4 Perspectives on Web Information Systems

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Abstract

In recent literature, many authors argue that "Web development" is new and different. The arguments are, however, both debatable and debated, and often it is neither clear what is meant by Web development, nor what it is supposed to be different from*. Often-suggested special characteristics of Web development do not seem special after all. I present a model describing four archetypical perspectives on Web Information Systems; the perspectives being characterized by different views on what the system is intended to communicate and on the direction of the communication. I argue that these perspectives (information provider, information system, advertisement, and community) can explain some of the quite opposite opinions on Web development one can find in the literature.*

1. Introduction

Through well over a year now, I have been trying to establish an overview of the area "Web Development". With a background in software engineering and information systems development, my ambition was to find out if, and in what ways, the development process leading to a running website was – and should be – different from more traditional systems development processes.

The literature provides quite conflicting opinions on this subject. On the one hand, quite a number of books, journal papers and conference proceedings advocate the view that Web development processes indeed are different: they require new methods, new tools, new people, and new working practices. One example:

"Developing Web-based systems is significantly different from traditional software development and poses many additional challenges. There are subtle differences in the nature and life cycle of Web-based and software systems and the way in which they're developed and maintained." [14]

On the other hand, a number of people oppose this view, saying that even though the Web is a new technology for many companies, the "old" virtues and methods from software engineering and systems development are still needed and applicable; this is, e.g., Roger S. Pressman's opinion:

"The basic principles that lead to high-quality systems apply whether you're building the latest and greatest Web application or the 3,000th version of a corporate payroll system." [35]

Adding to the ambiguity was also that it is unclear in what ways Web development is supposed to be new and different. When Murugesan et al. [31] outline a number of characteristics of Web development, they mention on one hand quite specific, almost technical aspects like:

- the Web is both an application medium and a delivery medium
- Web-based systems, at the user end, have to cater to diverse environments

But other characteristics mentioned in the paper are:

- greater bond between art and science
- visual creativity, multimedia
- vast variation in developers

Characteristics like these seem somewhat unrelated to the specific area of Web development, and more associated with the area of interactive multimedia development. Describing "the successful multimedia development team", Whiteside and Whiteside writes: "Creating an instructionally sound, sophisticated multimedia application requires individuals with a wide variety of talents and competencies to collaborate as a team" [43].

So, another problem related to the purportedly difference of Web development is the question of on what background this difference is identified. An illustrative example of conflicting views can be found in Pressman's (virtual) roundtable discussion [35]; Brent Gorda argues: "I don't think conventional engineering skills are irrelevant to the Web. In fact, I believe the Web's accelerated develop/publish capability increases the importance of tried-and-true software engineering prac-

tices," and Ted Lewis replies: "These systems aren't 'engineered' because no one uses our so-called 'software engineering' in real life".

Somewhat in line with Lewis' argument, some papers advocate the view that what is new is not Web development in particular, but rather the whole field of "IS services, their delivery and their associated organizational processes" [25]. In their view:

"the InterNCA [internetwork computing architecture] will result in an unprecedented speed of change and discontinuity in service alternatives, use new software-based mechanisms, lead to ubiquity of services and coalesce software with media design." [25]

So, it seems we have (at least) three conflicting opinions:

- Web development is different because of certain characteristics of Web information systems
- Web development is different because times have changed; we're in the Internet-era now
- Web development is no more "different" than any other kind of systems development

In this paper, I will shed some light on why the field of "Web development" is marked by a bewildering plethora of opinions. After giving a reasonable definition of Web Information Systems, I will discuss four areas in which many authors believe Web development is special and demonstrate the limited validity of their arguments. I will then argue that authors seem to view Web Information Systems in one of four different perspectives, and that the perspective they use may, at least partially, explain why they come up with conflicting conclusions. Awareness of these 4 perspectives may for practitioners lead to an improved, shared understanding of what a new or existing system should be like; for researchers in the field, the 4 perspectives may help in clarifying which kinds of systems and development processes they're talking about; and finally they may pinpoint new challenges to and qualifications needed by system developers in the field of Web information systems.

2. A rose by any other name …

In order to enter the discussion of the possible peculiarities of Web development, it seems reasonable first to clarify what kind of systems we are discussing. Also this area is rather confusing in the literature.

A number of different names are used for what appears to be the same real-world phenomenon: Web-based Information System, Web Information System (often abbreviated WIS), Web-Based System, Web-Based Application, Web Application, Web Software Application, Web Solution, Web Site, and Interactive Web Application (IWA) are among those I have come across in the literature.

Many authors don't explicitly define what they mean by Web Information System or whichever concept they choose. And those who do, come up with quite dissimilar definitions. Some choose a rather "technical" definition like this:

"We define a Web application as any software application that depends on the Web for its correct execution." [12]

This definition will, logically, also include applications like Web crawlers[1] with no Web-accessible user interface. Others choose a more "information system"-like definition, e.g.:

"A WIS *is an Information System providing facilities to access complex data and interactive services via the Web."* [15]

"WISs are information systems first, and Web systems second. … WISs enable users to perform work." [9]

Still others choose to focus on the "world wide" aspect of the Web:

"WIS represent a sub-category of mass information systems that typically support on-line information retrieval and routine tasks by way of self-service for a large number (thousands or millions) of occasional users who are spread over many locations." [39]

One might expect "Web Information System" to be a more extensive concept than "Web Application", but as the following quote illustrates, this is not always the case:

"This category [Web Software Applications] includes, among others, legacy information systems …" [6]

In this paper I will use the term "Web Information System" or "WIS" and define it as a computer-supported information system, utilizing the technology of the WWW, and accessed by the majority of its users via a browser.

3. What is special about Web development?

In the literature concerning Web development, quite a number of special characteristics have been proposed, but it is beyond the scope of this paper to discuss each of these. I will, however, discuss four of the perhaps most often mentioned: the new, incremental development process, the time pressure, the new professions, and a diverse and remote user group.

3.1 Development as incremental changes

Some authors think a central characteristic of Web

[1] Programs collecting data from the Web for later use in search engines like Google™.

development is its "organic" nature, supposedly very unlike the traditional waterfall model:

"Web-based systems change and grow rapidly in their requirements, contents, and functionality during their life cycle – much more than what we'd normally encounter in traditional software, information, and engineering systems. Web-based systems development is a continuous activity ... a Web-based system is like a garden – it continues to evolve and grow." [14] (see also [21, 22]).

Another example from the literature is Norton [33], when he as one of the distinguishing characteristics of Web application development, compared to "other forms of software engineering", writes:

"... a Web environment by its very nature is an immediate medium ...Web development projects should be evolutionary in nature, with multiple staged deliveries throughout the lifecycle."

3.2 The time pressure

Another, often-repeated argument for the peculiarity of Web development is the very hard time pressure, often referred to as development in "Web time" [7, 41] or "Internet time" [2, 24]; sometimes characterizing an Internet-year as one dog-year[2] [42] or as 3-4 months [41]. This view is also reflected in the following quotation:

"Design, and development of commercial web sites is a race against time ... the work practices have been intensified into time constraints which are breathtaking in their proportions." [16]

3.3 The new professions

When describing Web development processes, many authors emphasize the need for new competencies and thus the need for new project group members:

"Building a complex Web-based system calls for knowledge and expertise from many different disciplines and requires a team of diverse people with expertise in different areas." [14]

Some even think that this is *the* central characteristic:

"Web development is different because the people who build Web sites are different ... Contributors often have widely different backgrounds ... many can be characterized as 'non-technical' (e.g. graphic design, marketing, and editorial)." [33]

3.4 A diverse, disloyal, remote user group

A final characteristic of Web development, often mentioned in the literature, is the very broad and "remote" user group:

"Web-based applications, almost by definition, are meant for a more inclusive user base, which goes beyond the previous confines of departments, divisions, or organizations. One consequence is that application developers may not know who the users are. ... User interfaces for applications must consider unknown users (current and future) and compete—indirectly—with the interfaces that competitors and even collaborators create." [10]

It is often assumed that users are somewhat fickle:

"With web applications ... users can very quickly switch from one web site to another with minimal effort. As such the need to engage users and provide much more evident satisfaction of users' needs and achievement of their objectives becomes critical. The result is an increased emphasis on the user interface and its associated functionality." [23]

3.5 So, is it special?

Both in the literature and in real life, many examples can be found of Web projects that can be described as being developed incrementally, under hard time pressure, and by people with very diverse backgrounds. But it is an open question, whether these characteristics are *special* for Web development.

The incremental model of software development is widely accepted and used, see e.g. [8, 26], and hard time pressure is also a well-known condition in software development. As Ray Johnson argued in the previously mentioned round-table discussion: "Time-to-market and many other features of Web development are not unique to Web applications" [35], and Sawyer has identified "Time to market pressure" as being characteristic for the development of packaged software [38].

Some consider multiskilled teams to be part of "the future of software" [3]; problems of dealing with diverse and remote user groups have for a long time been a condition in the development of shrink-wrapped software [17], but may not be relevant for, e.g., company intranets; and the risk of "loosing a user to the competitor" seems hardly relevant, if we focus on e.g. systems for filing income tax return.

So maybe Web development projects *are* different – the question is, different from *what*? And this leads back to the question of what kinds of systems and projects we are discussing. What do different authors focus on, when they describe the new challenges of Web development?

4. A classification of communication

It is my view that one of the reasons why different authors have such different views and focuses on Web

[2] i.e. 1/7 of a normal year

development is that they have very different perspectives on the field. Below, I will present a model describing four perspectives; characterized on one hand in their different views on *what* the system is intended to communicate, and on the other hand in their different views on the *direction* of communication.

4.1 Communication as exchange of (objective) information

People with a background in software engineering or information systems will traditionally regard communication as exchange of *information*. This is the view embedded in the following citation from a textbook in Object-Oriented Analysis and Design: "Users work with information. They use computer systems to store and process information, and on this basis they act on the problem area" [27]. In this light, information may be represented as objects or other data-structures, objectively describing real-world phenomena.

The fundamental requirements for a new system will often be described as use cases:

"Each use case describes a scenario in which a user interacts with the system being defined to achieve a specific goal or accomplish a particular task ... The perspective provided by use cases reinforces the ultimate goal of software engineering: to create products that let customers do useful work." [44]

It is assumed that the user wants to perform some kind of task, and that the purpose of the system is to help the user fulfill this task. So when developing a Web application, the most important question to be answered is "which information should the system store, process, and communicate with its users" and questions of layout and design of the various Web-pages, although important, will be seen as subordinate. These decisions belong to the field of user interface design, where the focus is on the *usability* of the system: it should be easy to learn, use, and remember etc. [32].

4.2 Communication as transfer of (persuasive) messages

On the other hand, people with backgrounds in marketing or public relations will traditionally regard the communication as a transfer of *messages*; messages being different from simple information in their embedded intent – the sender of the message wants to persuade or influence the receiver. Instead of use cases, a *brief* will often be used as a basis in the development process, giving answers to fundamental questions like who the audience is, what you are promising them, what you want them to do about it, and what "one great thing" that will capture their interest [18]. Only when these questions have been answered, the informational content of the communication is considered.

This view can be seen in the following quote:

"So how does one measure the effectiveness of a home page or a site? ... The essential question [from an advertising perspective] is this: Did the message create desired beliefs and persuasive intent toward the message, the object/idea being propagated by it, and toward the sponsor of the message?" [40]

4.3 Direction of communication

In this dimension I focus on the direction of the communication, taking place between different users and the computer-based system. Greenbaum and Stuedahl distinguish between one-way and two-way communication:

"... most of the web site development projects we studied, were however, designed for an audience*, rather than for two-way communication. ... The combination of traditional systems development practices which viewed 'users' as passive recipients of software, and traditional advertising and broadcasting media practices which put information out to passive 'audiences'; accounts, in part, for this emphasis on one-way broadcasting in two-way interactive media."* [16]

I have, however, chosen to use the concepts *asymmetrical* and *symmetrical*, because they more accurately describe the different roles assigned to the communicating parties.

4.4 Asymmetrical communication: from system to users

On one hand, we may regard communication as primarily flowing *from* the Web information system *to* the users. In this view we have a sharp distinction between on one side the *external* users, the ones we want to communicate to, and on the other side the Web information system, supported by *internal* users. The objective of the system is to deliver information and/or messages to the external users. Communication the other way, from external users, is restricted and limited to e.g. entry of search criteria or personal information, supporting the communication's primary direction of flow, back to the external users. This is illustrated in figure 1:

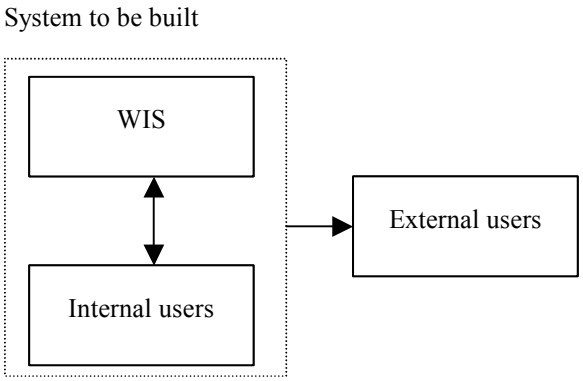

Figure 1. Asymmetrical communication: from system to external users.

4.5 Symmetrical communication: between users

On the other hand, we may regard communication as flowing *between* users, *via* the Web information system. Whether these users are internal or external is not of primary importance – they all contribute to the communicational flow. The objective of the system can be seen as providing a platform which facilitates this communication, thereby providing the opportunity for users to reach their goals. Because of the interest in supporting users, both internal and external, in their communication, this view will most likely also lead to an interest in organizational aspects for the external users also, e.g. consequences of introducing and using the WIS. This is illustrated in figure 2:

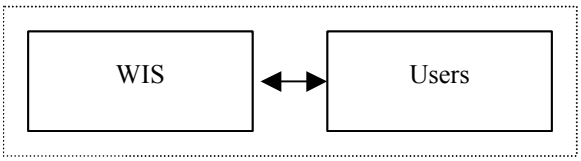

Figure 2. Symmetrical communication: between users, via the system

5. Four perspectives on a WIS

If we cross on one hand the communicational content (objective information or persuasive messages) with, on the other hand, the degree of symmetry in the communication (asymmetric or symmetric), we get a table showing 4 different perspectives on Web information systems. I have tentatively named these 4 perspectives, *Information Provider*, *Information System*, *Advertisement* and *Community*. I will discuss each of these 4 perspectives below.

	Asymmetrical communication	Symmetrical communication
Communication of objective information	**Information Provider**	**Information System**
Communication of persuasive messages	**Advertisement**	**Community**

Table 1. Four perspectives on Web information systems

5.1 WIS seen as information provider

If we regard the purpose of the WIS as primarily to distribute information to its users, the WIS can be seen as an *Information Provider*. As an example of this view I will quote Ginige's description of the development of a university website:

"When developing this site, a lot of thought had gone into identifying who the users were, what information they needed and how this information was going to be presented in a way that was easy to find." [13]

The focus here is clearly on one-way distribution of information, from the system to its external users. The considerations referred to by Ginige are quite similar to what we would expect in a non-web software engineering process. An examination of the Lecture Notes in Computer Science edition, dedicated to Web Engineering [30], shows a number of papers [5, 6, 23, 29] that use this perspective. Most of these propose new methods, tools, and techniques in order to better handle the "special" characteristics of developing and maintaining WISs. Often mentioned "special" problem-areas are:

- how to make systems usable for a very diverse spectrum of users
- how to handle continuously updated, large amounts of information
- how to deal with multimedia

Using this perspective, typical examples of WISs are on-line telephone directories, timetables, price lists etc.

5.2 WIS seen as information system

In this view, the WIS is seen as a special type of information system, and the system's purpose – like any other information system's – is to facilitate and support users in their work. This view can be seen in quotes like these:

"[A WIS] supports work, and is usually tightly integrated with other non-WISs such as databases and transaction processing systems." [19]

"WISs enable users to perform work – work that is inherently more complex than the rest of the Web." [9]

"Web information systems (WIS) differ from Web pages in that they are often integrated with organisations' other information systems, and they support knowledge work." [34]

The view is also characteristic for research conducted

in the DIWA-program[3], see e.g. [4].

In this view, some of the often-mentioned "special" problem-areas are:

- how to integrate new participators in the development process (e.g. graphical designers, marketing)
- organizational aspects of implementation and use
- problems related to requirements capturing and specification

Using this perspective, typical WISs are many company intranets, on-line systems for filing income tax return, flight booking etc.

5.3 WIS seen as advertisement

In this view, the WIS is seen as a marketing channel, and as such its purpose is to distribute promotional messages to an external audience:

"Home pages meet the conceptual definition of advertising, they resemble ads in physical appearance, and they perform the same basic functions – to inform and to persuade – as other communication messages." [40]

In [42] a "Web site decision maker" is quoted for saying:

"Our object is exposure ... to show that we're sort of a modern company, that we have the latest marketing outlet. Sales would be great, but I can't say we're accomplishing that. A Web site provides a proactive image of being in step with technology. Monetarily it is breakeven, but it gets us out there ... promotes good will."

As can be seen from the quotations, what is developed is referred to as a "website" or as "homepages", even though the supporting technology might very well include a "software application that depends on the Web for its correct execution", the definition of a WIS by Gellersen and Gaedke [12]. What really matters in this perspective is not the informational content or the specific facilities provided by the website (WIS), but the (hopefully positive) image of the organization, shaped in the site's visitors.

In this view, examples of "new" or "interesting" topics are:

- the "unique advantages of the medium" [40]
- problems related to communication with very inhomogeneous audiences
- choice of content and services
- how to attract visitors – and keep them

Using this perspective, typical WISs are many company (and private) websites, on-line advertisements etc.

5.4 WIS seen as community

In this view, the purpose of the WIS is to support the creation and development of a virtual community (also known as an on-line or Web community). According to Cliff Figallo [11], a community has the following characteristics:

- *The member feels part of a larger social whole.*
- *There's an interwoven web of relationships between members.*
- *There's an ongoing exchange between members of commonly valued things.*
- *Relationships between members last through time, creating shared histories.*

It is clear from the above that in this light the WIS should support symmetrical communication of persuasive messages. Symmetrical, because "these sites encourage communication *among* visitors to the site" [1, my emphasis] and "all the members of community are able to participate in communication on an equal basis" [20]; persuasive messages because members "tell each other not only what they know, but what they feel, what they've discovered, and what they can't put up with" [11].

In this view, what is new and interesting is:

- the new business opportunities (and threats) opened by these communities
- how companies should exploit these opportunities

Some of the WISs pointed to by authors with this perspective are the WELL [11], Timezone.com [36], CNN (community.cnn.com) and Heineken (www.heineken.com) [28].

6. Discussion

I have presented 4 different perspectives on Web Information Systems (WIS), which may be applied in order to – at least partly – explain why authors have so incompatible views on if, and in what ways, these systems and the way they are developed is different.

The 4 perspectives are certainly not mutually exclusive, and there are no hard-and-fast boundaries between them. There is no sharp distinction between symmetrical and asymmetrical communication, only degrees of symmetricality. Even if your focus is on communication *to* external users, you will most likely also consider ways of getting information and feedback *from* these. Likewise, the distinction between "information" and "message" is also quite blurred. Even if you plan to only use your WIS for the distribution of objective information, you will always consider how to present this information to your audience. And even though your only focus is on image-creation and attracting customers, you must also consider which "cold", objective information you will want your WIS to deal with – and how. The perspective may very well change over time: a company may start off with one-way communication to potential customers,

[3] "Design and use of Interactive Web Applications": a research program with 4 participating Danish universities

but will gradually open up for two-way communication; at first as simple feedback or data-entry, later as dialogue and extensive transactions [37].

It is obvious that many discussions relating to WIS-development cannot in a meaningful way be categorized as belonging to either one of the four perspectives. One example is the many papers discussing advantages and disadvantages of different server platforms, software technologies and data representation.

In section 3 of this paper, I referred to four often-mentioned, asserted special aspects of Web development: “development as incremental changes”, “time pressure”, “new professions”, and “diverse and remote users”. In my view, these special aspects cannot be said to be inherent to development of Web Information Systems, using the definition I gave in section 2. But they may seem special, if you, as a developer of traditional information systems and regarding WISs in this perspective, are confronted with projects and people who focus on WISs as advertisements or virtual communities. If you are not confronted with these views – maybe because you are developing an on-line ticket reservation system – you will most likely argue that Web development is not so different, and that old tried-and-true software practices are as important as they’ve always been.

A higher awareness of the perspectives used by different researchers and practitioners when they describe Web Information Systems, their possible special characteristics and consequences for their development processes will improve our understanding of these systems and the opportunities for producing high-quality systems in the years to come

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