

Web and Multimedia Systems Development – State of the Practice

Dijana Plantak Vukovac
University of Zagreb
Faculty of Organization and Informatics, Varaždin
dijana.plantak@foi.hr

Božidar Kliček
University of Zagreb
Faculty of Organization and Informatics, Varaždin
bozidar.klicek@foi.hr

Abstract. *Over the past few years there has been much academic interest in the development of complex hypermedia systems, particularly web-based ones. The literature suggests that the dominant development approach is the ad hoc approach, which fails to address many aspects of hypermedia systems development. Hence, many specialized web/hypermedia design methods have been introduced to discipline the development process and resolve issues typically not covered by software engineering development paradigms. However, some studies have shown that web and multimedia development is not as chaotic as it is generally considered despite the fact that the aforementioned specialized methods are not widely used. In order to explore Croatian web design organizations' practice of web and multimedia development, a web survey was conducted. In this paper the study findings are presented.*

Keywords. Multimedia, Web-based Systems, Web Development Practice

1. Introduction

With the advancement of numerous enabling technologies, particularly web-based ones, multimedia usage is moving from offline media to the online medium. This shift has been accompanied by the introduction of different kinds of applications ranging from simple online multimedia presentations (e.g. *brochureware* web sites) to large-scale hypermedia applications offering rich multimedia content and multiple navigational paths (e.g. complex web sites of the Olympic Games or World Championships). Also, multimedia and web technologies have been integrated into business information systems to support organizational activities such as sales, marketing, support or collaboration, on a B2B and/or a B2C level. Since web sites that facilitate business processes have more in common with traditional client/server applications than with static web sites, the software engineering principles are essential in the development of such systems [20].

Thus, "issues similar to those encountered in traditional IS development have emerged – such as how to

manage requirements, how to control development processes, how to co-ordinate the collaborative work of design teams, and how to effectively manage projects" [2].

Some authors [13, 14, 17, 20] suggest that the dominant hypermedia development approach is an *ad hoc* approach with "implement, test, release" development steps, which fails to address many important aspects of complex hypermedia systems development. Furthermore, "most web applications are developed with little or no control and without a formalized process" [22]. So, whereas on the one hand, there is a lack of a systematic approach and appropriate methodologies, on the other hand important issues are ignored because the current software engineering development paradigms do not fully cover the existing hypermedia features of web and multimedia systems.

Although the *ad hoc* approach is acceptable for creating simple web sites, it fails to deliver complex web-based systems of satisfactory quality [13, 17]. Thus a Cutter Consortium survey, referred to by Ginige in [7], showed that the majority of delivered systems neither demonstrated required functionality nor met business needs, whereof about half of them were of poor quality. Furthermore, the development process was behind the schedule and exceeded the budget estimates.

This leads to the conclusion that large web-based systems development is experiencing the same problems inherent in the IS development. However, hypermedia features inevitably give rise to a number of new issues, which makes web-based systems development different from IS development [16, 17, 22]. It is the hypermedia features, defined as different types of media connected by hyperlinks, allowing users to navigate through an information space following various paths, that create the point of distinction between the development of multimedia and web-based systems on the one hand and information systems on the other. In this distinction several aspects are implied [14, 16, 17, 18, 20]:

- non-linearity of hypermedia documents facilitates the occurrence of a complex structure subsequently hard to maintain as the application size grows;

- aesthetic and cognitive aspects of web/hypermedia systems are more important than in traditional systems;
- the audience of a web site is fairly wide, with users having different information needs and computer skills, so usability and accessibility aspects are of great importance;
- different development activities imply the need for a team with different professional backgrounds: graphic designers, programmers/developers, systems analysts, information architects, technical writers, media producers, project manager(s), marketing specialists etc.;
- rapidly changing web environment forces shorter life cycles of web/hypermedia systems;
- continuous changes in information content, technologies and standards used imply that development should be incremental and iterative.

As a result, drawing on the fact that the range of hypermedia applications is very broad indeed, over fifty new methodologies, methods, techniques and models¹ for web/hypermedia design have been proposed in the last decade or so, to respond to the call for "sound methodology, disciplined and repeatable process, better development tools, and a set of good guidelines" in order to "bring the current chaos in Web-based system development under control..." [7].

In most of these methods the *Design phase*, comprising *Conceptual design*, *Navigational design* and *Presentational design*, is prescribed in detail. Some of the methods cover all the phases of a web/hypermedia system life cycle, from *Requirements capture & Analysis* to *Testing & Maintenance*. The methods are based on the following software engineering techniques: entity-relationship techniques (methods such as Hypertext Design Method, HDM [6]; or Relationship Management Methodology, RMM [8]), object-oriented techniques (methods such as Object-Oriented Hypermedia Design Method, OOHDM [23]; Hypermedia Flexible Process Modeling, HFPM [9]; UML-based Web Engineering, UWE [15]), or a combination of techniques (methods such as Web Modeling Language, WebML [4]; World Wide Web Design Technique, W3DT [3]; Web Site Design Method, WSDM [5]).

However, despite the fact that many research papers about web/hypermedia-specific methods have been published, a few studies [1, 10, 25] conducted to explore the usage of those methods in practice showed that most practitioners were not familiar with them and did not use any web/hypermedia-specific methods. One of the reasons for that might be insufficient dissemination of the methods at universities and

in popular IT magazines. Another reason may be the questionable practical value of some of the methods which neither prescribe the whole system life cycle nor have flexible design tool support.

2. Review of previous research

Besides the web/hypermedia-specific methods usage, the overall web/hypermedia development practice has been a topic of interest to many researchers.

In 1998 Vora [26] conducted voluntary mixed-mode survey among web professionals in the USA to explore the characteristics of the web design process. He found that designers used design guidelines or style guides while developing web pages, which they subsequently optimized and evaluated, but were unhappy with browser incompatibilities and insufficient web sites usability.

Russo & Graham [22] conducted a survey among web developers of five hundred web sites indexed in the *1997 Internet & Web Yellow Pages*. Having obtained the response rate of just over 10%, they concluded that the majority of respondents did not have web development standards or guidelines and none of them was using a formal development methodology. A minority of developers, though, was using traditional development tools and diagramming techniques, such as ER diagrams, flowcharts etc.

Taylor et al. [24] conducted multiple case studies about activities, techniques and standards in web site development in different organizations in the North West of England. They found that the *ad hoc* approach was the dominant development approach, specialized techniques were scarcely used and some of the phases in the web site life cycle had been skipped. Half of the web designers had followed some formal guidelines for the web site development but they had been developed in-house and had nothing in common with the recognized web standards.

In Australia, Venable & Lim [25] conducted a postal survey about web information system (WIS) development methodologies. With the response rate of only 9.32%, they found that 66.7% of respondents were using some form of methodology (mostly embedded in the web development tools) to guide their WIS development, while RMM and W3DT were the only web/hypermedia-specific methods tried and used.

Lang [10, 11] conducted dual-mode survey among Irish hypermedia developers in 434 organizations who specialized in web/hypermedia systems development or whose companies had IS departments. This study is recognized as the most comprehensive study of hypermedia systems development lately. With the remarkable response rate of 44.5%, Lang found that most organizations were using a formalized or unformalized development process that had clearly defined tasks or phases in it, wherein 23% of respondents were using a hybrid, customized or proprietary in-house method or approach [12]. More than two thirds

¹ Methodologies, methods, techniques and models are terms widely used to name web/hypermedia design methods (methodologies). As these terms are often vaguely defined, they can either have a different or a similar meaning for the authors of methods (methodologies). Therefore, to avoid broad nomination, the term method is used in this paper.

of the respondents indicated that they had used formalized procedures or guidelines in hypermedia systems development.

Zhou & Stålhane [27] explored web system development practice in 11 ICT organizations in Norway. They found that the majority of respondents (80%) were using the iterative and incremental development approach, but half of them did not have a process model at all. Moreover, the level of the usage of engineering methods and techniques for reliability and robustness was not high.

Rosson et al. [21] conducted a survey among informal and experienced web developers in the USA. E-mail invitations to participate in the web survey were sent to 591 organizations, 334 (55%) of which sent back their responses, with 55% of the responses coming from web professionals. They found that web development process did not begin with the web page construction, but rather with some prior planning. The major problem identified by the survey was unsatisfactory collaboration within the web team.

Although researches mentioned above were conducted throughout the world, no similar study had been performed in Croatia. It is based on this very fact and by taking into consideration all the relevant issues in current web/hypermedia development that the authors of this study set the following research goals:

- a) to gain a broader view of web and multimedia systems development practice in Croatia (designers/developers profile, web and multi-media projects characteristics);
- b) to identify the exact way in which designers perform the development process as well as methods and techniques they use in design;
- c) to explore opinions and trends in web development.

3. Research methodology

The study was based on Lang's questionnaire [9], subsequently adapted to suit the local terminology and modified with questions concerning phases and activities in the development process, as well as opinions about web development trends. The research method used was a web survey, with the majority of questions being close-ended, and a few open-ended questions with a blank field for providing additional comments to the survey.

The population of interest for this research had to satisfy the following criteria:

- the company is registered in a court register and indexed in any one of the five online business registers;
- developing web and multimedia systems can be broadly classified as one of the company's primary business activities; this may include some of the following: web site development, web application/system development, software and/or information system development, multimedia system development, graphic and visual design,

marketing, branding, advertising, telecommunications, web hosting;

- portfolio and company information, including e-mail address (or contact form), is available on the company's web site.

The population sample was compiled from five different business search engines (Croatian Company Directory issued by the Croatian Chamber of Economy, WLW Business Search Engine, T-Portal Web Directory, VIP Web Directory and Net.hr Web Directory) and included companies from all the 21 Croatian counties.

The final population sample was filtered for duplicates, with the sample eventually consisting of 418 companies. All of them were sent an e-mail with the research description, a unique link to the web survey for access control and authorization data (username and password). The web survey was available online for 31 days and during that period, after two reminders about the survey, 169 responses by designers/developers were received, which amounts to the response rate of 40.43%. However, 68 surveys were insufficiently completed, so the usable response rate, based on the true population size, was 23.71%, or 101 participants.

4. Research results

4.1. Designers/developers profile

The survey data analysis revealed that an average Croatian web or multimedia designer/developer is a younger male person (87.13% of respondents were male, average age 32) working in a small sized company employing up to ten employees (80.20% of respondents).

The majority of respondents graduated from high school (39.60%) or university (54.45%) while just a minority of them holds a scientific degree (3.96%). Their professional backgrounds vary significantly. Some of those who finished secondary school identified themselves as having a high-school-diploma, or, more precisely, as electronics engineers, graphics technicians, economists, and even aircraft mechanics, nautical-school students, construction workers etc. Those who finished tertiary education identified themselves as bachelors of informatics, electrical engineers, graphics engineers, Bachelors of Economics, and even high-school teachers, Bachelors of Journalism, architects, aviators, etc. They perform different design roles and functions, including graphic designers, web designers, web programmers, developers, webmasters, multimedia programmers, project managers, art directors etc.

Additionally, in the survey the respondents claimed to have an advanced or very advanced level of proficiency in different professional disciplines relevant to web/hypermedia systems development: computer programming/software engineering, graphic

design, information architecture, user interface design and technical writing. The only area of which more than half of respondents have only basic knowledge, or no knowledge at all, is film production, which is consistent with the findings that almost half of respondents' companies are outsourcing audio/video producers (as 49.40% of 79 respondents claimed) and specialists in animations (as 45.42% of 75 respondents claimed).

Regarding their experience in developing different types of web/hypermedia systems, the respondents were able to claim it by specifying the number of years in their profession or the number of projects they participated in. More than half of respondents (58.59%) had between 5 and 10 years' experience, so on average, a designer/developer had about 7 years' experience (mean = 7.13, median = 7). Immense variations in the number of projects were indicated, ranging between 2 and 500, with almost 80% of respondents who participated in 20 or more projects.

4.2. Characteristics of web and multimedia projects

In the survey different characteristics of web and multimedia projects were explored: types and features of the developed systems and their complexity, as well as project management (team size, project duration and cost, documentation management).

The most common type of web/hypermedia systems developed was a simple *brochureware* web site: 88.30% of respondents had developed it during the past two years. The second most commonly developed type of system is the Content Management Systems (CMS), developed by 84.37% of respondents. More complex systems are also developed but less often (up to 5 projects in two years): Web portals/Web directories, electronic catalogues, transactional business applications, CD-ROM/DVD multimedia applications. However, a vast majority of respondents had never developed e-learning applications (74.74%), news and other information services (61.29%) or complex cross-referenced documentation (63.44%). A few respondents added feed aggregators, web services, blog systems, touch screen applications and interactive maps as web/hypermedia systems developed in the past two years.

The features that characterize most commonly developed web/hypermedia systems include a database-driven web site, dynamically generated web pages as well as frequent and significant changes in content. However, many respondents claimed to have no experience developing systems with support for multiple delivery devices and web 2.0 applications (44.09% and 43.01%, respectively) in the past two years.

Considering the system complexity, expressed by number of screens/on-line pages [10], almost half of respondents (46.46%) indicated that they usually developed small web/hypermedia systems (up to 50 on-line pages/screens) while large-scale systems were

developed by 38.39% respondents. That is similar to Vora's findings [26] but quite different from Lang's findings [10], where two-thirds of respondents stated that the size of the systems developed exceeded 50 pages/screens.

The average Croatian web team have 3 designers/developers (mean = 3.34, median = 3), which is consistent with the findings of other studies [10, 26, 27]. One-man team is found in 13.79% of the companies, two- or three-member teams are found in 51.72% of the companies, four- to five-member teams are found in 26.44% of the companies, while only 8.05% of the companies have more than five web team members.

The participants also had to indicate the actual and anticipated project duration and cost of their most recently completed large-scale project. The project duration (in weeks) was indicated by 71.74% of 92 respondents, while the project cost was acknowledged by only 38.37% of 86 participants who responded to the questions (other possible answers were „Don't know" or „Not planned/recorded").

To exclude extreme values gathered for both project delivery times and costs, a 5% trimmed mean and median were used as measures of central tendency. It was found that the average planned delivery time was 8 weeks (5% trimmed mean = 7.81, median = 5.5), while the actual project duration was 11 weeks (5% trimmed mean = 10.98, median = 6) or 2 and a half months (see Table 1). That is 3 weeks less than the average project delivery in Ireland [10].

Table 1. Project duration (anticipated and actual)

	Anticipated duration (N=66)	Actual duration (N=72)
1-4 weeks	45.45.%	30.56%
5-8 weeks	30.30%	30.56%
9-12 weeks	6.06%	15.28%
13-16 weeks	4.55%	6.49%
17-20 weeks	1.52%	1.39%
21-24 weeks	3.03%	1.39%
More than 24 weeks	9.09%	13.89%

Comparing the planned and actual delivery times of particular projects, it was found that 60.61% of projects exceeded the planned schedule, 21.21% of projects were delivered on time and 18.18% of projects ended ahead of schedule.

The average planned cost of a complex project ranged from about 15,000 HRK, or approximately 2,000 € (median value), to 40,085 HRK, or approximately 5,400 € (5% trimmed mean value), while the average actual costs were slightly higher (median ≈ 2,120 €, 5% trimmed mean ≈ 5,800 €), but much lower than in Ireland (median ≈ 18,000 €, 5% trimmed mean ≈ 41,382 € [10]). However, project

costs are far better managed than project schedules, with one-third of the projects being delivered within the agreed costs and one-third of the projects experiencing cost over-runs.

To identify documentation management in projects, the participants were asked to indicate the number of requirements and/or the number of pages within written requirements specifications, as well as the usage of documented procedures or guidelines for web/hypermedia development. Out of 94 respondents, 51.06% of them had written requirements specifications for the most recently completed project. Using documented procedures or guidelines for web/hypermedia development is a common practice in a minority of companies, as only 37.23% of 94 respondents responded affirmatively, which is a percentage similar to Russo & Graham's findings [22] but much lower than in Lang's findings [11]. In most companies procedures for project planning, interface design/usability, requirements documentation and technical design documentation were developed.

Despite the low percentage of using documentation identified, Croatian designers/developers believe that project plans and working methods are essential and have to be explicitly documented (94.70% and 59.38% of respondents believe that, respectively).

The lack of adequate design documentation represents a minor to moderately problematic aspect in the web/hypermedia development practice. The most significant problem concerning web project management is communication with clients, due to their volatile and changing requirements, followed by difficulties preparing accurate time and cost estimates as well as those controlling project scope and feature creep. On the other hand, the design of the user interface or lack of guidance in the use of design methods and techniques were not perceived as a problem by most of the respondents.

4.3. Development process

Our study is in line with the international studies [1, 11] stating that web development is not as undisciplined as it is generally considered: 85.15% of respondents indicated that their organization used a web/hypermedia development process that had clear tasks and/or phases. In 62.38% of cases the process used was not explicitly documented, while in 22.77% of cases the process was explicitly documented.

To further explore the web/hypermedia development process in practice, participants were given an open-ended question to describe phases and/or activities of their organization's development process. Fifty-one respondents (50.49%) provided a description of the development process in their organization.

After the analysis and classification of all the responses, several phases and activities were identified in the development process in practice. The phases vary according to the purpose and complexity of the future web-based system and the contract with the cli-

ent. Many respondents indicated the need for clients' feedback after every phase, which suggests that the development process is iterative and incremental, as it was recognized in [27]. The practice development process is as follows:

- *Requirements Capture & Analysis* – activities in this phase are:
 - identification of purpose, goals, information needs, content and potential users of the application during the initial meeting with the client;
 - analysis of business processes, definition of required functionality and selection of web technology and development tools;
 - analysis of client's organization brand, analysis of competitors' web sites and marketing research if necessary;
- *Initial Proposal* – the phase comprises:
 - setting the rough concept of the web site's graphic and navigational design;
 - presenting a proposal to the client by mock-ups and storyboards delivered on the paper or in graphic editing software;
 - after approval, collecting the content (text and other media) for the web site;
- *Design Phase* – in this phase three activities can be distinguished:
 - *Conceptual Design* – includes the design of the information architecture of the application, where the structure of the database is planned and different diagrams are built;
 - *Navigational Design* – includes the construction of models with different navigational paths;
 - *User Interface Design* – several templates of user interface are sketched and authored in HTML/CSS. At this stage different multimedia elements are edited and optimized;
- *Development or Programming Phase (Implementation)* – activities in this phase are:
 - database construction, programming modules development and/or CMS design or upgrade;
 - system integration;
 - content loading;
- *Testing & Implementation of Subprojects* – different types of testing are carried out as well as the implementation of smaller subprojects. Application is also upgraded on the basis of user evaluation or new specific requirements;
- *Launching* – a "soft" launch of beta version is performed before client approval and final release;
- *Education & User documentation* – if needed, education is performed to introduce client or maintenance team with the system functions. User and technical documentation is also provided;
- *Release* – the phase comprises:

- a "hard" launch when the application goes online for the wide audience;
- other activities such as site promotion and search engines optimization;
- *Maintenance* – the last phase comprises maintenance of the system and its enhancements.

When comparing this practice development process with the development phases of specialized web/hypermedia design methods, it is evident that it consists of all phases identified in the design methods and described in [14], [16] and [22]. The practice development process goes even further to include web project management activities. What is different, however, is the terminology used for naming the phases in practice and literature. In the literature the term "implementation" is used for "application building", but Croatian developers denote application building as the *Development or Programming Phase* and broadly use the term "implementation" to denote the *Launching Phase* (similarly, "implementation" considered as "installation of web application" is found in [22]). Another difference identified is a very loose margin between the *Requirements Capture* and the *Analysis* phases, so in the practice process development they are comprised within one phase.

To identify whether the web/hypermedia development process in practice is supported by any of the methods, a closed multiple-choice question was introduced. More than half of participants, or 52.48% out of 101 respondents, indicated that they used in-house or hybrid methods. Only 5.94% of respondents used proprietary methodology, while 26.73% of respondents did not know or 14.85% of them did not use any methods.

To further explore the usage of different methods and approaches in web/hypermedia systems design, a list of them was introduced, based on the categories proposed by Lang in [10]. The participants were thus asked to indicate the extent of use of these methods in their organization's development process. Not surprisingly, the majority of respondents often or continuously used tool-driven development approaches, e.g. *PHP, Java, Flash, ASP, J2EE* (70.33% of 91 respondents). The other top response category was object-oriented development methods and approaches, e.g. *OOA&D, UML and MSF* (25.29% of 87 respondents), followed by rapid or agile development methods and approaches, e.g. *RAD, Extreme Programming* (19.54% of 87 respondents). The majority of respondents did not know or use any of the methods or approaches (with the exception of tool-driven development approaches) and the top three least known categories were specialized web/hypermedia development methods, traditional "legacy" software development methods and approaches, and incremental or evolutionary methods and approaches.

Surprisingly, 12 respondents (13.48%) indicated that they used specialized web/hypermedia development methods to some extent, which is a high per-

centage compared with the findings of two other studies [11, 25] which identified 4 and 2 respondents, respectively, having ever used some of those methods. As far as the authors of this study are aware, no web/hypermedia development methods have been introduced by Croatian universities yet. We believe that such a high percentage represents a bias resulting from the respondents' tendency to rather provide a positive than a negative answer and the fact that those methods were first on the list of the proposed method categories. These findings imply the need for more extensive research to explore whether and how these methods are used in practice. Also, regardless of whether design methods are used or not, it would be worthwhile to further examine the development process approaches.

Consistent with the findings indicating a relatively low percentage of use of proprietary software development methods and approaches, it was also found that formalized software diagramming techniques for modeling the conceptual architecture of web/hypermedia systems, such as entity-relationship diagrams, class diagrams, statecharts and use case diagrams, have a significantly lower percentage of use (between 42.9% and 22.2%) than informal techniques (e.g. storyboards, 79.6%) and semi-formal techniques (e.g. flowcharts, also 79.6%). Moreover, 36.5% of 96 respondents believe that diagramming techniques are not vital to communicate the conceptual structure of a web/hypermedia system (in contrast to 4.9% of Irish respondents [10]).

4.4. Opinions about web/hypermedia systems development

In the study, opinions about web/hypermedia systems development were also explored. In Table 2 the respondents' attitudes to the development guidelines and web trends are presented.

Interestingly, 30.21% of respondents believe that the Web 2.0 concept is more a matter of current trends in the web development and less a result of actual user needs, to which 27.08% of respondents disagree. Whereas 20.83% of respondents are neutral in that respect, 21.88% of respondents do not know or have no opinion about Web 2.0, which leads us to the conclusion that a significant number of respondents are not familiar with the new ways of using the Web as a platform. Also, this lack of knowledge upholds the finding that respondents have difficulties following current development trends, which was recognized as a minor to moderate problem by more than half of respondents (54.25%).

However, the majority of respondents (97.89%) indicated the internet as the most useful informal knowledge source. Services as varied as forums, portals, mailing lists and Microsoft Developer Network (MSDN) for specialized subjects were specified as means of acquiring and sharing information. Other very useful information sources indicated are observ-

ing or consulting experienced colleagues (94.79%), reading books, periodicals and magazines (86.46%), and consulting external specialists (77.9%). Many respondents (30.21%) are neutral about the usefulness of organizational policies and procedures with a slight tendency towards the positive attitude, but the same percentage of them do not use this source of knowledge at all. About the same percentage of respondents consider formal education (secondary or tertiary) both

useful (40.63%) and not useful (38.54%). Possible reasons for the negative attitude are inconsistent and out-dated curricula and rapid advancements in web technologies, so "workshops about usability, naming conventions, formalized development methods, team management and documentation management, would be very useful", as one respondent commented at the end of the survey.

Table 2. Attitudes to development guidelines and web design trends

	N	Don't know / No opinion	Disagree	Neutral	Agree
Client requirements are more important than user needs and satisfaction.	95	1.1%	59.0%	23.2%	16.8%
Visual design is more important than the content and functionality of the web/hypermedia system.	98	0.0%	67.4%	26.5%	6.1%
Navigation should be consistent and uniform throughout the web/hypermedia system.	97	1.0%	7.2%	4.1%	87.6%
Usability and accessibility guidelines increase the quality of a web site.	94	5.3%	2.1%	11.7%	80.9%
Development of the web site according to W3C standards and testing decreases maintenance costs and facilitates enhancements.	96	10.4%	17.7%	14.6%	57.3%
Web 2.0 applications are more a matter of new trends and less a matter of justified user needs.	96	21.9%	27.1%	20.8%	30.2%

5. Conclusion

The findings of this research reflect the web/hypermedia development practice of Croatian web designers/developers and are in line with the findings of other studies [1, 11, 21]. A Croatian web team consists of 3 designers/developers who develop Web or multimedia systems through a process with clearly defined phases and activities, using mainly tool-driven development approaches, as well as informal and semi-formal diagramming design techniques. The survey analysis showed that the development process is not as undisciplined as it is generally considered. Moreover, it comprises development phases and activities identified in practice, similar to those in specialized web/hypermedia design methods. However, the use of proprietary development methods is scarce and the vast majority of designers/developers use in-house or hybrid methods, which rely on tool-driven development approaches.

A typical web project includes scope planning and requirements documentation, yet with low tendency to use written procedures or standards/guidelines/rules in the process of web site development. The biggest problems in web or multimedia systems development are communication with clients and controlling the project time, cost and scope.

Therefore, to deal with the recognized problems, several areas of action which could help all stake-

holders in building better web and multimedia systems have been identified by the authors:

- conducting new qualitative research to explore and analyze communications issues in both web team and customer-to-designer relations;
- providing revised and renewed curriculum to students and workshops to practitioners so as to cover different issues in web/hypermedia development: specialized development methods, good design practice, usability and accessibility, web metrics, project management, communications skills etc.
- introducing current and future clients with the complexity of web/hypermedia development by promoting scientific findings in IT magazines and newspapers, which could help in bridging the communication gap among them and web professionals.

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