

People, Organizations, and Processes: An Inquiry into the Adoption of User-Centered Design in Industry

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The aim of this article is to improve our understanding of user-centered design (UCD) adoption and provide accordingly useful advice to the UCD community. UCD adoption was investigated through a Web survey. The results show that the early involvement of UCD practitioners in the product life cycle is more frequent compared to 10 years ago. It is also true that the methods and the techniques employed have shifted their focus from summative evaluation to rapid development cycles and from quantitative to qualitative evaluation methods. Based on the survey, there are several organizational factors UCD practitioners and their management should consider. UCD should be part of the business strategy and supported by higher management. Usability goals must be set through competitive analysis and practitioners should be rewarded if goals are reached or exceeded. For bespoke systems, usability goals should be explicitly discussed with the customer. Special attention should be paid to communication inside and outside the company so as to clarify the outcomes and benefits of the UCD approach.

1. INTRODUCTION

User-centered design (UCD; Norman, 1986) changed the focus of Human Factors (HF) engineering from the evaluation of human performance and error to the cou-

This research has been supported by a Marie Curie fellowship of the European Community program "Improving Human Research Potential and the Socio-Economic Knowledge Base" under contract number HPMI-CT-2002-00221.

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pling of design and evaluation activities in one development process. Applying a user-centered approach in system development has long been advocated by the whole HF research community. After 20 years of UCD teaching and dissemination, to what extent has it been adopted? Is it integrated within the system development process? In 1993 at a Bay-SIGCHI meeting, Donald Norman pointed out that the main issues are not the lack of human-computer interaction (HCI) expertise or methods but rather social and organizational; more than 10 years later John (2004) acknowledged that organizational issues relating to process development are high on our research agenda.

Our subjective assessment, as HF practitioners in the industry, fully matches these judgments. We therefore decided to investigate the current state of UCD adoption to learn what kind of organizational issues must be tackled. We designed and carried out a Web survey, targeted at UCD practitioners, addressing the following questions:

1. What usability methods and techniques are used in the different phases of the system development life cycle; especially, to what extent are UCD methods applied early in the development life cycle?
2. What are the actions conducted by practitioners and management that contribute to integration of usability in development projects?

In this article we first examine previous research on UCD adoption (section 2). Thereafter, we describe how we designed and delivered the survey (section 3), and we then present the results of the survey (section 4). Finally, we discuss the implications of the results to the UCD practice and the limitations of the study.

2. LITERATURE REVIEW

The seminal article of Lundell and Notess (1991) identified the key factors for HF engineering involvement in a big company. Their sample included two groups, 14 HF engineers and 21 research and development (R&D) software engineers working at Hewlett Packard (HP) labs. This research—even if with a limited sample—underlines the differences in perception between the two groups in defining the favorable and less favorable factors for HF involvement. HF engineers were focused on quantifiable performance measurement, whereas R&D engineers were interested in product improvements and rapid feedback from usability evaluation activities. The main shortcoming of this study is its small sample, with all of the people coming from the same organization (HP).

Rosenbaum, Rohn, and Humburg (2000) surveyed 134 HCI professionals and rated the effectiveness of a number of organizational and technical approaches with respect to their impact on the enterprise. Usability testing, both inside and outside of the laboratory, was rated as the most effective. However, the authors made the organizational approaches and usability methodologies equal by questioning the practitioners about the strategic impact of both kinds of activities, and they did not define in the questionnaire exactly what they meant by “strategic im-

fact.” This research setting does not make explicit that a specific usability methodology as such does not necessarily have a strategic value: A strategic value does not lie in a single method but in the interplay between organizational factors and the usability methodologies chosen.

With respect to organizational aspects of UCD, Vredenburg, Mao, Smith, and Carey (2002, p. 472)—see also Mao, Vredenburg, Smith, and Carey (2005)—investigated the overall organizational impact of UCD practice and measures of UCD success, as perceived by practitioners. In their questionnaire, the practitioners were asked to assess on a 7-point Likert scale issues such as whether UCD (a) had been widely used in product development, (b) had made a significant impact on product development, (c) had improved the usefulness and (d) usability of the products developed, had helped to save product development (e) time and (f) costs, and whether UCD methods were going to (g) have more significant impact or (h) achieve wider adoption on product development in the following 5 years. We find these statements quite generic and difficult to rate, especially (g) and (h), because they ask the practitioners to make a forecast of UCD impact and adoption in 5 years’ time. Questions (e) and (f) seemed to be difficult to assess, and most of the practitioners remained neutral for both ($M = 4.37$ and 4.41 , $Mdn = 4$, $SD = 1.51$ and 1.5). It is not easy to rate such items, especially if the respondents are not at management level. As an ulterior proof of such an argument, whereas practitioners believed they have a major impact on the company, most of them was unable to apply the success criteria they themselves identified to assess their own UCD practice.

Similar interest in organizational factors is shared by the recent research of Gulliksen, Boivie, Persson, Hektor, and Herulf (2004), which focuses on Swedish usability practitioners. Gulliksen et al. investigated the type of development process used in the organization, the degree of user involvement, the methods and techniques used, and organizational factors. Results show that the level of user involvement is constant in most software development phases; practitioners rated as effective those methods that are relatively informal and focus on design activities and management support and early involvement of UCD were both rated as important organizational factors.

We share the interest of the authors just mentioned in investigating UCD practice. Our research, however, does not focus on the effectiveness of individual methods and strategies (Rosenbaum et al., 2000) or on the practitioners’ subjective assessment of their success (Vredenburg et al., 2002), but on *UCD integration*: understanding the organizational adoption of UCD and the integration of UCD into the business processes of the organization (Venturi & Troost, 2004). Some of these dimensions are drawn from the available usability maturity models (ISO/IEC 18152, 2003; Jokela, 2004). To our knowledge, this is the first empirical study on the dimensions of UCD integration.

We define UCD as *integrated* (a) when UCD is brought in a timely way into the product life cycle, (b) UCD team is provided with the proper skills and experience, and (c) by means of a proper UCD infrastructure, (d) UCD is supported by management commitment, (e) when UCD awareness and culture are properly disseminated inside and outside of the organization and (f) the results of the UCD activities have impact on design decisions.

3. THE SURVEY

In this section we detail the content, format, language, measurement, and administration of the Web survey, comprising two questionnaires.

3.1. Design of the Questionnaires

The content of the first survey questionnaire (see Appendix A) included 30 items grouped into the following six sections:

1. Organization profile (characteristics of the company and of the UCD group).
2. Representative UCD project and practitioner profile (size of the project, practitioner role, and experience).
3. Systems developed.
4. UCD methods and techniques.
5. UCD integration: Management and infrastructure.
6. UCD integration: Communication.

The first three sections were aimed at collecting the profile of the practitioner and the context in which UCD is applied. A clear and simple wording, formatting, and style were consistently used throughout the questionnaire. The questionnaire is relatively long; to avoid measurement errors due to the respondents' progressive loss of concentration we introduced each section with a brief explanation, and we questioned the respondents about a specific, representative UCD project.

The fourth section is aimed at gathering data about the methods that are most frequently used and in which phases of the product life cycle of the selected project they are used. The last two sections deal with the UCD integration factors.

In the second stage we designed a short questionnaire (see Appendix B) with three open-ended questions, mainly aimed at supplementing the first survey (measuring quantitative or objective indicators of UCD adoption) with qualitative data. We were especially interested in gathering comments on the most relevant and controversial results of the survey: timeliness of involvement of UCD into development and usage of qualitative evaluation methods.

3.2. Distribution of the Survey

In April 2004, we forwarded an invitation to participate in the first survey (Appendix A) to the major newsgroups and forums related to HF and interaction design (ACM-SIGCHI, IDX, UK-usability, BCS-HCI). We also distributed a flyer with the invitation at the CHI 2004 conference. We explicitly asked only UCD practitioners to answer our call; eventually 83 of them successfully completed the Web survey within a time frame of 40 days. We cannot calculate the response rate, because the number of subscribers to each group is unknown and many of them are multiple subscribers.

In the second stage (November 2005, 18 months after the first survey) we distributed the second survey to the respondents of the first one. We collected qualitative feedback from 16 practitioners, with a response rate of about 19%.

3.3. Profile of People and Organizations

The UCD practitioners who responded come from a number of business sectors (Figure 1), mainly HCI consultancies, computer, telecommunications, and financial services. They are mostly from the United States (39) and European countries (30), mainly the United Kingdom (9) and the Netherlands (8).

The respondents were mainly HF specialists (34%) or user interface designers (33%) with a significant experience in UCD: Their experience falls between 5 and 13 years, with a median value of 7 years of experience. Most of them are full-time UCD specialists, devoting about 80% of their time to usability.

The organizations that the respondents belong to fall into two categories: development organizations ($n = 67$) and HCI/usability consultancies ($n = 16$).

1. In the first category, the respondents represent corporations or large companies: 54% have more than 1,000 employees, and many have introduced UCD quite recently: 47% in the past 4 years and only 15 % more than 12 years ago. The number of UCD practitioners compared to the total number of company employees is less than 1%: Most of the companies employ between two and six UCD practitioners. UCD resources are organized in a central department (33%), in teams (21%), or both (25%). UCD work is funded through the research and development budget (35%), by specific project funding (“bill-back by project;” 30%) or annual budget (28%); more than 30% of the respondents have two or more funding sources.

2. Firms falling in the second category (HCI/usability consultancies) are small scale (1–10 people) and are organized in project teams. They are funded through bill-back by project.

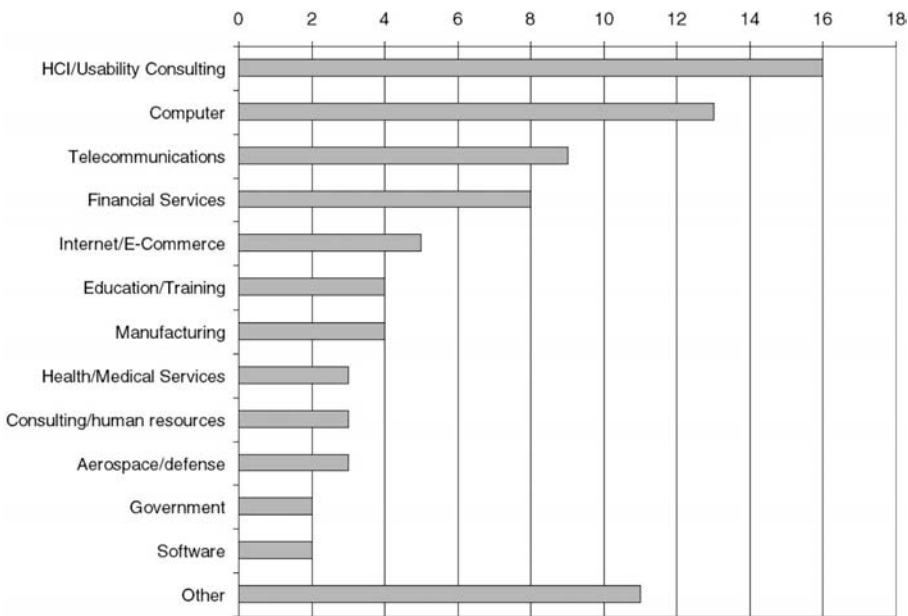


FIGURE 1 The respondents represented different business sectors ($N = 83$).

3.4. Profile of Projects and Products

Respondents reported having spent about 30% of their time in UCD activities in the project that we asked them to consider as representative of their work. However, there is a strong dispersion for this item: 50% of the answers range between 10% and 70%. Multidisciplinary teams seem not to be affordable: A significant number of UCD practitioner (31%) worked alone, and only 45% of UCD efforts can be considered truly multidisciplinary, which means involving more than three different disciplines.

Systems developed by respondents in the representative project were mostly based on a client/server architecture (64%) but also included single machine or embedded systems (26%). There were 45% of the systems supporting multiple users; 25% were specifically designed to support cooperative work.

4. RESULTS

4.1. UCD Methods and Techniques in the Development Life Cycle

We asked UCD practitioners to indicate the methods that they used in a representative project and in which phase (business analysis, requirements, analysis, design, development, test, and deployment) of the product life cycle. We can therefore analyze the methods usage life cycle in each phase of development. The results are shown in Table 1.

Overall, the most frequently used method is user interviews; 66 practitioners used it at least once in the representative project. Prototyping techniques are also used very frequently: high-fidelity (hi-fi) and low-fidelity (lo-fi) prototyping frequencies are 62 and 60, respectively. Lightweight usability evaluation methods also score high: expert and heuristic evaluation (58) and qualitative, “quick and dirty” usability test (57). Observation of real usage—which can be used either in requirements or evaluation phases—is frequently used too (56).

What might be the profile of the “average,” “real-life” UCD process? We can select the most frequently used techniques for each life cycle phase. A business analysis starts with an analysis of competing or existing products and user interviews; requirements analysis is carried out through user interviews, early human factor analysis, and use case analysis. In the analysis phase together with user interviews and use case analysis, the practitioners also use lo-fi prototyping, whereas in the design phase both hi-fi and lo-fi prototyping and qualitative, quick and dirty usability tests are widely used.

The average UCD process therefore employs use case analysis as a key technique to translate the user requirements into a specification, which is later embodied in one or more prototypes. The evaluation is mainly carried out with user involvement, but only qualitatively. Qualitative evaluation was carried out at least once by 57 practitioners, mostly in the design phase (39). Quantitative usability testing was less frequent: It was used in 34 projects at least once: 15 during the design phase and 14 during the test phase.

Table 1: The Use of Methods and Techniques at Various Phases of the Development Life Cycle

Method/Technique	Life Cycle Phase							
	Used in at Least One Phase	Business Analysis	Requirements	Analysis	Design	Implementation	Testing	Deployment
User interviews	66	21 ^b	43 ^a	34 ^a	34	13	16	5
Hi-fi prototyping	62	—	9	23	50 ^a	23 ^a	12	—
Lo-fi prototyping	60	8	22	34 ^a	44 ^a	8	8	—
Expert or heuristic evaluation	58	12	19	24	28	17	19 ^b	—
Qualitative, quick and dirty usability test	57	—	14	23	39 ^b	20 ^b	21 ^b	8
Observation of real usage	56	15 ^b	25	28	25	15	24 ^a	10 ^b
Scenarios	46	8	27	23	26	6	6	—
Style guides	46	—	13	8	33	23 ^a	10	4
Early human factors analysis	45	11	38 ^b	24	16	—	—	—
Use case analysis	45	9	33 ^b	31 ^b	20	10	6	—
Competitive analysis	44	29 ^a	25	15	9	—	—	—
Setting quantitative usability goals	40	4	19	22	13	7	9	—
Usage centred design	38	11	16	24	28	14	11	5
Req. engineering techniques	37	7	31	17	11	5	—	—
Usability walkthrough	37	—	10	11	25	13	14	—
Focus groups	35	12	23	13	15	7	7	—
Contextual analysis	35	11	21	17	14	4	5	—
Storyboarding	35	6	6	18	25	5	4	—
Cognitive walkthrough	34	—	12	15	17	9	12	—
Quantitative usability testing (to collect performance)	34	—	8	10	15	6	14	9 ^b
Hierarchical task analysis	34	6	19	20	8	—	—	—
Personas (Alan Cooper)	33	8	21	14	14	5	5	—
Usability checklist	30	—	6	15	15	9	16	5
Satisfaction questionnaires	30	—	5	11	15	8	14	13 ^a

Note. N = 83. Hi-fi = high fidelity; low-fi = low fidelity.

^aThe most frequently used method(s) for each phase. ^bThe second and the third mostly used methods in each phase.

The comments of the respondents in the second survey indicate that one potential reason for this choice of methods is the scarcity of resources in respect of time, facilities, and competencies. For example,

The problem I have run into is that it is difficult to get to large numbers of customers for quantitative surveys. I always try to do this, and get blocked by a number of factors: corporate folks who want to control access to the customers ... and sometimes lack of resources to do the survey and analysis

and “Due mainly to resource and time limitations we do little or no quantitative measurements. We rely mainly on feedback from internal and external users. I believe management would need some hard evidence to consider resourcing such evaluations.”

Out of 17 respondents, 10 indicated otherwise, that qualitative methods were especially suited to UCD:

In the real world, it's hard to get access to any representative users for testing, certainly not enough for statistically significant results. I use a mix of quantitative and qualitative (data) and always try to publish findings with some numeric metric/scale even if it is only that “80% of test users failed to complete this task.”

And “Qualitative methods are more appropriate for UCD, because quantitative values are at best averages, and are not representative of the majority of users.”
And

It is the qualitative insights that have a positive impact on design. I would add one other thought. In some cases, there is not as much summative (quantitative) testing done because metrics can be collected live ... as more qualitative work is done during the early envisioning and design processes, confidence in the products is higher, and the need for summative testing reduced.

The data also reveal the overall deployment of UCD at the various phases of a development life cycle (Figure 2).

Most UCD activity is carried out during requirements (71), analysis (70), and design phases (73): Less activity is reported in the test and deployment phases (52% and 27%, respectively). Based on these results, one can conclude that UCD is usually involved in a timely manner in the product development life cycle. This result, confirmed by comments from our respondents, contradicts the preconception that usability is often brought up at the end. These comments include the following four:

In our organisation the User Experience Group is involved early in the process. We have influence on the requirements, UI parts can only be implemented if we have designed it and specified. We work together with product management and development (which leads to get the best possible design.

And

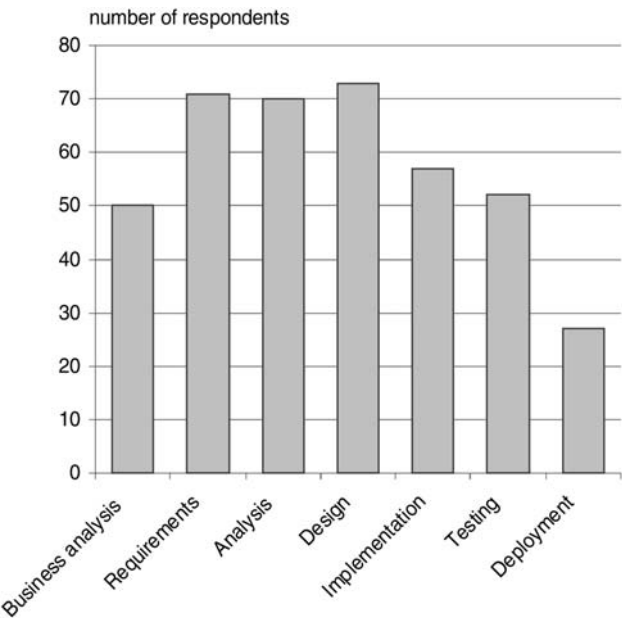


FIGURE 2 Adoption of UCD methods at various phases of a development life cycle. For each phase, we included those projects that employed at least one UCD method (*y* axis).

UCD was brought up early, there was a flurry of interaction between the designers and target users, once that initial exchange of ideas was over, the designers went away and the target users were never brought into the process until version 1.0 was rolled out.

And “At our company we start the requirements capture process by defining the User Requirements, but I would prefer to consider UCD even earlier, at concept and feasibility stages.” And

I do as much as possible before the implementation, even before the specification of the realization concept. We have to work hand in hand with the product managers who specify the basic requirements, and refine them in terms of interaction model/user workflow.

One respondent coming from a HCI consultancy gave his own explanation of why UCD is better incorporated at the beginning:

It has been my observation (as an external consultant) that in many companies, people who work in business analysis or have other early-stage responsibilities have had an easier time in incorporating UCD. This is, I believe, because they are not adding new steps to the process, but changing the focus of existing steps.

However, other respondents reported that the early involvement of UCD sometimes has a difficult time in integrating with other business processes, especially if centered on engineering or marketing:

It really depends on the environment. If it's an engineering based environment, then UCD is typically an afterthought—we'll just slap a skin on it at the end. If it's an advertising agency, or marketing company, then visual design and selling is a priority first, followed by UCD. So, in those cases, we're typically brought in somewhere in the middle. So, really it depends. We tend to work with larger clients who get it a bit more than engineering, advertising, and marketing driven companies. So, we're typically brought in the first phase of the project, but still not at the very beginning, which would be ideal.

And

Depending on the acceptance for UCD methods and the skills/seniority of the UCD professionals, UCD may not be well integrated. Requirements are often driven by marketing or engineering, with minimal input from UCD. Design is a more successful stage for UCD involvement, in my experience, but organizations differ widely in how many of the UCD team's concerns get incorporated into the final design.

4.2. UCD Integration

The last two section of the questionnaire include a set of 10 integration factors related to the management (see Table 2; M₁–M₆) and communication (C₁–C₄) of UCD. According to the answers of the UCD practitioners ($N = 83$), management usually understands that usability and UCD should be part of the business strategy (M₁) and takes actions to maintain and improve user-centered design skills, resources,

Table 2: Management and Communication Factors

<i>Factors</i>	<i>Items</i>	<i>Yes</i>	<i>No</i>	<i>Not Sure/No Response</i>
M ₁	Does business management understand that usability and user-centered design (UCD) must be part of the business strategy?	51	17	13/2
M ₂	Does business management set usability goals on usability for systems? Is there a reward mechanism for reaching these goals?	56	21	1/5
M ₃	Is UCD focus addressed in acquisition activities? Are goals shared with the customer?	35	29	13/6
M ₄	Does business management take action to know how the usability of their product compares to that of their competitors?	33	38	6/6
M ₅	Does senior management take action to maintain/improve UCD skills, resources, technology, awareness, and culture in the organization?	42	33	3/5
M ₆	Are direct/indirect, short-term and long term business benefits tracked by business management?	33	27	15/8
C ₁	Have common terminology, templates or tools for the exchange of data between the different professions involved in UCD been developed and used?	57	20	3/3
C ₂	Are UCD outcomes (e.g., design solutions, error reports) understood and applied inside the company?	51	23	5/4
C ₃	Is effective communication made to raise the awareness and culture of UCD inside your company?	56	18	6/3
C ₄	Is effective communication made to raise the awareness and culture of UCD outside your company?	35	36	9/3

Note. This table displays the frequencies ($N = 83$) of management (M₁–M₆), and communication factors (C₁–C₄).

Table 3: Chi-Square Tests of Association Among the Diverse UCD Integration Factors

	C ₁	C ₂	C ₃	C ₄	M ₁	M ₂	M ₃	M ₄	M ₅	M ₆
C ₁	—	.240*	-.036	.087	.014	.107	-.071	.138	-.055	.038
C ₂		—	.284*	.90	.385**	.140	.215	.046	.132	.295*
C ₃			—	.402**	.532**	.143	.123	.272*	.331*	.227
C ₄				—	.300*	.356**	.396**	.523**	.274*	.251*
M ₁					—	.215	.275*	.325**	.487**	.232
M ₂						—	.381**	.521**	.278*	.213
M ₃							—	.365**	.230	.146
M ₄								—	.373**	.240
M ₅									—	.369
M ₆										—

Note. The table shows the results (ϕ) of 36 tests of association among the UCD integration factors. Strong and medium effect sizes are in bold. UCD = user-centered design.
* $p < .05$. ** $p < .01$.

and technology and usability awareness and culture in the organization (M₅). However, management does not seem to set usability goals or provide incentives for reaching good usability (M₂). Commitment from the management was often cited among the most important factors for a successful adoption of UCD. One respondent commented that “support for integration of UCD by Development Executives is the single most critical factor.”

Communication between the different disciplines involved in UCD is a frequent activity: Most of the companies have developed common terminology, templates, and tools for the exchange of data between the different stakeholders involved in UCD (C₁). They also understand and apply UCD outcomes such as design solutions and error reports (C₂). Effective communication on the business value of UCD takes place more frequently inside of a company (C₃) than to stakeholders outside (C₄).

Being dissatisfied by a descriptive level of analysis, we explored the extent to which the management and communication factors (M₁–M₆, C₁–C₄) are related. For example, if management in a company is committed to UCD, does it typically take action to maintain and improve UCD infrastructure (skills, resources, technology, awareness, and culture)? Does it track short-term and long-term business benefits? In other words, what is the likelihood that the diverse factors are mutually dependent? To find out the relationships, we applied a chi-square test of independence, which is a specific statistical method for measuring the association between nominal variables. We applied chi-square tests ($df = 1$, $N = 83$) on the 10 factors pairwise (M₁ and M₂, M₂ and M₃, etc.; see Table 3) obtaining 45 values of association (Phi coefficient, ϕ). In the analysis, we excluded for each pair of factors the categories *not sure* and *no response*.

The results of the analysis (Table 3) show a high number of statistically significant (4 with $p < .05$ and 12 with $p < .01$) associations particularly between a set of management (M₁–M₅) and communication factors (C₃–C₄). Some of these associations show a large effect size¹ (M₁–C₃, $\phi = .532$; M₄–C₄, $\phi = .523$; M₄–M₂, $\phi = .521$).

¹Cohen (1998) conventions for ϕ are that .10 is a small effect size, .30 is a medium effect size, and .50 is a large effect size.

In other words, it is very likely that

1. If business management sees UCD as part of its business strategy (M_1), an effective internal communication is carried out to raise the awareness and culture of UCD inside the organization (C_3).
2. If business management takes action to know how the usability of their product compares to that of their competitors (M_4), communication is carried out outside the company to raise the awareness and culture of UCD (C_4).
3. If business management takes action to know how the usability of their product compares to that of their competitors, it does set usability goals on usability for systems—and incentives for reaching them as well (M_2).

We wanted to detect the structure of the relationships we discovered through principal components and factor analysis. Are the seven variables we selected (C_3 – C_4 , M_1 – M_5) related to one or more groups of factors? We applied a principal component and factor analysis on this subset, and we discovered that they refer mainly to one group.

The results show the weight of each of the chosen dimensions on the main factor (see Table 4) that has a high eigenvalue (2.8) and explains about 41% of the total variance. The other components extracted are much less influential (eigenvalue < 1). In other words, the interaction between the UCD factors we chose is mainly explained by one component that we can relate to the “UCD integration” definition that we introduced earlier.

Table 4: Principal Component and Factor Analysis for UCD Integration Factors

<i>UCD Integration Factors</i>	<i>Loadings: Factor 1</i>
Business management takes action to know how the usability of their product compares to that of their competitors (M_4)	.738
Effective communication made to raise the awareness and culture of UCD outside of the company (C_4)	.700
Usability and UCD must be part of the business strategy (M_1)	.669
Senior management takes action to maintain/improve UCD skills, resources, technology, awareness, and culture (M_5)	.620
Business management sets usability goals and incentives for reaching them (M_2)	.613
Effective communication made to raise the awareness and culture of UCD inside the company (C_3)	.583
UCD focus addressed in acquisition activities and usability goals shared with the customer (M_3)	.553
Explained variance (%)	41.23
<i>Eigenvalue</i>	2.886

Note. This table displays the results of principal component and factor analysis made on a subset (C_3 – C_4 and M_1 – M_5) of the user-centered design (UCD) integration factors. The main factor has a high *eigenvalue*, and it explains about 41% of the total variance. The other components extracted are much less influential (*eigenvalue* < 1).

5. IMPLICATION

Our study suggests that there are several factors critical for a successful adoption of UCD in a development organization. These dimensions should be taken into account by UCD practitioners and in particular by the managers responsible for the effectiveness of UCD processes.

1. Management should ensure that UCD is part of business strategy, included in the mission of the company and supported by higher management (factor M_1). Management should set usability goals (performance, satisfaction, etc.) and provide incentives that should be awarded whenever usability goals are reached or exceeded (M_2). For bespoke systems, these goals should be explicitly discussed with the customer (M_3).

2. Competitive analysis should play an important part of the UCD process when determining usability goals. A company's products should be benchmarked against competitive products in terms of usability (user performance and satisfaction, M_4).

3. Outcomes delivered at different phases of a UCD process should be clear to the development staff and to the customer when applicable. Communication of UCD must be a primary concern for UCD practitioners and their management. This activity should therefore be carried out both within and outside of the company (C_3 and C_4). The study by Rosenbaum et al. (2000) confirms the importance of this task. Their study revealed cultural resistance to UCD or usability (26%) and lack of knowledge and ineffective communication of UCD value (30.6% combined) among the major organizational obstacles.

6. DISCUSSION

The results of the research show that, not surprisingly, the top five UCD methods are user interviews, expert/heuristic evaluation, qualitative usability test, hi-fi prototyping, and lo-fi prototyping. Lo-fi prototyping is as frequently applied as hi-fi prototyping. This suggests that computer-based prototyping has become more affordable and easy to perform than some years ago. Overall, the most frequently used evaluation methods are qualitative, allowing rapid feedback to the design activities. This result is consistent with the practitioners' perception of the effectiveness of methods (Gulliksen et al., 2004). UCD practitioners currently make use of a larger mix of interaction design and formative evaluation techniques—in contrast with the practitioners interviewed by Lundell and Notess in 1991, who were mainly focused on techniques for summative evaluation. Such an early coupling in the design cycle between interaction design and usability evaluation means that the focus is on formative evaluation and rapid development of prototypes.

Another interesting result is that UCD activities are typically carried out during the early phases of the product life cycle: requirements, analysis, and design. This result is new, and it conflicts with the long-held myth that usability is usually brought in at the end, too late to have significant impact on design solutions.

The results further show that a set of management and communication factors should be taken into special consideration by UCD practitioners and management: UCD should be included in the business strategy (M_1 in Tables 2 and 3), usability goals should be set through competitive analysis (M_4), reaching the goals should be included in the reward mechanism of the organization (M_2), usability goals should be discussed with the customer (M_3), and attention should be paid to the communication within and outside of the company (C_3 and C_4).

6.1. Limitations

As is the case with earlier surveys, some of our findings are based on perceptions of UCD practitioners rather than on hard facts. Another limitation of our study is the fact that a Web survey does not allow the calculation of an exact response rate, unlike a mail survey. Moreover, we cannot be sure that our sample is a representative set of the whole population of UCD practitioners.

Some of the respondents reported the questionnaire to be too long. After collecting and analyzing the data, we realized that we should have excluded some items in particular in section 2, which proved not to be useful for further analysis and for drawing useful conclusions.

7. CONCLUSIONS

The results of this survey reveal new insights on how UCD is adopted in industry. Today UCD seems to be brought in in a more timely fashion at the beginning of the product life cycle than it was 10 years ago. UCD now plays a particular role in the requirements, design, and analysis phases. The most frequently used evaluation methods are qualitative, and they allow rapid feedback to the design activities. Surprisingly, lo-fi prototyping is applied as frequently as hi-fi prototyping, probably because of the advancement of tools and techniques for prototyping. We also found how organizational factors play an important role in adopting UCD. We recommend that to further enhance its position, UCD should be part of the business strategy and endorsed by higher management; usability goals should be set through competitive analysis, and incentives should be granted for reaching or exceeding such goals. In designing bespoke systems, usability goals should be explicitly defined with the customer. The outcomes and benefits of the UCD approach should be clearly communicated within and outside the company.

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APPENDIX A

First Questionnaire

(1/6) Please answer some questions related to your company.

1. What is the name of your company?
2. What is the business sector which your company belongs to?
 - Aerospace
 - Automotive
 - Computer
 - Education/Training
 - Financial Services
 - Government
 - Health/Medical Services
 - HCI/Usability Consulting
 - Internet/E-Commerce
 - Manufacturing
 - Oil & Gas/Petroleum
 - Publishing
 - Retail/Wholesale
 - Defense
 - Telecommunications

- Other _____
3. What is the size of the company?
 - Sole practitioner
 - 2–5 employees
 - 6–10 employees
 - 11–25 employees
 - 26–50 employees
 - 51–100 employees
 - 101–250 employees
 - 251–500 employees
 - 501–1,000 employees
 - 1,001–5,000 employees
 - 5,001–10,000 employees
 - over 10,000 employees
 - More
 - I am not sure/I don't know
 4. How many years ago was UCD approach first introduced in the company?
 - _____
 - I am not sure/I don't know
 5. How many UCD people are there in your company?
 - _____
 - I am not sure/I don't know
 6. How are UCD people organized in your company?
 - They belong to a Central department.
 - They are in different teams.
 - Both. They are in different teams but they belong to a central department too.
 - Other _____
 - I am not sure/I don't know
 7. How is UCD group funded? (You can use a multiple choice if you think you need it)
 - Annual budget
 - Bill-back by project
 - Part of R&D Budget
 - Other _____
 - I am not sure/I don't know

(2/6) We will ask to you some questions related to the use of UCD approach in the company. To better answer to them, please try to focus on a single, specific, representative project.

8. What was your main role in the project UCD project team?
 - User interface designer
 - Graphic designer
 - Human factor specialist
 - Tech. manager
 - Software developer

- System engineer
 - Marketing manager
 - Technical writer
 - Human resource manager
 - Support
 - Other _____
9. How many years of experience do you have in UCD-related activities?
- _____
 - I have no experience in UCD related activities
10. Could you possibly estimate how much of your time (in percentage, over total) was devoted to UCD activities?
- _____ %
 - I am not sure/I don't know
11. How many single disciplines, including your one, were represented and included in the UCD team?
- 1 (only me)
 - 2
 - 3
 - 4
 - More
 - I am not sure/I don't know
12. Could you possibly estimate the number of man-days used by the project on UCD activities?
- _____
 - I am not sure/I don't know
13. Could you possibly estimate how much of project time (in percentage, over total) was devoted to UCD activities?
- _____ %
 - I am not sure/I don't know

(3/6) The following questions will focus on the system(s) developed in the representative project.

14. Where the system developed was physically resident?
- On a single machine
 - On a server
 - Other _____
 - I am not sure/I don't know
15. What was the typology of the system?
- Commercial off-the-shelf product
 - For in-house use
 - Customized for a specific customer
 - Other _____
 - I am not sure/I don't know
16. What was the typology of system-user interaction?
- Single user
 - Multiuser

	<i>Business</i>							
	<i>Analysis</i>	<i>Requirements</i>	<i>Analysis</i>	<i>Design</i>	<i>Implementation</i>	<i>Test</i>	<i>Deployment</i>	<i>Other</i>
Usability checklists	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Usage centred design	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Architecture usability evaluation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Model based design	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Usability walkthrough	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Card sorting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Participatory design	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Qualitative, "quick and dirty" usability test (to obtain feedback)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Quantitative, usability test (to collect performance metrics)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Satisfaction questionnaires	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (1):	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (2):	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

(5/6) Please answer now to some questions related to the overall UCD in business strategy, in your company.

19. Does business management understand that usability and UCD must be part of the business strategy?

- Yes
- No
- I am not sure/I don't know

20. Does business management set usability goals on usability for systems? Is there a reward mechanism for reaching these goals?

- Yes
- No
- I am not sure/I don't know

21. Is HCD focus addressed in acquisition activities? Are usability goals shared with the customer?

- Yes
- No
- I am not sure/I don't know

22. Does business management take action to know how the usability of their product compares to that of their competitors?

- Yes
- No
- I am not sure/I don't know

23. Does senior management take action to maintain/improve user-centered design skills, resources, technology, awareness, and culture in the organization?

- Yes
- No
- I am not sure/I don't know

24. Are direct/indirect, short-term, and long term business benefits tracked by business management?

- Yes
- No
- I am not sure/I don't know

(6/6) Finally, answer to some questions related to the overall communication and reuse of UCD data, culture, awareness.

25. Have common terminology, templates or tools been developed and used for the exchange of data between the different professions involved in UCD?

- Yes
- No
- I am not sure/I don't know

26. Are UCD outcomes (e.g., design solutions, error reports) understood and applied inside the company?

- Yes
- No
- I am not sure/I don't know

27. Is effective communication made to raise the awareness and culture of UCD inside your company?

- Yes
- No
- I am not sure/I don't know

28. Is effective communication made to raise the awareness and culture of UCD outside your company?

- Yes
- No
- I am not sure/I don't know

APPENDIX B

Second Questionnaire

1. What are, in your opinion, the critical factors for a successful adoption of UCD in a development organization?

2. Our study gives evidence that UCD is usually brought up in the early phases of the product life cycle: requirements, analysis, and design. How does this match with your experience?

3. Our study gives evidence that qualitative methods are more often used than quantitative evaluation methods. How does this match with your experience?

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