CRITICAL SUCCESS FACTORS (CSF'S) FOR SUSTAINABILITY OF GEOGRAPHICAL INFORMATION SYSTEMS (GIS) IN GOVERNMENT INSTITUTIONS OF DEVELOPING COUNTRIES.

Introduction

Despite the immense **potential** of Geographical Information Systems (GIS) for executive level decision making, planning and many other diverse applications, these systems are largely **underutilised**. This paper outlines some of the reasons for this and identifies four **critical** success factors (**CSF's**) for implementing a GIS in a government institution of a developing country. A short section on management issues pertaining to open source technology is also contained within this paper.

It is the author's belief that **not enough time** is spent by GIS practitioners debating the "bigger picture" or management issues related to GIS and this is a major factor impeding the success of GIS at all levels. These management issues are critical both for **open** source and proprietary GIS implementations.

CSF 1 – Understanding the Business

One of the **most** important issues in implementing an information system, such as a GIS, is to acquire an understanding of the **core business** that the system will support. A successful IT/GIS implementation is essentially the coming together of **technology** and **business** processes. Systems that effectively **support** user requirements linked to critical business processes have a much better chance of **survival**.

Having worked in the local, provincial and national government information management environment for a number of years now, it is the author's view that the best information systems in the market are, for example, those that have been **developed** by engineers for engineers. The simple reason for this is that engineers would understand the business better than IT specialists in this case. In the context of government, many of these systems are typically information systems which have GIS functionality.

The debate as to whether **GIS** is a **system** or **part** of a **system** is not the focus of this paper but is worth thinking about in the context of the success or otherwise of a GIS implementation. It could be that many GIS systems **fail** because they attempt to be a **the** system and not part of the system. A fundamental misunderstanding of the core business into which they are implemented is probably the main reason for this.

The challenge for GIS practitioners however is that they are often required by users to develop diverse applications using GIS in a number of different business areas or sectors in government without necessarily being "business" specialists in any of these areas. The capacity challenge in government institutions further compounds this problem as many end users cannot articulate their core business to these service providers due to high staff turnover etc.

A strong understanding of the core business and in the context of government, the legislated mandate of a department, is therefore fundamental to the success or otherwise of a GIS implementation.

CSF 2 - Information Systems Best Practice

Information system (IS) best practice is considered to be a critical success factor for the simple reason that many GIS practitioners have entered the "**world**" of **GIS** from a non IT background. The author became involved in GIS from a civil engineering background for example. Information systems principles and best practice were therefore completely new areas of knowledge that had to be learned the "hard way".

The chances of successfully implementing an information system if one is not aware of the best practice principles is very small, as is confirmed by the following research:

26 % of all IT projects succeed

The Standish Group[1], a leading IT research group, conducted a study into 300 000 information systems projects. The research, released during 2001, showed that only 26% of these projects succeeded. Success was defined as "projects completed within time and budget and in accordance to their original specifications".

The top four reasons for IT project failure were:

- Insufficient user involvement,
- Lack of executive management support,
- No clear business objectives,
- No experienced project manager.

A similar study, undertaken by the same group in 1994, reported that only 16% of projects succeeded. In this earlier survey, participants had cited the following top three causes of project failure:

- lack of user input,
- incomplete requirements and specifications, and
- changing requirements and specifications.

IS best practice is essentially avoiding all of the major pitfalls listed above. Although IS best practice is a very broad topic, the specific sub areas of system specifications and project management have been selected and are elaborated on as critical success factor (CSF) 2 within this section CSF 3 in the next section.

Measure it to Manage it?

[1] http://www.standishgroup.com

We all know the adage, "If you cannot measure it, you cannot manage it". The question of GIS project management, addressed as CSF 3 really therefore begins with the question "How do we measure or specify an GIS project?".

Although many Government initiated GIS projects run into millions of rands, a large percentage are implemented with largely sub standard system specifications. IT industry best practice calls for a System Requirements Specification (SRS) as the non-negotiable point of departure for any IT/GIS project. A typical SRS will define the project in terms of the following broad categories:

GIS Project Requirement Category	**Typical Questions asked per Category**
Data	What data will the system require initially? What data will be required on an ongoing basis (maintenance)? What database management system should be used?
Hardware	What hardware (server/desktop) will be required to implement the system? How much will this hardware cost? Where will the hardware reside (is an air-conditioned secure server room required)?
Software	Which software technologies are available to meet the requirements? Should open source or proprietary software be used for different parts of the systems architecture? What is the corporate IT policy regarding systems and standards (GIS for example)?
Integration	What other internal/external IT systems will the system have to integrate with? How will data sharing between systems be handled (xml/ftp etc)?
People	Where are the users of the proposed system located? How will users access the system (intranet/internet/LAN/WAN)? What and how much training will users require?
Processes	Define the business processes that the system will support (a system that does not support the business will not be used) What information is generated/required by each business process? Which parts of the business process should the software support?

The SRS usually forms the basis for a "request for quotations" or tender document, a critical part of any formal procurement process. One is more likely to obtain an accurate cost estimate from the private sector because the system has now been described in sufficient detail. In some instances one could expect lower quotations as risk to both parties is minimized – usually where specifications are vague, private sector elevate their prices to price risk into their quotations.

CSF 3 – Project Management

Once a comprehensive SRS has been generated, specific quantifiable tasks can be drawn out of this document. These tasks can then each be allocated time frames and deadlines; which is essentially the basis of project management and it's associated project implementation plan.

For example, once the "people" section of the SRS has been completed, one will know how many people require how many sessions of training on which modules of the software. The "training task" having been properly defined/specified can now be given a realistic duration and deadline.

The "Integration" section may define how many other IT systems the planned system must integrate with. These other external systems will then become a task or line item on the project plan. Specific deadlines will be allocated to these tasks and they therefore now become "manageable".

In terms of project managing the service provider that implements the system, payment can be structured and based on key deliverables as defined within the SRS. This gives government institutions more control over IT/GIS projects.

CSF 4 – The Soft Side of the Software

The institutional, organisational and social components of a GIS are undoubtedly the most critical, complex and least controllable potential success factors in any GIS implementation. One must acknowledge that social factors are more critical to the success of a GIS initiative than technical factors are.

GIS is a technology which crosses functional boundaries not only within (intra) but also between (inter) organisations. It is important that this inter-organisational nature of GIS is understood. It is widely agreed that the benefits of GIS come from both intra- and inter-organisational sharing of spatially referenced data. Success therefore now depends on alliances not only within but also between organisations.

This single "attribute" of GIS is what makes it so complex and unique. It is enough of a challenge to implement a system in one organisation, but when the success of your implementation depends on internal factors within the organisation AND external factors outside the organisation, complexity escalates .

When it comes to the institutional embedding of software into an organisation, mentoring is far more effective than training is. In most government institutions, users typically use a fraction of the powerful functionality of any given GIS (20%?). Training usually implies exposure to as much of the software a group of users have time for on any given day. This usually results in users learning about large parts of the software that they will never use. One might call this method of "information impartation" a traditional top down method of training.

Mentoring on the other hand involves more of a one on one approach where the system implementer sits with each user in an attempt to understand their specific need for the software provided. The user now obtains focused training in only that part of the system that they need to use to undertake their core function.

T**raining** is useful to the extent that it gives users the bigger picture but **mentoring** is far more important when it comes to coercing the user to actually use the system. The mentoring approach is strongly recommended in the context of government information systems implementations in South Africa.

The Open Source Debate

Although this paper is essentially a discussion on management issues that affect GIS implementations, the paper will be presented at an open source GIS conference. A few comments on open source GIS are therefore made in the paragraphs that follow.

When considering the option of open source GIS in South Africa, a number of factors must be considered. Advantages of using open source software can include:

- the potential to create a local software industry,
- a reduced reliance on external software giants (monopoly),
- a reduced cost of ownership,
- user based software provided user base is large enough,
- the potential for collaborative parallel development involving source code sharing which has the potential to increase efficiency and reduce development time,
- reduced software bugs due to the fact that many users are also developers and can find and fix bugs.

Disadvantages of using open source software can include:

- potentially compromised security due to fact that the source code is public,
- the lack of formal support,
- the lack of a clear development path,
- software is provided without any guarantees,
- a lack of documentation in some instances,
- a difficulty to integrate with proprietary software.

Any decision on a specific set of GIS software components for a given implementation, open source or proprietary, must be made by weighing up the pro's and cons of each technology based on some sort of rational criteria, such as the framework suggested above.

Conclusion

A thorough understanding of the business into which a system is to be implemented must be the point of departure for any GIS implementation. The GIS should be thoroughly designed and the system requirements accurately captured within a System Requirements Specification. This specification in turn will provide the baseline upon which the tried and tested principles of project management can be applied. Finally, a professional team with people skills and a bottom up approach to training should be involved in the implementation.

The sustainability and success of GIS in South Africa depends on a better understanding of the management issues described within this paper. As GIS practitioners, we do not spend enough time coming to terms with the "bigger picture" issues, a better understanding of which will greatly increase the probability of any given GIS initiative being a success.

Peter Reinecke is a registered professional civil engineer who graduated from UCT in 1997 and recently completed a part-time honours degree in Information Systems at the University of Rhodes/Fort Hare. He is a project manager with SA Solutions, an information management and GIS company, and is responsible for a number of GIS and Information Systems projects in the Eastern Cape and throughout the country. Peter can be contacted on 082-375-4191 or peter.r@sa-solutions.co.za.