

Innovation in Business Processes: An experiment using CAIN

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Abstract

Business to consumer electronic commerce will need better tools, beyond browsers and gadgets, for the user to take full advantage of the opportunities of the electronic marketplace. On the other side, business needs to rethink their positioning, and to deal with this new customer using new methods and tools. We present in this paper a tool for navigating large information spaces, such as the Web, using what is called here “rough guides”. The tool uses user preferences to perform adaptive guidance. Rough guides bring new interactions into the electronic commerce arena: how they are produced, sold, and updated using consumer’s feedback can be done in several and different ways than in a classic economic framework.

1. Introduction

The way people buy and sell is certainly changing with the advent of electronic marketplaces. Current information technology already has a strong influence both on before-sale and after-sale techniques and systems. These systems take the form of help desks, call centres, logistics and distribution systems, and strong enterprise alliances to outsource important client functions, from development to marketing. With some exceptions, namely the UPS Tracking System (<http://www.ups.com>), none of them was developed with the internet in mind.

These business support systems can be seen as a visible sign of the more than probable move to full electronic commerce. In effect, protocols like Electronic Data Interchange (EDI) or systems supporting government to citizen relationships (like the Portuguese Infocid platform) are already in place and have been used for several years. Financial institutions and banks have used for several years electronic transactions. This gives a true field to implement electronic commerce both between businesses and between government and citizens.

Business to business electronic commerce is already on the move and several authors give figures that show its growing importance in the context of business to business relationships and in the global context of electronic commerce where it represents in a near future 80% of the value of transactions.

In this paper, we will concentrate in the business to consumer electronic commerce, where there is still much to be developed and where a lot of research about use and development of new methods, tools and processes is still being devised. It seems that two key factors are essential to leverage business to consumer electronic commerce:

tools to allow it, and consumer trust. Current tools, such as search engines, information warehouses, electronic mail and bulletin boards, do not scale well in a global market, and do not allow for shopping guidance. The user ends giving up either because of large waiting times, lots of information, lost pointers, or lack of confidence.

2. The proposal

Our proposal is based in the following:

- simple, anonymous, secure, and reliable payment schemes will find the mainstream, and will eventually be adopted. Electronic wallets and micropayments are the most promising (Choi et al. 1997);
- an information-based economy will enable consumers to be also producers (prosumers), and trading of information will take off. Information about what is on the Web, where it is, and how much it is worth, can be a catalyst for micropayments to take place between prosumers;
- automated services, such as intelligent agents, webcrawlers, and search engines, will be increasingly disappointing as 1) firewalls and other security features prevent them from entering web sites, 2) unstructured information is and will be difficult to filter and process automatically, and 3) more and more information is stored in server databases and cannot be found in html pages.

There are already some partial solutions to the problems outlined above: strong cryptography allows for digital cash to be a reality; internet communities exist linked either by interest or by other social factors and internet auctions are a success; and directory services, such as Yahoo, although facing the overwhelming task of manually indexing up to 300 million web pages, are the preferred starting point for navigation as they are more reliable (Chakrabarti, 1999).

In our proposal, users have at their disposal available information about several themes, consisting of a compilation of internet addresses. These compilations are called “rough guides”, and they are much pretty the same as their city guides or tourist guides analogs. Rough guides can be used in a standard web browser, in a standard way, as described latter. Depending on the profile of the user, rough guides show different information to the user, allowing thus to adaptive navigation and guidance. The implications we see are the following:

- rough guides can be produced and sold about a great variety of themes. The authors can be individuals or companies. Good and bad guides will exist, but this is a market problem, and the market will solve it. Guides can be produced on specific themes — for example, “the 10 best places for information on History”, “buying technical books”, or “best design pages” —, or very general ones, such as “complete listing of government services on the internet”;
- rough guides should allow for easy updating, as internet pointers come and go. They should also allow for comments from different users to be included, opening the

way to co-operative navigation. As a more advanced feature, the adaptive algorithm could learn from different users, and modify its navigation strategy accordingly;

- micropayments should help foster a community of rough guide users, producers, and reviewers. They would be willing to pay (be payed) a small fee for a service considered worthwhile. In the material, classical economy, who has never bought a “Michelin Guide”?

In a new economy, with new rules and habits, there will be certainly a place and a need for digital rough guides. Before describing our system, we will present some of the current thoughts on how the new economy will be, and how business and consumers will fit.

2.1. A digital economy

Don Tapscott (1996) proposed 12 themes for the New Economy — a digital economy. They are:

Theme 1 : Knowledge

Theme 2: Digitisation

Theme 3: Virtualisation

Theme 4: Molecularisation

Theme 5: Integration/Internetworking

Theme 6: Disintermediation

Theme 7: Convergence

Theme 8: Innovation

Theme 9: Prosumption

Theme 10: Immediacy

Theme 11: Globalisation

Theme 12: Discordance

Some of these themes can be of interest in our discussion of business to consumer electronic commerce. In particular knowledge and virtualisation seem to be key factors to make consumers move from more traditional ways of buying what they need.

A discussion of consumer needs seems to be central in establishing a valid scenario where a consumer can use electronic commerce not because commercial systems impose it, or were transformed to apply more efficient and technological approaches to their processes, but because consumer needs are essentially different. The differences result from new habits, and can be seen as ongoing transformations reported by several

authors. These transformations are also the joint effect of the listed Tapscott themes for the digital economy.

2.2. Two issues to assist the business to consumer relationship

From the knowledge and virtualisation themes, some lessons can already be learned from current literature. It seems that without truly knowledge of processes, consumer needs and consumer profiles, developing successful business to consumer systems will be difficult.

Current research shows that:

- although initial alerts, consumers prefer brands and value them more than the price of a product. The image of a business is an important asset, as consumers trust some more than others, specially new entrants or unknowns (Gallaugher 1999);
- new brands have to fight to enter the market, where the price is not the most relevant issue. Although it is easier to reach consumers, gaining their confidence is harder (Elofson & Robinson 1998);
- there seems to be a trend to concentrate services around a main brand and/or place, most of the times calling it a portal. Again, brands are important, corporate image is important, and a solid reputation also;
- security and trust is seen as a key factor for the consumer, giving place to some regulatory issues, such as on-line consumer protection, confidentiality, security, and privacy, the later being one of the most important (Bakos 1996).

These facts introduce the first issue: consumers still need to feel confidence and some evidence as their knowledge of the electronic market place must exist to allow them to have an emotional relation with it (Bhimani 1996).

As what concerns the virtualisation theme, we can state the importance that the content, as collections of information items, can have to the consumer (and to the legislator also). Although important, content itself will not have great value for the consumer unless it provides him with a valid structure. This being so, structure is more important than content, in the sense that it allows the consumer to use the content. Even access will be more important than content as it drives the cost and the difficulty level of using (and buying) the content.

When we propose a sequence for structure, access and content, we also propose what can be sold as a product at different levels. An important issue in electronic commerce is what to sell and how to do it. In effect both the product and the process are on change in the electronic commerce. Some examples follow, as they show how this questions are still open:

- some internet service providers and telecom operators are giving way computers to sell communication time;

- some added-value enterprises are giving way free access to know more about user patterns and profiles;
- some internet sites are giving way valuable information in order to get consumer attention and availability, such as reports and intelligence.

These examples have also some interesting information. It seems that we can have for free from some, what we have to buy from others. This will lead us to the second issue; the one of the potential, the most effective asset in the current environment of business to consumer electronic commerce.

2.3. Human factors importance

Information technology now is different from the one devised several years ago. Current products tend to have better human interface solutions, and thus have led to new fields and problems. With the research related with Internet, and more closely with the World Wide Web, this trend has increased.

Past experience in introducing new systems dealing with people and technology show that technology in itself can not be seen as a generic problem solver. Two examples are videoconferencing where besides the promise of substituting face to face meeting, it did not happen, and expert systems, where most of their implementations were discontinued because they failed to acquire, store and maintain knowledge.

These two examples are just a small part of technology systems that although they represent well designed solutions to a given problem have not considered the human factors around.

In the business to consumer electronic commerce the same reasoning applies. This will lead the way to consider the two sides of the same equation. We need to consider the user (client) and the process (enterprise). Successful electronic commerce technology to serve consumers must combine user needs with enterprise processes.

We will next discuss some of the technical characteristics of our proposal, and shows some results of experiments in an educational setting.

3. The web as the marketplace

From the user side, two key factors apply: the trust in the given information and the cost to access and understand it. A large volume of information, such as the one available over the Web has an inherent application potential in an educational setting. Unfortunately, besides inheriting and enhancing most of hypertext's qualities, the Web also incorporates and stresses common hypertext problems (Brown 1990; Shum 1996; Shum & McKnight 1997).

It is the Web's disorganized nature that mainly prevents its most effective use as a pedagogical tool and, as such, research is needed to develop the means that will help to transform the available data into meaningful information able to support learning or initial research activities (Eklund & Ziegler 1996; Marshall 1995).

The **Computer Aided Information Navigation** project (CAIN) attempts to provide adaptive navigation support as a way of increasing the Web's value as a pedagogical tool (Lamas 1998). CAIN's approach is a reactive one as the effort goes into providing a way to deal with the vast amount of useful information available on the Web as is, rather than to try to improve or alter the Web's infrastructure in any way.

In order to help users reach their goals, CAIN provides direct guidance navigation support as a form of non-obtrusive *weak hypertext linearization* enabling the user to follow a context specific ranked sequence of selected Web pages without ever needing to perform any search or follow any link if they do not wish to. This approach does not intend to prevent goal-oriented exploration but to provide a sound thread or guideline to help users to retain their focus in the way a **Rough Guide** does.

The system's representation of the Web, crucial to the success of its adaptive features, builds on the Dublin Core (Weibel & Lagoze 1997) and on the Resource Description Framework (Lassila & Swick 1998).

The users' representation combines three user modeling techniques resulting in a hybrid solution that uses stereotypes, overlays and attribute-value pairs (Benyon & Murray 1993; Brusilovsky 1996).

Navigation support is accomplished by a basic route-finding heuristic which selects context specific Web model items, sorts them using associated qualitative ratings and presents them to the user, one at the time, based on the attributes of the user's model (Lamas 1998).

The next pages present and discuss the results of an experiment undertaken to test if the directed World Wide Web navigation guidance provided by the CAIN improves the performance of Web users under appropriate conditions. Section 4 describes the empirical study and discusses the experiment's results. Finally, section 5 highlights some related empirical work and section 6 discusses the validity and completeness of the experiment and provides future work guidelines.

4. Empirical study

It is hypothesised that contextualized direct guidance over the information available on the World Wide Web improves comprehension under the specific condition that:

- users are either inexperienced in Web use or have little expertise in the target subject topic or both;
- users use the system pursuing learning, discovering, or initial research goals.

For this purpose, a standard task was devised in which volunteers were required to use the WWW to learn as much as they could about two given subject topics — cryptography and poetry — using either **CAIN** or alternative tools the users chose to use.

The experiment compared the use of **CAIN** with conventional tools on three measures of performance:

- **Comprehension** as measured by a multiple-choice questionnaire;
- **Time taken** to complete the tasks; and
- **System usage appreciation** assessed by a like/dislike rating at the end of each task.

Performance was examined as function of:

- **Tool used**, either *CAIN* or *Free*¹;
- **Web expertise**, the Web experience of the users, either *Low* or *High*; and
- **Subject expertise**, the users' expertise in the target subjects topic, either *Low* or *High*.

In order to implement the experiment, volunteers were recruited from the university's population, specialist help was required to build the domain model and to provide the subject abstracts and questionnaires and a specially designed environment was prepared to implement the experiment.

The next figure illustrates the fact that CAIN produces faster performance than Free under all combinations of levels of the independent variables except when the volunteer has High Web expertise and High subject expertise, i.e. it suggests that:

- time taken may be slower with CAIN when the user is a highly experienced Web user and a an expert in the learning assignment field, but;
- CAIN is faster when users are inexperienced Web users and inexperienced in the study subject or inexperienced in the Web and experienced in the subject or experienced in the Web and inexperienced in the subject.

Note that, as shown in the table and figure, Web expertise alone does not slow performance when using CAIN. In fact, highly experienced Web users performances are slightly faster under CAIN than Free. It is the particular combination of High Web expertise and High subject expertise that slows performance using CAIN compared to using other tools on the World Wide Web.

<i>Web expertise</i>	<i>Tool</i>	<i>Subject expertise</i>		<i>Mean</i>
		<i>Low</i>	<i>High</i>	
Low	Free	91.70	86.50	89.10
	CAIN	86.17	68.50	77.34
High	Free	74.67	61.50	68.09
	CAIN	50.50	75.44	62.97
<i>Mean</i>		75.76	72.99	

Table 1: Web expertise vs Tool vs Subject expertise performance times contrast

¹ Where Free stands for any other tool but CAIN.

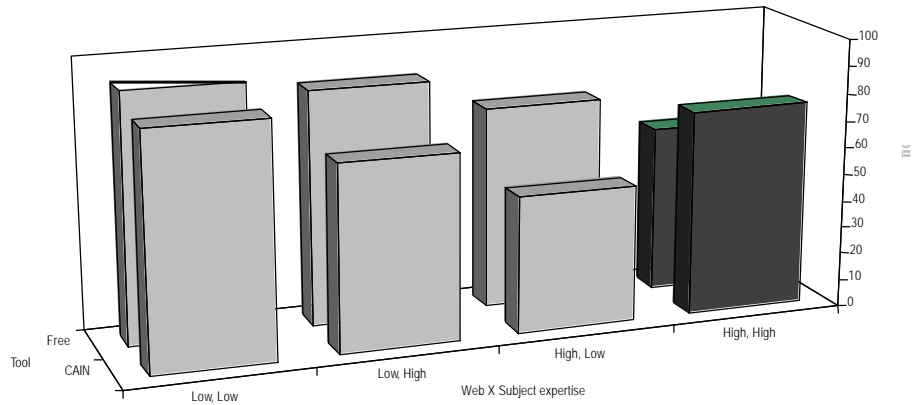


Figure 1: Performance times contrast

5. Related empirical evidence

Although to date empirical studies on the value of adaptivity in hypertext based learning environments are limited, they are critically important to validate the different approaches in this research area.

Although most of the existing empirical evidence, reviewed by Eklund and Brusilovsky (1998), fails to show if adaptive hypertext navigation contributes at all to improve the student's or researcher's performance, it provides an intuition that adaptive navigation could be valuable.

Nevertheless, in experiments measuring the number of hypertext nodes used to accomplish some predefined goal, existing empirical evidence favours *adaptive curriculum sequencing*² versus adaptive link annotation over a closed information corpus. Although not directly related with CAIN, these results do not contradict this project's approach.

Further, on the InterBook³ experiment reported in the same review, apart from other results, it is also stressed that the direct guidance mechanism was chosen by test subjects in over 90% of the transactions. Again, this system relies on a closed information corpus but nonetheless, the experiment's results provide added support to CAIN's approach.

This is however an under-investigated area and there is clearly a need for continued studies on the value of adaptivity in hypertext based learning environments.

6. Final Remarks

The experiment herein presented examined the nature of the interaction between the users' Web expertise, Subject expertise and the used Tool and its results show that CAIN, as specified and implemented, does indeed improve user's comprehension by

² a direct guidance approach

³ an adaptive hypertext system supporting adaptive link annotation and direct guidance in the form of a *continue* link

30% when supporting learning or initial research tasks performed over the World Wide Web.

This is probably due to the way CAIN guides the user through a sequence of previously selected and relevant Web resources.

Though not in a very significant way, the experiment's results also suggests that the time taken to accomplish such tasks can also be reduced when using CAIN except when there is no point in using it *i.e.* when the user is already an expert using the World Wide Web and an expert on the task's subject.

As far as enjoying the system, the results do not show any significant difference between using CAIN or any other approach to navigate the World Wide Web. In fact, the results show that users in general enjoy using the Web with whatever tools they use.

Although encouraging, this experiment's results are not sufficient to understand all the implications of a system like CAIN and further studies must be undertaken. In fact, the current investigation only measures the adaptive guidance support leaving untouched issues related to all the other relevant areas brought together in this work such as:

- the adequacy of the metadata records and associated rating strategy;
- the soundness of the implicit co-operation model;
- the reliability of the relevance feedback mechanism; and
- the validity of adaptivity itself.

Specifically, it fails to understand other success factors such as:

- how relevant is the order in which Web resources are presented to the user?
- how do users cope with the domain building process?
- are the rating criteria adequate and easy to apply?
- is such Web representation successful for all its users?
- how does the system cope with long term users?
- how does physical distance affect the system's collaborative nature?

This is an under-investigated area and there is clearly a need for continued studies on the value of adaptivity in hypertext based learning environments.

In conclusion, the **Computer Aided Information Navigation** seems to be in the right direction and research will continue in order to achieve this collaborative environment's long term goals: To *guide* the user while *learning*, *memorising* and *forgetting* things in order to increase *motivation*, *attention* and *empathy*, reducing the environment's noise and improving the knowledge acquisition process. Whether it will help users in an

electronic commerce environment it remains to be tested, but we believe, from the results we present, that CAIN can be a valuable help.

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