Reducing IT Cost by Properly Identify Business Needs

WHITE PAPER

SEPTEMBER 2003

cognitive
Usefulness & Usability

www.cognitivegroup.com

Francois Aubin
President and CEO,
Cognitive Group

July, 2003

Introduction

Organizations invest hundreds of billions of dollars annually in information technology (IT) replacing, upgrading, and automating and/or integrating systems. Many IT projects are inevitably delayed, exceed budget or simply fail to deliver the expected benefit. These implementation problems account for a major portion of IT costs. These implementation problems are caused either by bugs (code defects) or more commonly, gaps between the user's needs and the system/technology. Whereas bugs can be identified and are likely to be resolved, identifying the cause of a gap between user's needs and systems is difficult and can be costly to resolve.

Traditional Approaches

IT projects originate with specification (need) documents. In more formal cases, these can be prepared by a prospective client and outlined in a Request for Information (RFI), Request for Proposal (RFP) or other solicitation. Specifications can also be developed by a business unit in an organization and handed to internal IT teams for implementation. In other cases, organizations and companies develop specifications working with external consultants for vendor selection or directly with a solution provider.

These specifications ultimately form the basis for a tender response, proposal or contract to develop and implement a system/solution.

Most organizations use the following process to produce specifications:

1) Users or representatives describe their needs to analysts through meetings, focus groups, interviews or surveys;
2) Analysts write specifications or document users' needs;
3) Users or representatives are then asked to approve the specification, and;
4) Analysts and developers scope, plan and develop the IT solution.

Gathering user's needs and preparing specification documents with this approach results in a gap between user's needs and the specification because:

1) There is no guarantee users can express their needs effectively:

    a. Often subtle operations are difficult to recall and express verbally because they are natural or second nature to experienced employees.

    b. Most tasks and operations are organized temporally and spatially. There is a natural alteration between right and left hemispheres of the brain that makes it very difficult for humans to verbally describe visuo-spatial operations. If five people witnessed a car crash and are were then asked to describe the event, it is not surprising that we would get five different stories. Similarly, if we ask five employees to describe their needs, process and problems, we expect the information will vary from one employee to another.

c. Human memory is organized by experience. It is much harder for someone to recall experiences out of the context. This means a person's ability to recall information during an interview is very difficult.

2) There is no guarantee analysts transcribe needs correctly. Results are variable from one analyst to another. Analysts are subject to human attention limitations and bias. Even when carefully selected, they have their own perception of the tasks. There is also no guarantee they represent the user community.

3) There is no guarantee users are able to understand requirement documentation or specifications, even when presented clearly and concisely in so-called "plain English." This becomes worse when documents are organized with a technical perspective and abstract terminology.

This process of gathering needs and preparing specification result in a system that is not aligned with the business process and require modifications.

Consequence

A system that is not aligned with the business process and users' needs makes implementation much more difficult and IT more costly because:

It either requires users to adapt or change methods, or most likely results in change requests that could bring delays of implementation. In a worst-case scenario, it could result in total cancellation of the project.

Since cancellation is often a career limiting solution, the executive/manager in charge of the project is left with two options:

1. Delay implementation in order to integrate some change requests;
2. Force users to adapt to the new system.

Delayed Implementation

Often, the client ends up paying for the changes because the client has already approved specifications. With the current process, adjustment and changes seems never-ending. With each iteration, the same needs gathering process is used, resulting in missing pieces of information.

Forcing Users to Adapt to the New System

Forcing users to adapt to a system not aligned with their business process increases operational costs. It increases the time to perform unfamiliar tasks and increases the rate of errors.

Often the management expects that with time or training users will modify their methods and will see the "benefit" of switching to the new system.

This in turn may annoy users, creating a climate of distrust between management and employees, which may ultimately lead to good employees leaving the organization.

Complaining or refusing to adapt or use the new system is viewed by management as bad behavior. Employees who remain silent and begrudgingly use the new system are considered to be good. In fact the opposite is true and those who remain silent are the ones exhibiting poor behavior.

When a system is not aligned with the business process will render typical comments from system users where there is a disconnect with their needs, such as:

"I was able to do it in five seconds before and now I need to go through all those screens"

"They did not consult with us"

"If I am forced to use it, I will not be responsible for mistakes."

Fact: Specifications prepared with these approaches produce systems that do not match user goals and expectations and lead to implementation problems.

Industrial Engineering - Cognitive Approach: The Right Method to Properly Identify Business Needs

Industrial engineering - Cognitive approach is an integration of engineering and cognitive ergonomics.

"Ergonomics" mean the study of humans at work. It stems from the Greek words "ergon" (work) and "nomos" (science of). Cognitive ergonomics methodology (Cognitive Approach) focuses on the study of mental work. This science emerged after the Second World War following analysis of human errors.

Cognitive approach provides a way to understand the thinking process, which in turn provides an understanding of information needs, business rules and concepts. Cognitive approach ensures the design of information solutions that minimize the time to accomplish tasks and prevent human errors. The industrial engineering- cognitive approach views people as the center of the system. It comprises rigorous field observation, cognitive task analysis, ergonomic design and field usability experimentation.

Field Observation

Observation is performed in the field and users are asked to think aloud while they are performing, or describe or show what they did after the fact. Observation sessions are videotaped and transcribed for further analysis. This ensures we gather non-verbal information such as subtle visual and manual tasks. Each user has his or her method, efficient strategies and problems. Typically five to eight users provide a good sample to observe user variability. The raw material is transcribed verbatim from the tapes that comprise cognitive tasks, identify problems, efficient strategies and mental models. Artifacts such as screens capture, samples of reports, documents and/or pictures are also collected during the field observation.

Task and User Analysis

Human work is naturally organized as a hierarchy of goals, sub-goals and methods. Among different methods to model tasks, the most common and natural approach is called Hierarchical Task Analysis (HTA). Cognitive goals, sub goals and methods are described hierarchically. Methods are extracted with *how* questions and goals are extracted with *why* questions. All aspects of cognitive tasks are reviewed: Perception, user attention, diagnosis, selection of action. This facilitates the description and understanding of very complex cognitive processes such and risk analysis, medical diagnosis, process control and complex organization. In addition, for processes involving multiple departments, flow chart diagrams are used. User analysis enables identification of cognitive style, training, knowledge, skill, habit and context of use.

Ergonomic and system design

The task models are mapped into an interactive mockup up integrating general constraints, human factor principles and guidelines. Both the task models and the interactive mockup can be the result of a variety of methodologies such as Use Case Methodology (a popular software engineering methodology). Ergonomic design must ensure that the design:

1. Fits the task and user profile;
2. Respects ergonomic design principles

    1. Design depends on the task, user profile and the context of use. The importance of ergonomics criteria is a function of the context of use and the user profile. The table below shows some context of use examples and the associated criteria:

Example of Context of Use	Ergonomics Criteria
Occasional and non-mandatory usage	Short Time to learn
Frequent usage	High Speed
Critical task	Low Error rate

    2. Integration of ergonomic design principles and guidelines ensure:

        - Information organization is compatible with the cognitive task;
        - Information organization minimizes user attention, work load and memory;
        - Errors are prevented, or properly detected, corrected, recovered from and systems provide easily understandable warnings to users;
        - The user is in control;
        - Terminology is clear and text comprehensible;
        - Text is legible and visual objects are clear;
        - Consistency is maintained throughout the design and other context.

Field Usability Testing

Interactive mockups are developed with graphical design tools and presentation software to create a simulation of the future system. Scenarios of use are prepared. The design is iterative and field testing is conducted with each iteration. The first iterations focus on information mapping and task compatibility. The last iteration focus on detail design aspects such as terminology, consistency and visual appearance.

To ensure the best feedback, users are asked to perform a set of representative tasks with the interactive mockup in their work environment. By testing the mockup in the field, they can relate to external factors and context which more effectively elicit their response and recollections. Often the field test might elicit some real life examples that are not covered facilitating an ability to visually validate the task models. This avoids asking them for subjective opinions in a meeting room setting.

With each iteration, the mockup is modified to integrate user comments and problems. Six to 10 users provide a precision of 85%-95% precision. Two to three iterations are usually required.

Once the mockup is tested and modified, everything is in place to prepare effective and accurate specifications for the future system. This includes goals of the system, user profiles, tasks, user interface, business rules, benefits (problems we solve), information and data architecture.

Result with Cognitive approach

We have applied and practiced cognitive ergonomics engineering for 15 years through hundreds of projects. Here are some significant results achieved through the cognitive approach:

Industry	Situation	Process	Result
Process Control	A $1.13 billion automation and substation construction project at **Hydro Quebec**'s 1,600 MW Beauharnois Power Plant was designed using traditional IT approaches. Based on all standard study and design practices, this meant using computer screens to replace a 60-foot control panel that was the primary interface between operators and one of the world's most complex arrays of high-voltage generating equipment. The project stalled halfway through the changeover when operators raised safety concerns over losing visibility of critical information with the new system. Unable to resolve the implementation problems, Hydro Quebec called in the Cognitive Group to determine what could be done to resume the project.	A comprehensive cognitive ergonomics and task analysis was performed at the operator level. This resulted in recommending and designing a new control panel that integrated with the complete automation project and met all the visibility, safety and decision-making needs of the operators. This process involved videotaping the operators at work, asking them to think aloud as they went about their daily tasks, explaining what they were doing and how they accomplished things.	The complex project is back on track and well on its way to completion. "The design has already proved itself … I've never seen such a good response like we have had to it," said Andre Gascon, the Hydro Quebec official in charge of the project. "In fact, after a year of use, I went to the power station to interview operators to find out what could be improved in the second half and … they didn't want to change a thing."
Online Banking	One of the 10 largest banks in North America was looking for a way to ease the process for existing customers to open secondary bank accounts. The problem faced was in how to ensure that selection process was accurate for customers who would be opening these accounts online without the in-branch assistance of staff.	We reviewed the bank's requirements and conducted a cognitive analysis with account managers to analyze the decision process they employ. We developed an algorithm that could be used for online queries. Then, we worked to develop a series of online prompts that would guide customers in the shortest, easiest route to complete the task.	"Four or five clicks of the mouse and it's done. End of story," said the bank's project manager. Customers now open more than 2,000 secondary accounts online each month with immediate access. The process saves customers inconvenience, time and travel costs to go to their branch. The bank saves more than $1.5 million a year through the online process and enhances customer loyalty.
Data mining, Business Intelligence and Customer Relationship Management	A top 10 North American bank implemented a $3 million business intelligence (BI) "e-metrics" portal to give 1,500 executives and managers a way to keep track of the banks rapidly growing online banking and e-commerce offerings. Instead of clarity	We conducted a strategic review of the implementation. We conducted a comprehensive cognitive ergonomics and task analysis with managers and executives. Based on this	"After the Cognitive Group came in, the majority of our feedback was full of compliments," said the project manager**.**

	and visibility, reaction from users went from "This doesn't seem intuitive to me," to "I can't seem to get through it, I don't know the answers – can't you just tell me what the answer is?"	research, We redesigned the e-metrics portal interface to support the goals and tasks. We developed new query algorithms to run behind the interface layer so that with one or two clicks, users could quickly get to the information they needed.	The BI implementation turned from failure to success with complete adoption by target users.
Call Centers	For a large utility company having over 3 million customers and 6 million call yearly. A new $25 million call center implementation was stalled. Users had approved specifications but were not able to accept the system as delivered. The initial system design contained 400 on-screen pages. The logic was based on an event metaphor that was fairly different from the user perspective.	We conducted cognitive task analysis of the call center agents. After one week, we had a model that provided a framework for 90% of the occurrences. We then proposed a redesign and tested the new user interface with a mockup.	The redesigned system requires only two screens for the task of understanding 90% of the calls and seven transaction screens. Users were happy and the system has been approved and rolled out successfully.

Managing cognitive approach projects

We have successfully applied our cognitive ergonomics methodology and science in hundreds of projects for our clients. We have had a unique opportunity to apply cognitive ergonomics in various industrial sectors and we have been able to draw some valuable lessons that guide us in managing ergonomics projects.

- First and foremost people are placed before machines. Problems are analyzed in terms of process, attention and memory overload, instead of blaming poor design and bad user behavior. This in turn helps us in design effective solutions and spark creativity.

- The goals must be clearly stated and referenced on a daily basis. The focus is on reducing time, errors and the learning curve, instead of focusing on delivering a function or a feature. Most developers are used to a traditional development approach where delivering a maximum number of functions or a robust feature set is the priority. They must be constantly reminded that results such as saving time or reducing errors are more important than adding new features.

- User-centered design is managed through iterations. The first iterations are performed with only the user needs and goals as constraints. Other constraints such as legal, technical, and corporate are integrated in later iterations without altering the results achieved in the first iterations

- Analysts' models are a limited approximation of the real world that will be verified and modified in the course of the experimentation. The real world is always more complex than one can understand.

- Design is a process that can be managed and planned through rigorous observation, analysis, design and experimentation. Projects can be managed with traditional project management techniques where tasks are planned over time and followed on a periodic basis.

- The multidisciplinary team is centered on industrial engineer. One industrial engineer is the performance of daily tasks and the other is having a principal to oversee the tasks in order to have a detached perspective on the project. Users are involved in one-on-one sessions.

- Analysts, specialists and managers are also seen in one-on-one sessions. Once there is enough material and a hypothesis can be formulated, group meetings are conducted where ideas are exchanges.

Conclusion

- Traditional approaches to system design leads to gaps between specifications and real user's needs. This lead to systems, which are difficult and costly to implement.

- Cognitive approach is more effective than the traditional approaches in designing information technology solutions because it enables gathering user's needs accurately and effectively.

- Cognitive approach is effective because it permits analysis of the thinking process and the capture of non-verbal information with techniques such as field observation, thinking aloud and post-event recollections within the work or process environment.

- Traditional approaches are not effective because gathering needs through meetings, interviews, focus groups and surveys does not permit the gathering of non-verbal information and subtle visual or manual actions.

- Cognitive approach has been validated through hundreds of projects and the cognitive approach has been proven in companies ranging from start-up to Fortune 500, across a variety of industry sectors.

- Cognitive approach has been particularly effective in rescuing difficult implementations from the brink of failure.

- Benefits of cognitive approach are visible at the user interface level. They are extended to the whole system architecture including data models, technology selection and application structure thus reducing risk and cost.

About the Author

Francois Aubin is a cognitive ergonomics and usability practitioner. Over the last 15 years, he has designed more than 100 systems, performed over 2,500 cognitive task analyses in the field and conducted more than 2,500 usability-testing sessions.

After completing a B.Sc in Physics, Mr. Aubin became interested in interactive systems through contracts with multimedia artists. He completed a Master's Degree in Cognitive Ergonomics at Ecole Polytechnique de Montreal. While pursuing his master's degree, he researched human errors, 3-D display, and usability principles and guidelines.

Mr. Aubin spent three years as a practitioner at the Centre de recherche informatique de Montreal (CRIM), a non-profit organization founded in 1985 to strengthen ties between universities and firms of every size active in the information technology industry.

In 1994, Mr. Aubin formed the Cognitive Group and is the firm's president and chief executive officer.

Mr. Aubin recently completed the development of complete end-to-end solutions for credit adjudication and compliance monitoring for commercial lending. He has published numerous papers on 3-D display technology, wearable computers, input devices, and task analysis.

He frequently gives workshops on usability, web design and task analysis and teaches at University of Quebec and the Ecole Polytechnique de Montreal.

About the Cognitive Group

The Cognitive Group Inc. provides world-class consulting services specializing in the application of cognitive approach to system design.

Cognitive's experts analyze how people handle complex situations and processes, then design or redesign the process or system so that the interaction becomes second nature or instinctive. This "people first" approach which looks at how people think and designing systems accordingly, eliminates costly errors, delays and failures, with systems or processes that work right the first time.

The Cognitive Group has successfully employed this process with major North American companies in a variety of sectors. Clients include Tier One companies in power generation, telecommunications, finance (banking and investment), and call centers. In each case, the Cognitive Group has delivered enterprise-wide maximum efficiency software or business process solutions in record time.

The Cognitive Group is a privately held company headquartered in Montreal, Canada.

To find out more about how the Cognitive Group can help you:

Cognitive Group Inc.
1155 Rene Levesque W., Suite 2500
Montreal, Quebec, Canada H3B 2K4

Phone: (514) 861-1212
Fax: (514)-875-8967

e-mail: info@cognitivegroup.com
www.cognitivegroup.com