

PNSOC

OCTOBER 9-11 2023

AMP IT UP:

TRANSFORMING QUALITY

PNSQC.ORG

Elevating User Experience Across Your Software Organization: A Guide to UX Maturity Models for Software Teams



Application of Usability Testing to GUIs For The Electronic Design Automation Industry

By Kirolos George

Top Paper Award



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Philip Lew President, Pacific Northwest Software Quality Conference



KIROLOS GEORGE





Biography

- Senior quality assurance software testing engineer in Siemens EDA for almost 11 years
- ISTQB & ASTQB certified tester (Foundation Level Agile Tester Mobile Tester Usability Tester – Test Analyst)
- Best speaker award in PNSQC 2022 as first author: Application of usability testing to GUIs in the electronic design automation industry
- Primary author of paper addressing freelancing digital platforms at ICT in Our Lives 2020
- Co-author of SPIE Advanced Lithography 2014 paper
- Bachelor's degree in electrical engineering, electronics and communications from Ain-Shams University, Egypt
- MBA from ESLSCA European University
- Interested in: software testing & quality, electronic design automation, semiconductors, digital platforms & marketplaces.



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- Introduction
- Business Value of Design
- Industry Insights
- UX Lifecycle
- Capability Maturity Models
- Various UX Capability Maturity Models
- How to Transform your Organization





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PNSQC 2023 Speaker Feedback

Please share your best words from this talk on LinkedIn using the Hashtag #pnsqc2023 #kiro_uxmm





Introduction

- Design is at the heart of both disruptive and sustained commercial success in physical, service, and digital settings
 (Ex: the Swiss Army knife, the humble Google home page, or the Disneyland visitor experience)
- Companies need stronger design capabilities than ever before





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Business value of design

- In 2018, McKinsey tracked the design practices of 300 publicly listed companies over a five-year period in multiple countries and industries.
- Their senior business and design leaders were interviewed or surveyed. McKinsey team collected more than two million pieces of financial data and recorded more than 100,000 design actions.
- They analyzed all these data and came up with the McKinsey Design Index MDI which rates companies by how strong they are at design and—for the first time—how that links up with the financial performance of each company





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Business value of design

 McKinsey found a strong correlation between high MDI scores and superior business performance.) year period. 3000

publicly listed companies tracked.

>100k

design actions recorded.



pieces of financial data collected.



Traditional product development

Many software companies rely on the functionality of their products

- They claim they know what the user need (without research)
- They are functionality-driven
- They do lots of rework after production



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Today's software market characteristics



- Using latest technology
- Offering more than the user needs
- Targeting multiple segments and multiple generations (X - Y –Z)
- New business models: SaaS, PaaS, etc....
- More competition



UX Definition & the relationship between user experience and usability



User experience includes all the users' emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviors and accomplishments that occur "**before, during and after use**" (ISO 9241-210).





HOW UX WANTS TO BE SEEN

- Field research
- Face to face interviewing
- Creation of user tests
- Gathering and organizing statistics
- Creating personas
- Product design
- Feature writing
- Requirement writing
- Graphic arts
- Interaction design
- Information architecture
- Usability
- Prototyping
- Interface layout
- Interface design
- Visual design
- Taxonomy creation
- Terminology creation
- Copywriting
- Presenting and speaking
- Working tightly with programmers
- Brainstorm coordination
- Design culture evangelism

HOW UX IS TYPICALLY SEEN

- Field research
- Face to face interviewing
- Creation of user tests
- Gathering and organizing statistics
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- Product design
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- Working tightly with programmers
- Brainstorm coordination
- Design culture evangelism









US

UX strategist

Objectives clarification
Employs methodology
Vision and solutioning
Planning prioritization
Roadmap strategies
Execution oversight
Measurement

UR

User researcher

Owns research strategy
 Performs heuristic reviews

- Plans, conducts research
- Reviews analytics
- Builds personas, empathy
- maps, journeys
- Voice of the user / customer

BA Business analyst

- Understand business strategy, scope

Articulates, clarifies
business objectives
Deep product knowledge
Defines business value

- Person-logical

- Navigation schemas

- Scalable patterns

- Journey maps

- Taxonomies

- Organization schemas

architectures

Defines business value
 Voice of the business

Information architect

ID Interaction designer V

Interaction modeling
Experience design
Mental modeling
Storyboards
Wireframes
Mockups
UI accessibility

CS

Content strategist

Content mapping
Tone, voice, style
Content creation
Cultural context review
Content organization
Copy editing
Communications

Visual designer - Graphics and art - Iconography - Typography - Color - Style - Branding - Spacing and hierarchy

VD

Front-end developer - Code to implement designs - Front-end frameworks - Development languages - Web, native, hybrid

FED

- Functionality and integration - Coded accessibility

(User Experience is a team effort)

@MECUXD 2020

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Value of usability



Usability is one of the most important quality characteristics of software intensive systems and products. Usable systems are easy to learn, efficient to use and satisfactory in use

Usability results in many benefits, including:

- Increased productivity
- Improve error-avoidance
- Enhanced quality of work
- Improved user satisfaction
- Increase in use & ease of use
- Reductions in support and training costs



Key for today's product development



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Industry insights



UX practitioners from the Bosch Design Studio work alongside product engineers to build optimized user-centric solutions. They start with empathetic user research which lays the foundation for the design process that follows. **Using storyboards, customer journey maps, user-flow diagrams, sitemaps and prototypes, they collaborate with the customer in an iterative process**, thereby delivering a product/service desired by them.



https://www.bosch-softwaretechnologies.com/en/explore-and-experience/how-ux-can-make-todays-businesses-more-profitable/



Business Benefits of UX



- Reduce development costs
- Reduce support costs
- Competitive advantage
- Increased customer retention



https://www.bosch-softwaretechnologies.com/en/explore-and-experience/how-ux-can-make-todays-businesses-more-profitable/



Press Release



Schneider Electric Wins UX Design Award Concept Category, Underscoring Innovative, User-Centric Approach to Facility Management





"Building management software and solutions can be very technical and when displaying all possible information, they may create complexity in making fast decisions," said Manish Kumar, Executive Vice President of Global Digital Energy Division at Schneider Electric. "We've worked to solve this issue in our Design Lab by developing a model for a unique, user-centric interface that simplifies and prioritizes relevant data and addresses the needs of the facility manager — by providing relevant information at the right time with an attractive look to the interface. We're delighted that the judges recognized the value of this approach and how we implemented it at IntenCity."



Acquisitions are typically an indication that a company sees an opportunity to enhance its own product offerings

- Capgemini closes its acquisition deal of Idean, an experience design consultancy firm [1]
- Tangent, the creative technology agency, has stumped up £1m to acquire Decibel Digital, the experience design agency, in a move geared toward bolstering its user experience offer. [2]



1. <u>https://www.globenewswire.com/news-release/2017/02/16/917846/0/en/Capgemini-Capgemini-strengthens-its-digital-leadership-with-the-acquisition-of-digitalstrategy-and-design-consultancy-Idean.html</u>

2. https://www.thedrum.com/news/2017/01/05/tangent-lays-down-1m-decibel-digital-bolster-user-experience-offer

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UX LIFECYCLE

Primary UX lifecycle processes specified according to ISO 24744

The proposed UX lifecycle involves four primary processes or phases:

- Analysis
- Design
- Formative evaluation
- Summative evaluation
- and produces two outcomes
 - User requirements
 - The product





Kieffer, S. *et al.* (2020) 'A process reference model for UX', *Communications in Computer and Information Science*, pp. 128–152. doi:10.1007/978-3-030-41590-7_6.

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How to improve the usability of software?

To improve the usability of software and information systems,

user-centered design (UCD) methodologies have been established:

- Usability engineering (UE)
- Human-centered design (HCD)
- User-centered design (UCD)
- Agile user-centered design integration (AUCDI)

DT vs UCD vs HCD



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How to improve the usability of software?



Some organizations view UCD as:

- Not very visible
- A challenge

Start by evaluating your current state using **current state analysis**

Such current state analyses are often called **capability maturity models** (CCMs)



Capability Maturity Models

Definitions



Capability: refers to the ability to achieve the required goals of a process

Maturity: refers to the ability to **consistently** implement processes.

Sometimes we have the capability but not the maturity

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Maturity models

- Maturity models have their roots in quality management.
- Maturity models have been proposed for a range of other activities, such as:
 - Research and development effectiveness
 - Product development
 - Innovation
 - Product design
 - Collaboration
 - Product reliability



Other names for maturity models

- Stages-of-growth models
- Stage models
- Stage theories
- Engines for continuously improving systems
- Roadmaps for guiding organizations
- Blueprints for designing new entities

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Typical purposes/uses for maturity models

Descriptive: The model diagnoses current capabilities

Prescriptive: The model suggests specific actions for improvement



Comparative: The model enables benchmarking with similar organizations



Maturity dimensions



Process maturity: extent to which a specific process is explicitly defined, managed, measured, controlled, and effective



Object/technology maturity: extent to which a particular object like a software product, a machine, or similar item reaches a predefined level of sophistication



People: extent to which the workforce can enable knowledge creation and enhance proficiency

Mettler, T. (2011) 'Maturity assessment models: A design science research approach', *International Journal of Society Systems Science*, 3(1/2), p. 81. doi:10.1504/ijsss.20 11.038934.

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Criticism of maturity models



MMs are characterized as "step-by-step recipes" oversimplifying reality and lacking empirical evidence.



MMs tend to neglect the potential existence of multiple equally advantageous paths



MMs are not configurable according to the organizational environment



MMs should prioritize the factors that drive change and evolution, rather than focusing on a specific sequence of levels leading to a predetermined end state.

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Criticism of maturity models

5.)

Many identical maturity models



Unsatisfactory documentation of the design process



Overemphasis on the process perspective and MM's disregard of people's capabilities



Too strong a focus on formalization of improvement activities accompanied by extensive bureaucracy can hinder people from being innovative

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Logic Aging behind /Technological Maturity Mature **Technology Performance** maturity models Growth Embryonic Effort Expended/ Time

Innovation maturity


The "S" curves of innovation



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Diffusion of innovation





Relation between maturity and diffusion of innovations



Mettler, T. (2011) 'Maturity assessment models: A design science research approach', International Journal of Society Systems Science, 3(1/2), p. 81. doi:10.1504/ijsss.2011.038934.

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Capability maturity models

Capability/Maturity Models (CMMs) include a Process Reference Model (PRM) and a Process Assessment Model (PAM).

- PRM defines a set of processes characterized by statements of process purpose and process outcomes
- PAM is a measurement structure for the assessment of the capability or performance of organizations to implement processes
 - A PAM is related to one or more PRMs. It forms the basis for the collection of evidence and rating of process capability.

CMM Best Practices (PRM) Assessment tool(s) (PAM)



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Capability maturity models

CMM



CMMs include five or six levels that describe the level of capability/maturity of a process



To determine the capability levels of processes and maturity level of an organization, the organization's practices are compared to activities or best practices defined in a process reference model

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ISO 15504 levels

Optimising

The process is continuously improved to meet relevant current and projected business goals



Level 5

Optimizing

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A process area is:

A group of related activities that together contribute to the achievement of a common goal

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Capability levels vs. maturity levels



NOTE: Higher levels of capability may give greater confidence that an organization's business goals will be met; lower levels of capability may indicate potential sources of risk.

- Capability levels apply to an organization's process improvement achievement in individual process areas.
- Maturity levels apply to an organization's process improvement achievement across multiple process areas.





Maturity levels

Each maturity level matures an important subset of the organization's processes, preparing it to move to the next maturity level.





UX Capability Maturity Models

Who studied and developed UX maturity models

Many UX experts and researchers, practitioners, and thought leaders have investigated this topic

Christiane Gresse

von Wangenheim

Pekka

Abrahamsson

A Guide to UX Maturity Models for Software Teams

Thaísa C.

Lacerda

Bill Hefley

Mikko

Siponen

Bronwen Taylor

Eric

Schaefer



Jonathan

Earthy



Watts

Humphrey

Suzanne

Kieffer

Vincent Kervyn de Meerendré

Jakob Nielsen



Luka

Rukonić

Timo

Jokela

Philip B. Crosby



Jean Vanderdonckt



UX maturity models roots

- The ancestor of all usability maturity models is **Crosby's maturity grid**, QMMG (Crosby 1979).
- Many models have CMM or ISO 15504 as a background
- Some models can be used for the examination of the user-centeredness of individual development projects only, while other models can be used to analyze the status of UCD in various other organizational viewpoints.





Measurement Categories	Stage 1: Uncertainty	Stage 2: Asrakening	Stage 3: Enlightenment	Stage 4: Wisdom	Stage 5: Certainty
Management understanding and attitude	Ne comprehension of quality as a management toot. Trend to blame quality expandment for "quality problems"	Recognising that quality management may be of value that not willing to provide money or time to make it all happen	While going through quality improvement programme learn more about quality metagement becoming supportive and helpful	Participating Understand absolutes of quality menagement, Recognise there personal role in continuing emphasis	Consider quality management as an essential part of company system
Guality organisation status	Guality is hidden in minufacturing or engineering departments, inspection probably not part of organisation Emphases on appraisat and serting.	A stronger quality leader is appointed but main emphasis is still on appraisis and moving the product. Skill, pain of manufacturing or other	Guality department reports to top management, all appraisel is incorporated and management of company	Guality manager is an officer or company effective status reporting and preventive action. Involved with customer affairs and special assignments	Guality manager on bot of directors. Prevention main concern. Guality is thought leader
Problem handling	Problems are fought at they occur no resolution; insdequate clinitrition; tots of yelling and accurations	Teams are set up to attack major problems. Long-range solutions are not solicited	Corrective action communication established. Problems are tacked openly and resolved in an orderly way	Problems are identified early in their development. All functions are open to suggestion and intprovement	Except in the most unusual cases, problem are prevented
Cost of quality as % of sales	Reported: Unknown Actual: 203	Reported: 3% Actual: 18%	Reported 8%	Reported: 5.5%	Reported: 2.5% Actual: 2.5%
Guality Improvement actions	No organised activities, No understanding of such activities	Trying obvious "motivational" short-range efforts	Implementation of a multi-step programme is g. Crosby's sa-steppinish thoreuppn understanding and establishment of each'step.	Continuing the multi-step programme and starting other pro-active / preventive product quality initiatives	Guality improvement is a normal and continued activity
Summary of company quality posture	"We don't know why we have problems with quality"	"Is it absolutely necessary to always have proteiems with quality."	Through management commitment and quality improvement we are identifying and resolving our problems."	"Defect prevention is a routine part of our operation."	"We know why we do n have problems with quality"

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What is the value ?

The value of this process improvement approach has been confirmed over time.

Organizations have experienced:

- Increased productivity
- Increased quality
- Improved cycle time
- More accurate and predictable schedules and budgets [Gibson 2006]





UX capability/maturity





Usability capability/maturity determines the ability of a development organization to perform effective user-centered design and thereby to develop usable products.



How do we improve the usability capability of development organizations? • The first step in an improv



- The first step in an improvement process is to understand the current status: What are the strengths and weaknesses in usercentered design in the organization?
- In the world of software development, PAMs have been introduced as a basic method for analyzing the current organizational status by performing process assessments in software development organizations.



UX maturity

A UX maturity model is composed of two main elements:

- A set of organizational areas, such as development practices, processes, infrastructure, and skills
- The capability maturity levels for rating each of the areas





Process area

A process area is:

A group of related activities that together contribute to the achievement of a common goal

Rukonić, L., Kervyn de Meerendré, V. and Kieffer, S. (2019) 'Measuring UX capability and maturity in organizations', *Design, User Experience, and Usability. Practice and Case Studies*, pp. 346–365. doi:10.1007/978-3-030-23535-2_26.

Process Area Process Attributes PA1 Product Development high-fidelity prototypes PA2 Visual Design design principles (icons, font, colors, look & feel) PA3 Stakeholders Involvement stakeholders analysis; context meeting; focus group PA4 Discount UX Evaluation inspection; think-aloud; low-fidelity prototypes inspection(heuristic evaluation; cognitive PA5 Experts involvement walkthrough); GOMS; hierarchical task analysis **PA6** User Involvement regularly throughout development lifecycle PA7 Iterative Design creation of redesign solutions; formative UX testing PA8 UX Resources UX skills; infrastructure (prototyping tools; labs) **PA9** User Research experience sampling; surveys; interviews; personas context of use analysis and specification (A1-A5); PA10 Contextual Design UX goals setting; work modelling perception of UX; management support of UX; PA11 UX Culture lifecycle integration; link to business goals PA12 Continuous Improvement Link to business goals; UX training; UX KPIs; UX effectiveness data collection; PA13 Monitoring of UX



UX process assessment model (UXPAM)

Evaluate:

- The integration of UX within the organization
- UX budget
- Researcher-designer-developer ratio (Designer:Developer (D:D) ratio)
- UX buy-in throughout organization
- The frequency of UX evaluations as key indicators of UX capability/maturity
- Infrastructure to implement UCD in projects (e.g. prototyping tools or usability lab)
- Efficiency, effectiveness and quality of the planning and implementation of UCD



UX process assessments format

Assessments are done in the form of:

- Questionnaires
- Interviews
- Checking work products evidence
- Self-assessments

Assessments are done by:

- Internal experienced experts
- Third-party assisted
- Certified professionals





Previous UX maturity models





The first usability maturity models were:

- 1. Trillium by **Bell Canada** (a general maturity model including usability engineering)
- 2. Usability Leadership Maturity Model by **IBM (US)**
- 3. HumanWare Process Assessment model by **Philips (Netherlands)**
- 4. User Centered Design Maturity by **Loughborough University (UK)**

All these models were developed in the early 1990s.

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Previous UX maturity models

Further developments for usability maturity models include:

- Human-Centeredness Scale
- DATech in Germany
- SDOS in Japan
- KESSU in Finland



International Organization for Standardization (ISO) contribution

Since the late 90s, the International Organization for Standardization (ISO) has actively contributed the documentation of UCMMs/UXCMMs.

- ISO/IEC 15504 (revised in 2015 by ISO/IEC 33004):
 - Area of concern: Process reference models, process assessment models, and maturity models for software engineering.

• ISO 13407 (revised in 2019 by ISO 9241-210):

• Area of concern: Human-centered design principles and activities throughout the lifecycle of computer-based interactive systems.

• ISO/TR 18529 (revised in 2019 by ISO 9241-220):

- Area of concern: Processes and outcomes of human-centered design within organizations.
- ISO 18152:
 - Area of concern: Human-systems (HS) model for assessing the maturity of an organization in performing processes that make a system usable, healthy, and safe.
- ISO 9241 -220 & 221
 - Area of concern: Human-centered design process and the assessment of human-centered design practices.







Various UX maturity models

Jonathon Earthy, 1998

ID	Title	
Level X	Unrecognised	
	(no indicators)	
Level A	Recognised	
Al	Problem recognition attribute	
A2	Performed processes attribute	
Level B	Considered	
B.1	Quality in use awareness attribute	
B.2	User focus attribute	
Level C	Implemented	
C.1	User involvement attribute	
C.2	Human factors technology attribute	
C.3	Human factors skills attribute	
Level D	Integrated	
D.1	Integration attribute	
D.2	Improvement attribute	
D.3	Iteration attribute	
Level E	Institutionalised	
E.1	Human-centred leadership attribute	
E.2	Organisational human-centredness attribute	

Renato Feijó, 2010

Eric Schaefer, HFI, 2004					
Jsability Maturity M	odel			/	O Human
Not there () Somewhat present () Pre-	Inex		Ma	naged Usab	ility
Usability Activity	Level 1 Beginning Usability	Level 2 Executive Champion	Level 3	Level 4	Level 5
Strategy					
Written Strategy	0	0	0		
Infrastructure					
Product and Site Review Process	0	0	0	0	0
User Centered Design Methodology	0	0	0	•	0
Integrated Software Dev. Process	0	0	0	0	0
Corporate Design Standards	0	0	0	•	۲
Showcase Projects	0	0	0	•	0
Education and Training					
Continuous Training	0	0	0	0	0
Usability Staff	0	0	0	0	0
Developer	0	0	0	0	0
Management.	0	0	0	•	0
Staffing					
Executive Champion	0	0			
Usability Team	0	0			•
CUA on Staff	0	0	0		0
10% Usability Staff	0	0	0		۲
Organization Certificate Audit				8	8

Johan Berndtsson, 2014

@jjkercher 🤗

Jakob Nielsen 2006			
UX Maturity Stage	Featuring	Time to next stage	
1: Hostility	Developers simply don't want to hear about users or their needs	Up to decades	
2: Developer-Centered	Design team relies on its own intuition	2-3 years	
3: Skunkworks	Guerilla user research or external usability experts	2-3 years	
4: Dedicated Budget	Usability is planned for	2-3 years	
5: Managed	Someone to think about usability across the organization	6-7 years	
6: Systematic Process	Tracking user experience quality	6-7 years	
7: Integrated User- Centered Design	Employing usability data to determine what company should build	~ 20 years	
8: User-Driven Corporation	Usability affects corporate strategy and activities beyond interface design	~40 years to get from star	









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2

Unrecognized

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UX maturity models categories

- **Standard process assessment models** (ISO 18529, ISO 18152) use the format of process assessment models used in software engineering.
- Non-standard models (Trillium, Philips, KESSU) examine processes, but with non-standard approaches.
- Generic models (ULMM, UCDM, UMM-HCS, DATech UEPA, Standardized Usability/User-Experience) include process aspects, but also larger issues such as management awareness, skills, and organizational position on usability.
- **Specific models** (HCD-PCM visioning) have a limited focus.

Standard	Non-standard
process assessment	models
models	(Trillium, Philips,
(ISO 18529,	KESSU)
ISO 18152)	examine processes
Generic models (ULMM, UCDM, UMM-HCS, DATech- UEPA, Standardized Usability/User- Experience process aspects + management awareness + skills + organizational position on usability	Specific models (HCD-PCM visioning)



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UX maturity models



Jokela, T. *et al.* (2006) 'A survey of Usability Capability Maturity Models: Implications for practice and Research', *Behaviour & Composition Technology*, 25(3), pp. 263–282. doi:10.1080/01449290500168079.

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UX maturity levels

Increase UX process in product development and in management acknowledgment

Level	Characteristics
1: Unrecognized	UX not considered A wake-up call is needed
2: Initial	Low/late user involvement Individuals perform UX processes Ad-hoc management of UX Unpredictable quality of products (processes often changes)
3: Tactical	Insufficient support from top executives UCD is accepted, but sometimes traded off for development Lack of formal UX literacy
4: Strategical	Full understanding of UX ROI UX ROI is linked to the business goals UX is controlled and predictable
5: Optimal	Continuous improvement of UX processes UX culture established The leadership is user-centered

Rukonić, L., Kervyn de Meerendré, V. and Kieffer, S. (2019) 'Measuring UX capability and maturity in organizations', *Design, User Experience, and Usability. Practice and Case Studies*, pp. 346–365. doi:10.1007/978-3-030-23535-2_26.

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How to transform your organization

Maturity model application phases (SPAT)



Mettler, T. (2011) 'Maturity assessment models: A design science research approach', *International Journal of Society Systems Science*, 3(1/2), p. 81. doi:10.1504/ijsss.2011.038934.

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What to consider when selecting a model

Origin: Academic - Practitioner-based

Select Phase **Reliability:** Untested - Validated

Practicality: General recommendations - Specific improvement activities

Accessibility: Free - Charged

Application method: Self-assessment – Third-party assisted – Certified professionals

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What to consider when preparing deployment

Realization: Informal appraisal - Formal assessment project

Prepare Deployment phase



Application area: Specific entity - Multiple entities

Respondents:

Management - Staff - Business partners - Combination

Training: None - Basic - Extensive



What to consider when applying the model

Frequency of application: Non-recurring - Repeated



What to consider when taking corrective actions



Line organization - Staff organization - Externals





Recommended UXMM

- Jonathan Earthy usability maturity model (UMM)
- Human factors integration process risk assessment (HFIPRA)
 - The process model was further validated through international review by ISO TC159/SC4/WG6 and published as ISO 18152
- KESSU developed in a national research project at Oulu University in Finland
- Nielsen Norman UX maturity model
- ISO 9241 -220 & 221



UX maturity models in practice

 • UX awareness • Accessibility • UX training and education 	 User centered design User Research Standardized design process 	 • UX Roles • Requirements engineering • Software architecture • Cross functional collaboration and communication 	 • UX KPIs • UX Budget • UX Decision Making
UX Education	UX in	UX in	UX in
	development	organization	management



Important takeaways

 Organizations need to take care to remain on the best maturity level they have reached

 An organization may have some processes of high capability, but the usability-driven results may be diminished in decision making


Requirements for high usability products or services in a nutshell



Business Management committed to usability as a competitive asset



Infrastructure: skilled resources (usability experts) and tools (usability labs)



Management of implementation of user centered design activities in development projects

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A Guide to UX Maturity Models for Software Teams



