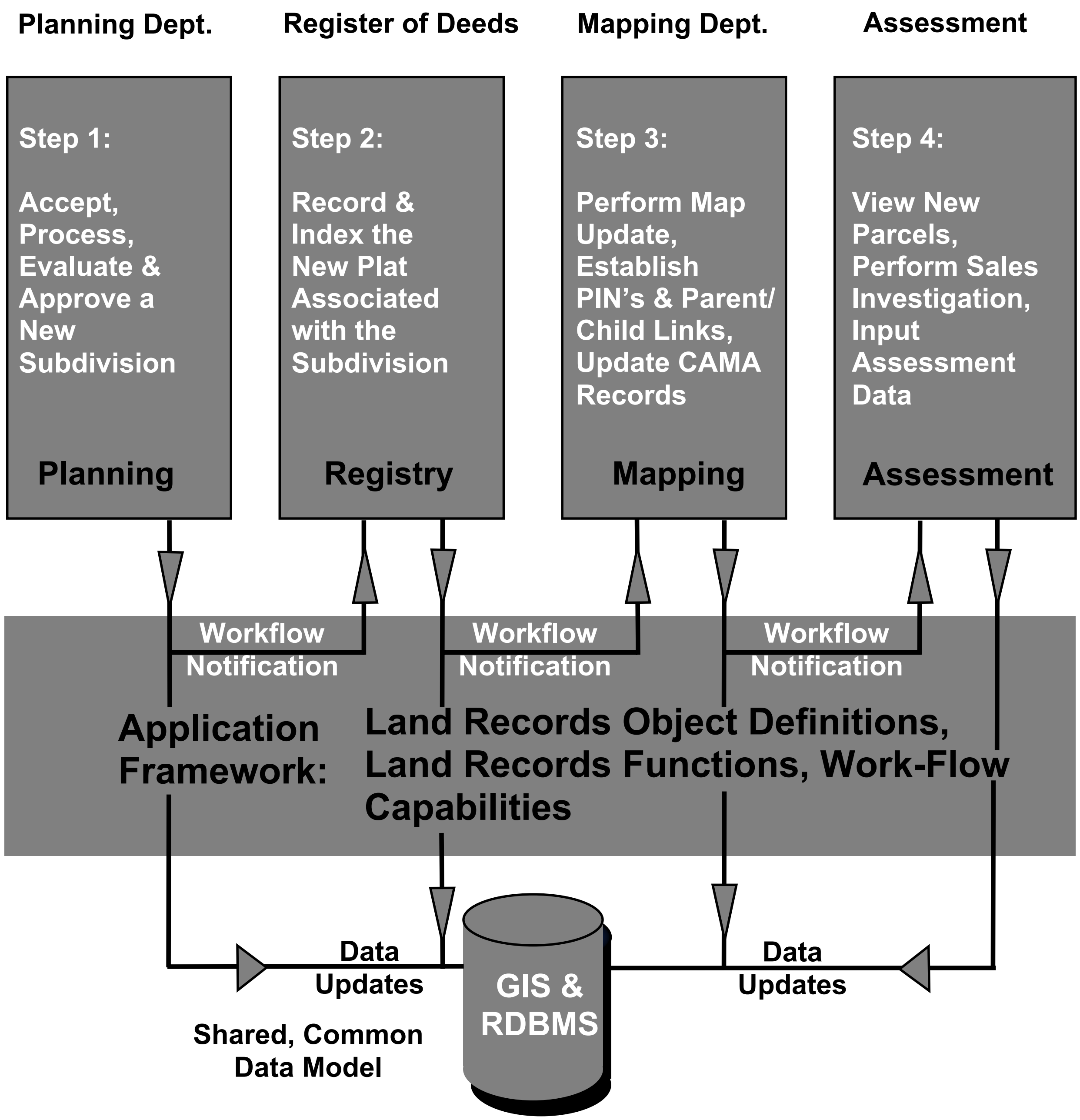
Integration is the answer to maximizing the use of information technology within an organization. Without any levels of integration, most systems become an individual piece of technology that might not have any affect on the overall business processes in an organization. If the goal of an organization is to utilize IT investment to improve corporate efficiencies, then integration is a must.

If the integration is not supplied by the vendor, then the ability to customize the system involving data model changes and functional access is necessary to allow someone else to create the integration. If the chosen systems cannot be modified or customized then integration becomes impossible.

Seeking to understand the varying levels, limitations, consequences or benefits of integration between systems is a critical need not only during implementation, but even in the selection of technologies for the organization. Integration is only made possible through the efforts of vendors to create technology that allows for integration.

There are many products on the market. Users, IT professionals, Managers and Elected Officials should begin to understand the importance of integration in maximizing IT investments. Having definitions and criteria for establishing integration should be beneficial during technology selection.

The following is an example integrated, land records, workflow scenario:



Information in this fully integrated land records environment is entered only once and shared among all the departments. This produces a streamlined business process that saves hundreds of man-hours each month. Achieving this level of integration takes planning, work and a thorough understanding of the levels of integration that are possible in the IT environment.

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