

Integrating Usability and Human Factors in Software Engineering Lifecycle and Organizations

Software Usability Economics

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Outlines

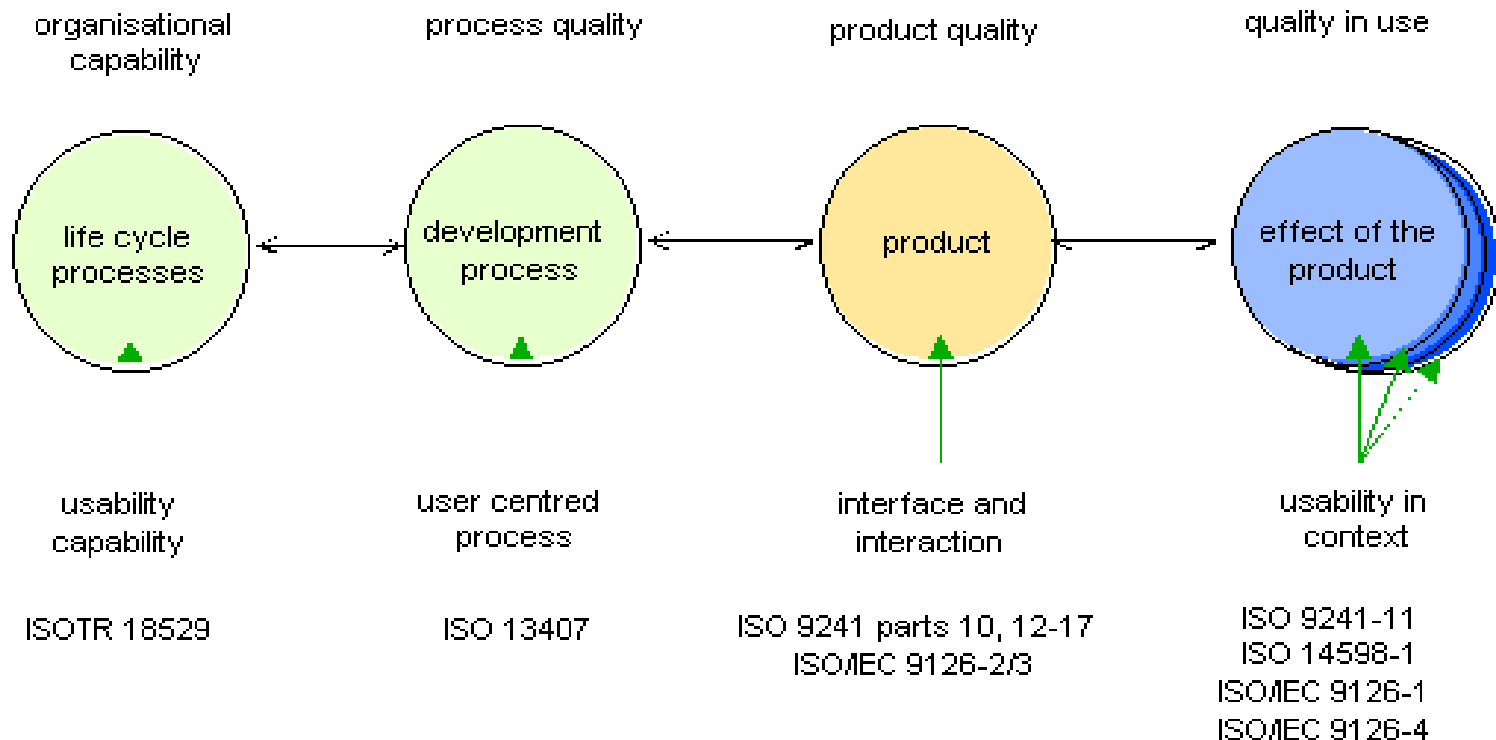
- ◆ **Usability as a Software Quality Characteristic**
- ◆ **Surveys on Software Usability Cost-Benefits**
 - **Training and Support**
 - **Marketing and Sales**
 - **Development and Maintenance**
- ◆ **How Usability can be Engineering and Integrated in Software Engineering?**

Usability is so popular...

- ◆ **IBM (1999) “It makes business effective. It makes business efficient. It makes business sense”.**
- ◆ **American industry and government will become even more productive if they take advantage of usability engineering techniques” Ex-Vice President Al Gore**

Usability is recognized...

Human Computer Interaction



Usability is recognized...

Software Engineering Quality Models

- ◆ Boehm Model (1978)
- ◆ Mc Call Model (1977) - also called GE model or FCM for factor, criteria and metric
- ◆ ISO 9126 Model (1991, 2001) - Software engineering standard on quality characteristics and and guidelines for their use

Usability is a Software Quality Characteristics

ISO 9241-11 - Guidance on Usability defines usability as a high-level quality objective

- ◆ “The extent to which a product can be used by a specified **set of users** to achieve specified goals (tasks) with **effectiveness**, **efficiency** and **satisfaction** in a specified context of use”
- ◆ Effectiveness, efficiency and satisfaction are measurable attributes

Usability is a Software Quality Characteristic

ISO/IEC 9126-1 define usability as the external attributes of software quality

- ◆ “A set of software attributes that bear on the effort needed for use and on the individual assessment of such use by a stated or implied set of users”

Usability is a Software Quality Characteristic

ISO/IEC 14598-1 build a bridge between system quality as and the quality in use

- ◆ **“Quality in use** is the extent to which a product used by specified users meets their needs to achieve specified goals with effectiveness, productivity and satisfaction in specified contexts of use”
- ◆ **Cause/effects relationship between quality in use and internal attributes of software product**



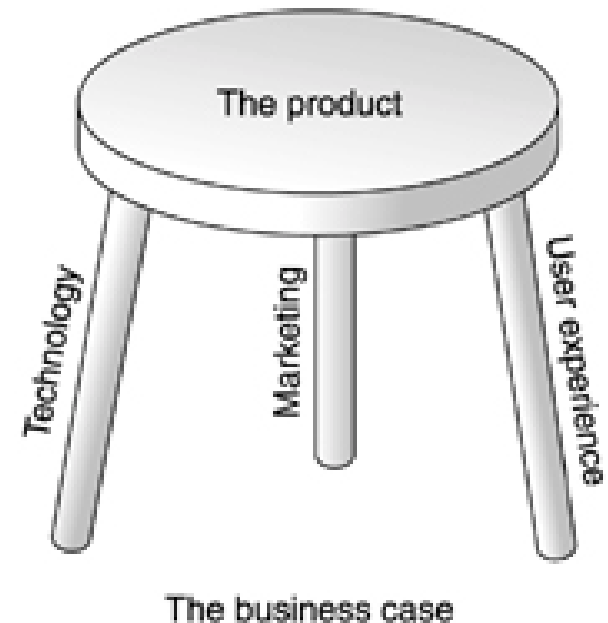
Some of the Benefits of Usability



- ◆ Increased sales and customer satisfaction
- ◆ A competitive and advertising advantage
- ◆ Improve productivity and efficiency
- ◆ Reduced training costs and time
- ◆ Lower support and maintenance costs
- ◆ Health and safety legislation compliant
- ◆ Lower documentation and support cost
- ◆ Litigation deterrence

Usability Cost-Benefits

- ◆ For a company – usability decreases development and maintenance costs and increases sales.
- ◆ For end users – usability increases user satisfaction, productivity and performance
- ◆ **Cause/effects relationship:** A commitment to usability in the **software development lifecycle** can increase **user satisfaction** and **sales**



Decreasing Training and Support Costs

American Express Customer Service

- ◆ Integrating an electronic performance support system (Wizard) in an existing system
- ◆ Conclusions after usability testing
 - Training period – 12h > 2h
 - Productivity – 17 > 4 minutes/request
 - Errors rate – 20 > 2%

AT&T saved \$2,500,000 in training expenses as a result of usability improvement

Increasing Sales

Creative Goods tested 10 e-commerce sites for the 1999 holiday season

- ◆ 39% of shoppers failed in their buying attempts because sites were too difficult to use.
- ◆ 56% of search attempts failed (i.e. using the search engine on the e-commerce site).
- ◆ If these search attempts had been successful and only 25% of them had resulted in purchases, online retailers would earn an additional \$3 billion this year.
- ◆ Lack of usability is the most important reason

Reducing Development Costs

Human Resource department of a company complains of redundant data entry screens for processing a job application

- ◆ Human resources and usability expert estimate cutting processing time in 25% if one screen was used.
- ◆ Currently it takes 4 hours to process an application costing \$25 *4 hours = \$100

Reducing Development Costs (Continued)

- ◆ The company receives 1000 applications a year with a cost of \$100,000 to process ($\100×100).
- ◆ The company will save \$25,000 if the one screen approach is to be implemented.
- ◆ It will cost \$ 2400 ($\$60 \times 40$ hours) to implement the system
- ◆ The company uses 8% discount factor
- ◆ Typical life span of a system at the company is 3 years

Net Present Value Analysis for Implementing the Project

	Year 0	Year 1	Year 2	Total
Development cost	\$2,400.00	\$0.00	\$0.00	
Discount factor of 8%	1.000	0.926	0.857	
Present value of annual cost	\$2,400.00	\$0.00	\$0.00	
Total present value of cost				\$2,400.00
Benefits derived from system	\$25,000.00	\$25,000.00	\$25,000.00	
Discount factor of 8%	1.000	0.926	0.857	
Present value of annual benefits	\$25,000.00	\$23,150.00	\$21,425.00	
Total present value of benefits				\$69,575.00
Net present value of investment				\$67,175.00

Decreasing Support Costs

It cost between \$12 and \$250 per call to provide telephone support for computer software

- ◆ Ford motor company incurred a one time cost of \$70,000 to build a usability lab and usability test for an accounting software used by car dealership
- ◆ Ford got support calls down to zero
- ◆ Initial saving was \$100,000 and the benefits continued in subsequent years

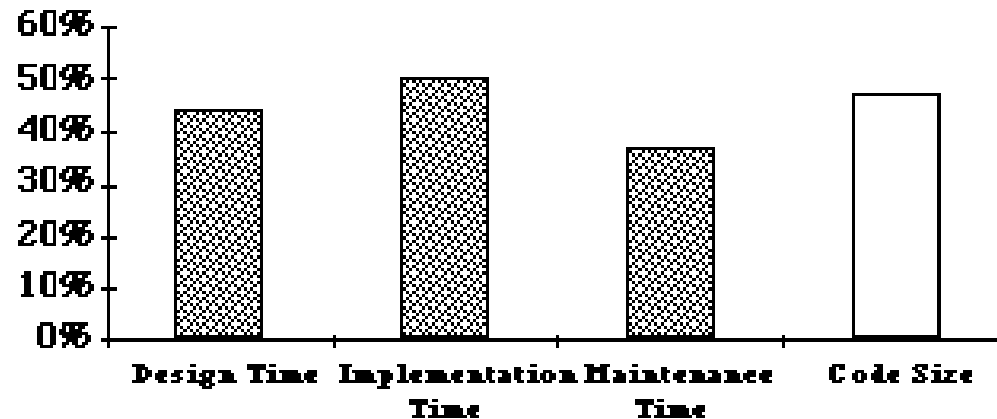
Human Safety and System Failures

Usability was identified as a major cause of a law suite

- ◆ American Air Lines law suit against Budget, Marriott Corp. and Hilton Hotels after the failure of \$165 million car rental and hotel reservation system

User Interface is an Important Neglected in Software Development

- ◆ 47-60% of the code devoted to the interface
- ◆ 50% the development time is spend on the user interface (MacIntyre et al, 1990; Mayer, 1995)



User Involvement in Software Development

Involving users in the development lifecycle ensures that the product is being designed so that users will be satisfied

- ◆ User involvement is one of 12 best influences on software engineering [IEEE Software, January 2000]
- ◆ In a survey of 8.000 of projects, the Standish Group found that the number one reason that projects succeed is due to users involvement during the development process

User Involvement in Software Development

Project Success Factors	% of Responses
1. User Involvement	15.9%
2. Executive Management Support	13.9%
3. Clear Statement of Requirements	13.0%
4. Proper Planning	9.6%
5. Realistic Expectations	8.2%
6. Smaller Project Milestones	7.7%
7. Competent Staff	7.2%
8. Ownership	5.3%
9. Clear Vision & Objectives	2.9%
10. Hard-Working, Focused Staff	2.4%
Other	13.9%

User Involvement in Software Development

Project Challenged Factors	% of Responses
1. Lack of User Input	12.8%
2. Incomplete Requirements & Specifications	12.3%
3. Changing Requirements & Specifications	11.8%
4. Lack of Executive Support	7.5%
5. Technology Incompetence	7.0%
6. Lack of Resources	6.4%
7. Unrealistic Expectations	5.9%
8. Unclear Objectives	5.3%
9. Unrealistic Time Frames	4.3%
10. New Technology	3.7%
Other	23.0%

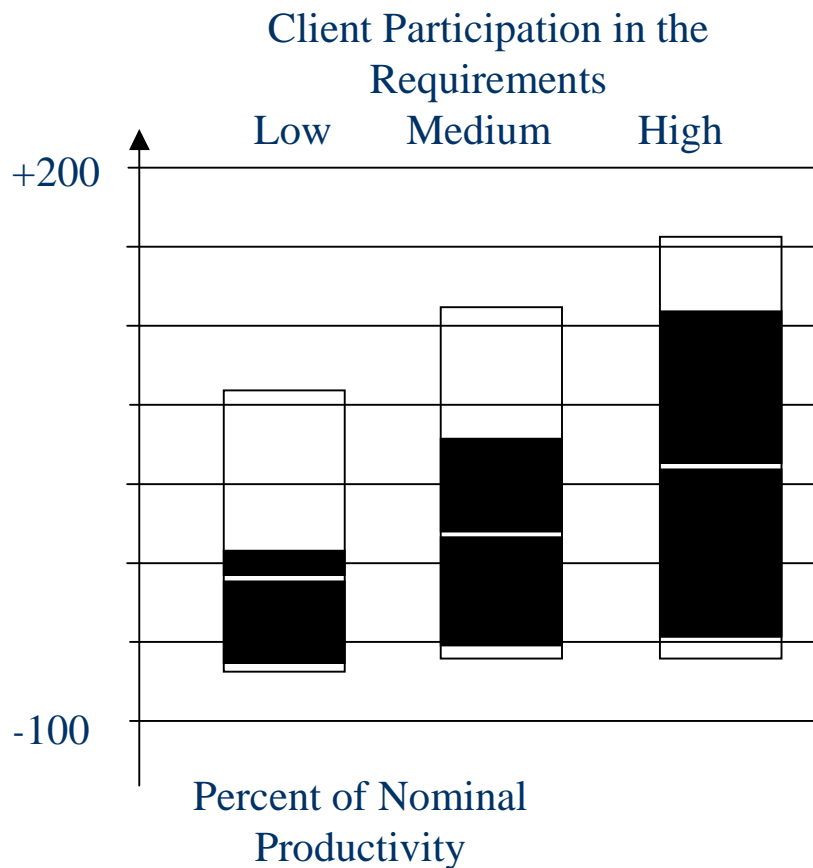
User Involvement in Software Development

Project Impaired Factors and ultimately canceled	% of Responses
1. Incomplete Requirements	13.1%
2. Lack of User Involvement	12.4%
3. Lack of Resources	10.6%
4. Unrealistic Expectations	9.9%
5. Lack of Executive Support	9.3%
6. Changing Requirements & Specifications	8.7%
7. Lack of Planning	8.1%
8. Didn't Need It Any Longer	7.5%
9. Lack of IT Management	6.2%
10. Technology Illiteracy	4.3%
Other	9.9%

A common myth is that usability engineering adds to development time and costs

- ◆ Usability engineering has demonstrated reductions in the product-development cycle by over 33-50%
- ◆ 63% of all software projects overran their estimates, with the top 4 reasons all related to usability
- ◆ Yourdon (1993) reports that peopleware issues can literally cause 10-fold productivity improvements, while investments in CASE, methodologies, or other technologies rarely cause more than a 30-40 percent improvement.

User Involvement Increases Developers Productivity



- Vosburgh et al. (1984) reports that productivity was about 50 percent higher than average when customers had a high level of participation in the requirements specification

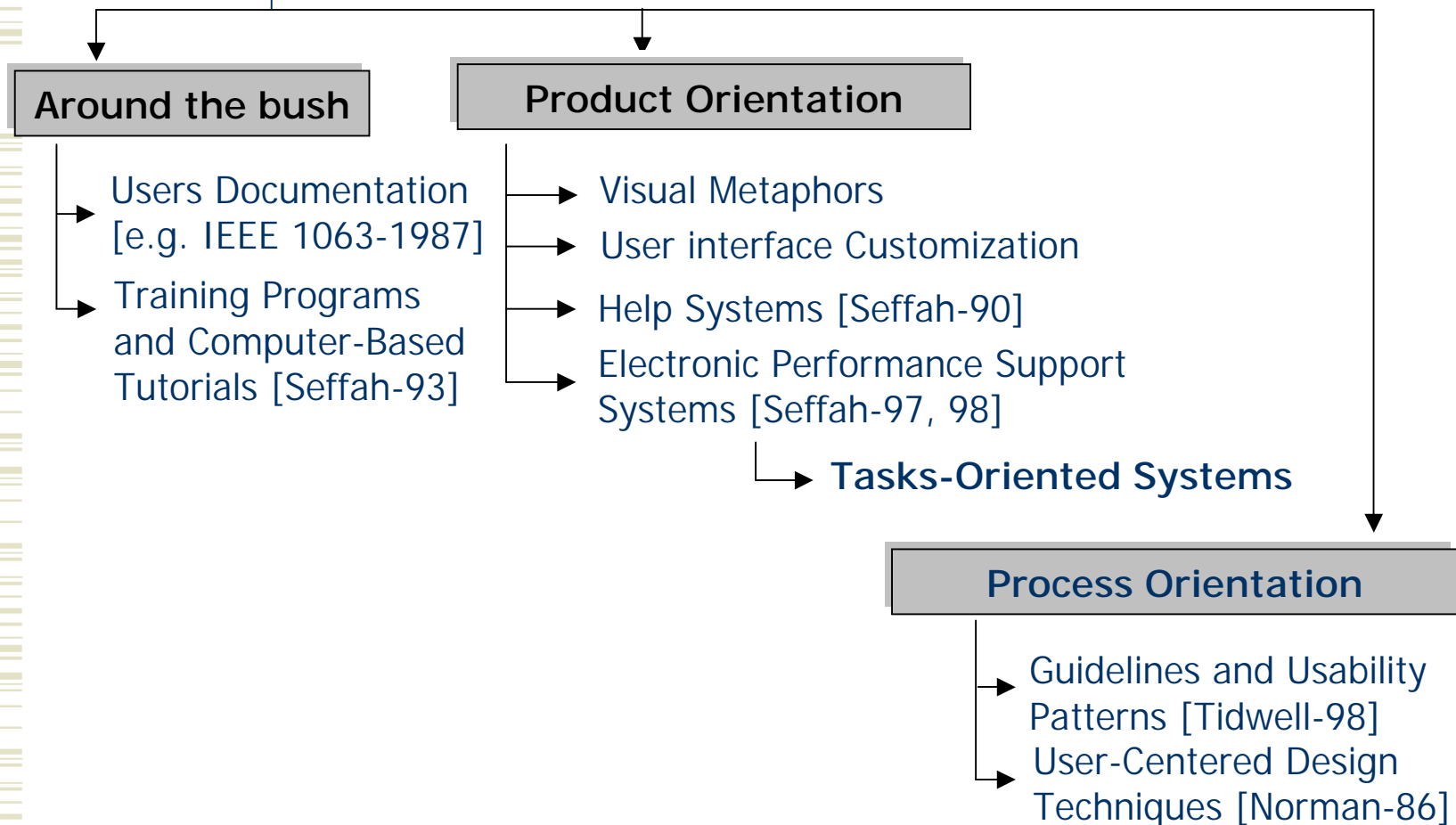
User should be Involved before and not after Development

- ◆ Maintenance costs represent 80% of total software development costs
- ◆ 80% of total maintenance costs are related to problem of user with the system; not technical bugs (Boehm, 1991; Pressman, 1992; Martin, 1993)
- ◆ Among them, 64% are related to usability problems (Ease of use and learning) (Laundauer, 1995)
- ◆ A change may cost 1.5 units of project resource during conceptual design, 6 units during early development, 60 during systems testing and 100 during post-release maintenance (Pressman, 1992).

How much money, a software development company can save?

- ◆ The rule of thumb: for each dollar a company invests in developing the usability of a product, the company receives \$10-\$100 in benefits (Karat, 1995)
- ◆ For each dollar spent to fix a problem during product design, \$10 is spent to fix the same problem in product development, and \$100 or more are spent to fix the problem after product release.

How Usability Can be Engineered?



Software Usability Future – Need of Integration

Yes, usability engineering is a shorthand descriptor for the process and techniques intended to make a systems easy to learn, easy to remember, efficient, error-preventive and satisfying.

But, software engineering have their own techniques and tools for managing this whole process, so where exactly in this usability and its related engineering techniques should be placed and integrated with existing software engineering methods to maximize benefits gained from these.



Current Investigations



- ◆ QUIM - Model and Tools for Specifying, Measuring and Predicting Quality in Use
- ◆ UPADE - Usability Patterns-Assisted DDesign Framework for Web and Mobile Applications
- ◆ SUCRE - Software-to-Usability Communication and (in) User Requirements Engineering
- ◆ Human-Centered CASE Tools



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- ◆ Standish Group. “CHAOS Chronicles or CHAOS: A Recipe For Success”. 1995