Towards Augmenting Human-Centred Design: Generative AI Tools for Interaction Research and Design

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Abstract. Generative AI tools are hailed as a motor for revolutionising our work and life. Recently, tools based on large language and foundation models, such as ChatGPT, have also become a hot topic in interaction research and interaction design. This paper contributes a discussion of whether and how Generative AI tools can be used to augment interaction research and interaction design throughout the whole process of Human-Centred Design for Interactive Systems as defined by the International Organization for Standardization. The paper compiles an extended, up-to-date version of the process model covering highly relevant additions of methods bridging the gap between interaction research and interaction design in each of the processes. It then suggests Generative AI tools to support those methods. Finally, it discusses vital aspects of interaction research and interaction design concerning the current design practice, the respective design situation, and the design circumstances at large.

Keywords: Human-Centred Design; Generative AI; Process Models; Methods; Interaction Research; Interaction Design.

1 Introduction

Human-computer interaction is concerned with understanding users and their needs as well as technological opportunities to fulfil their needs, designing new and innovative ways of interaction between users and technology, and evaluating those new types of interactions to assess their quality [31].

The goals and methods of understanding, designing, and evaluating are distinct. The goal of understanding is to get insights into the users and their characteristics as well as their needs and requirements for future systems. Prominent examples of methods used for understanding users are interviews and experience sampling in the field [23] that inform personas that characterise groups of users and scenarios that provide a look into future interaction opportunities between users and systems [10]. Designing refers to envisioning new and better opportunities for users to reach their goals and fulfil their tasks with the help of inductive systems. Sketching is a central method for producing the first visual representations of a future system, typically with paper and pencil [6]. Those sketches can then be discussed with users and later used as a basis to develop early prototypes and final systems. Evaluating is critical to get feedback from diverse stakeholders involved—particularly the future users of the system. The methods here

range from informal quick-and-dirty feedback on early sketches and prototypes to systematic empirical research on proper systems that is well planned, well executed, and thoroughly analysed and documented [41].

The origins of those methods are as broad and diverse as the backgrounds of the actors in HCI in academia and industry. They can be broadly clustered into interaction research and interaction design [22]. From an interaction research perspective, HCI has been defined as being at 'the intersection between the social and behavioural sciences on the one hand, and computer and information technology on the other' [8, p. 1]. Indeed, many actors in HCI have backgrounds in psychology, sociology, and anthropology, as well as computer science, information technology, and engineering. Concerning interaction design, designers contribute their backgrounds in visual design, product design, and industrial design to it.

The literature focusing on interaction research primarily covers methods for understanding and evaluating but less for designing the above phenomena. HCI textbooks with thoughtful introductions to the field and broad chapters on methods are [7, 10, 13, 36, 38, 57]. In general, if they contain book chapters on designing, those textbooks look at the design from an 'engineering design' perspective where typically, design follows a requirements phase and aims at generating solutions for relatively well-known and well-specified design challenges [59]. Research here often refers to empirical research—research that applies observation or experiments. Observation captures phenomena such as 'human thought, feeling, attitude, emotion, passion, sensation, reflection, expression, sentiment, opinion, mood, outlook, manner, style, approach, strategy, and so on'. In contrast, experiments typically capture phenomena in a controlled setting where an independent variable influences a dependent variable [41, p. 130]. Observations are often used for understanding, and apply a qualitative research strategy, whereas controlled experiments are often performed for evaluation and apply a quantitative research strategy.

The literature with a primary focus on interaction design and a considerably smaller focus on understanding and evaluating are on the edge of HCI—that is, they are known and used by many academics and practitioners in HCI but are more dominant in study programmes of design and less in those explicitly on HCI [9]. Excellent textbooks are [3, 14, 18, 28, 34, 35, 47]. Those books often focus on designing the above phenomena from a perspective of 'creative design' that starts more openly where the definition of the design problem is part of the solution process and where the problem sometimes cannot easily be grasped and specified [59]. The design addresses different levels of human processing: the visceral level as the most immediate, with fast assessments and signals to muscles; the behavioural level relating to tasks and actions; and the reflective level as consciously judging over the

visceral and behavioural levels [48].

Process models have been developed and applied to bridge the gap between interaction research and interaction design by organising the overall process systematically into steps that often include the identification of the need for human-centred design; understanding and specification of the context of use; specification of the user and organisational requirements; production of the design solutions; and evaluation of the design against the requirements [31].

Despite HCI's user-centred process model's great merits concerning structuring and standardising the development of interactive systems, they have been criticised for narrowly focusing on an engineering design paradigm [39]. The basic assumption of engineering design is that at the outset of a project, we have a well-known design challenge that leads to clear requirements for the future system. This allows for a straightforward design and development process to find a solution for the future system. In contrast, the situation in a creative design paradigm is considered to be less clear. The design problem might be less known or not seen equally by all stakeholders. Different stakeholders might have contradictory requirements. Overall, in user-centred design, the engineering design perspective seems to dominate and emphasise the importance of the process [59].

The tremendous new opportunities of Generative Artificial Intelligence have the potential to play an essential role in HCI and to revolutionise many aspects of interaction research and design.

This paper contributes a discussion of whether and how Generative AI tools can be used to augment interaction research and interaction design throughout the whole process of Human-Centred Design for Interactive Systems as defined by the International Organization for Standardization. It first looks at related work concerning process models in HCI, Generative AI in interaction research and induction design, and user-centred practice. Then it compiles a process model based on Human-Centred Design for Interactive Systems with some extensions and details from more recent literature bridging the gap between interaction research and interaction design. It presents ways how Generative AI tools can be used to support the methods throughout the whole process model. It discusses the challenges of using those tools for the current design practice, the design situation, and the design at large.

2 Related Work

Our work builds on great inspirations from related work on process models to structure the overall research and design process, on using Generative AI tools for interaction research and interaction design, and on essential distinctions between engineering design and creative design.

2.1 Process Models in HCI

Process models aim to provide both novices and experts with guidance throughout the whole process. They make the process reliable and consistent. They are a basis for having repeated routines that can be achieved and offer a learning experience and documentation of the learnings. In larger projects, process models help the team maintain a shared understanding of the trajectory through the different steps in a project [20, 27, 44]. They suggest sequences of activities to reach a goal. They come in different flavours and have specific pros and cons.

In the engineering domain, the importance and reliability of a structured process are well-known [10]. Processes in HCI have been inspired by vital process models from

software engineering [31]. Here, 'the systematic approach that is used in software engineering is sometimes called a software process. A software process is a sequence of activities that leads to the production of a software product.' [58, p. 9]. Process models are structured representations of process recommendations—'a software process model is a simplified representation of a software process. […] These generic models … are abstractions of the process that can be used to explain different approaches to software development.' [58, p. 28].

In HCI, the standard process model from the International Organization for Standardization is entitled 'Human-Centred Design of Interactive Systems' [31]. Its processes are identification of the need for human-centred design; understanding and specification of the context of use; specification of the user and organisational requirements; production of the design solutions; and evaluation of the design against the requirements. There are many process models, and they all have specifics regarding processes, sub-processes, and activities, as well as ways of documenting their activities. However, most of them cover the processes of the ISO model in one way or another [10, 19, 21, 24, 25, 27, 57].

2.2 Generative AI in Interaction Research and Interaction Design

In HCI and beyond, Generative Artificial Intelligence is an 'AI system that uses existing media to create new, plausible media' [46, p. 1]. Generative AI tools based on Large Language Models (LLMs) and Foundation Models (FMs) are increasingly widespread. Several of those tools, such as ChatGPT of OpenAI, are used in many domains for generating text, images, and source code. They prompt users for input, and users can assign roles to the tool, specify their roles, and ask for output [50]. ChatGPT can be used for general research, as well as for interaction research and interaction design.

Practical guides to the use of ChatGPT for research in general, suggest how to use the tool for writing research proposals, for data analysis, for literature reviewing, for grant writing, for modelling, for reviewing and critiquing, for learning complex topics, for title brainstorming, for presentation preparation, for writing improvements, and for generating literature review flow. Thereby, the user can instruct ChatGPT to take specific roles such as research assistant, senior researcher, peer reviewer, research librarian, journal editor, etc. [1].

Generative AI tools were suggested to be used for various types of HCI contributions in phases such as research planning, prototyping, data collection, analysis and synthesis, as well as dissemination and communication. For instance, in research planning they can be used to find relevant literature, to identify research gaps, and to help develop study designs and materials [16].

Overall, creativity support and tools to support creativity in HCI research have been a relevant topic in HCI, also before the widespread use of generative AI tools [53].

2.3 User-Centred Practices

In design research, the actual practices of designers during the design process are studied, analysed, and documented. User-centred practises of interaction research and interaction design have been characterised as partly engineering design and partly creative design process [59].

Design Research uses several criteria to distinguish research and design scenarios. Central criteria are the design goal, the steps towards the design goal, and the assessment of the results. Concerning the design goal, it is essential to distinguish the degree of formalisation—in other words, is the design goal clear and formalisable, or is it not? Consequently, the steps towards the goal can be more or less clear and more or less formalised at the outset. Moreover, with respect to assessing the result, it is important to distinguish if precise measurements can be applied [33].

User-centred design, seen and practised from an engineering design perspective, works well for situations with a high degree of structure, a low degree of complexity, and a low degree of dynamics [11]. Here, the requirements can be specified precisely at the outset, and then projects can be carried out step-by-step strictly according to the process model. No, or hardly any, improvisations and adaptations are required throughout the process.

User-centred design needs to be seen and practised from a creative design perspective if the situations have a low degree of structure, a high degree of complexity, and a high degree of dynamics. Such situations typically involve many stakeholders with diverse perspectives and priorities. Here, it can be necessary to develop many ideas in parallel and revisit basic assumptions during the project [59]. While having a clear plan here is necessary, it is equally important to be prepared for spontaneous improvisations and adaptations along the way.

3 Process Models and Methods

Process models are common in engineering and spread to software engineering. As we will see below, process models in software engineering provided an excellent basis for process models in HCI. HCI process models mainly include classical processes from the ISO norm but also come in more modern flavours. More recently, some works have suggested how to integrate generative AI into process models.

3.1 Lessons from Process Models in Software Engineering

Process models in engineering, particularly software engineering, have a long tradition and provide an excellent basis for modern process models in HCI. Early on, they targeted activities towards the analysis of the status quo and activities towards designing future systems. Several seminal models—especially the waterfall model and the spiral model—provide excellent references for organising processes until this day [61].

Process models in software engineering provide recommendations on how to organise individual processes and how to step through chains of processes. Often, their focus

is on an abstract representation of the phases, leaving it to the respective teams to choose specific methods for individual activities in each process [58].

The classical waterfall model featured a sequence of steps to be followed in software engineering projects starting with system requirements, and moving on to software requirements, to analysis, to program design, to coding, to testing, and finally to operation [55]. The level of detail should increase through those different phases of analysis and design. Jumping a single step backwards or forwards for feedback or feedforward between steps was foreseen. However, significant iterations involving moving backwards and forwards between multiple steps were not part of the model.

The 'Spiral Model of Software Development and Enhancement' added such an iteration throughout the whole process. Each iteration throughout an entire cycle of the spiral started by identifying objectives concerning various parts of the project (e.g., the functionality or the performance of the project). It continued by designing alternatives for implementing those objectives. Various aspects of each alternative should be considered (e.g., schedule, cost), and risks should be minimised [5, p. 65]. Then, the scope was enlarged, and the next iteration could start.

In later models, the integration of users and consideration of users' needs became more explicit. The Unified Process, for instance, saw software development processes as a 'set of activities needed to transform a user's requirements into a software system' [32, p. 4]. Use cases drove it and thereby departed from users and their requirements for future functionality. It was software architecture-centred and focused on components and interfaces between them. In addition, it was iterative-incremental, which allowed to breakdown of the activities in all processes into smaller chunks that could be organised more efficiently. The Unified Modelling Language (UML) helped better structure software components and their interfaces [32, 61].

Overall, these and other process models in software engineering provided significant stimuli for process models in HCI. For instance, many process models in HCI up until today include use cases—often in HCI referred to as scenarios and storyboards. Likewise, many models function iteratively and incrementally, whereby it is essential to have the option to partly repeat some processes if necessary. However, at the same time, one should always keep an increment in mind in order not to run in a circle without making any progress.

3.2 The ISO Process Model in HCI

The process model of ISO entitled 'Human-Centred Design for Interactive Systems' is the most widespread process model in HCI and suggests six generic processes that should be part of all projects that develop interactive systems of software and hardware for human use [31].

This process model organises activities towards the development of interactive systems that users can interact with in an effective, efficient, and satisfactory way (cf. **Fig. 1**). Each project should start with a plan for the human-centred design process. Then, it is crucial to understand and specify the context of use and document it in a description of the context of use. Later, the user requirements are specified and documented in various papers, including the context of use specification, the user needs description,

and the user requirements specification. Design solutions are developed that aim to meet these requirements. The design solutions are documented in a user interaction specification and a user interface specification, and the design solutions are then implemented. The design solutions then need to be evaluated against the previously specified requirements. The evaluation is documented in a conformance test documentation and long-term monitoring results.

The Human-Centred Design for Interactive Systems combines various essential principles. The process is analytic and addresses interaction research from the beginning, when users, their tasks, and their environment are analysed and specified, but also when design results are systematically evaluated. The process is design-oriented and addresses interaction design by multi-disciplinary teams. Finally, the process is participatory in that it involves users throughout the whole process, and it is iterative in that it iterates through the different activities until a satisfactory result has been found, which means the user requirements.

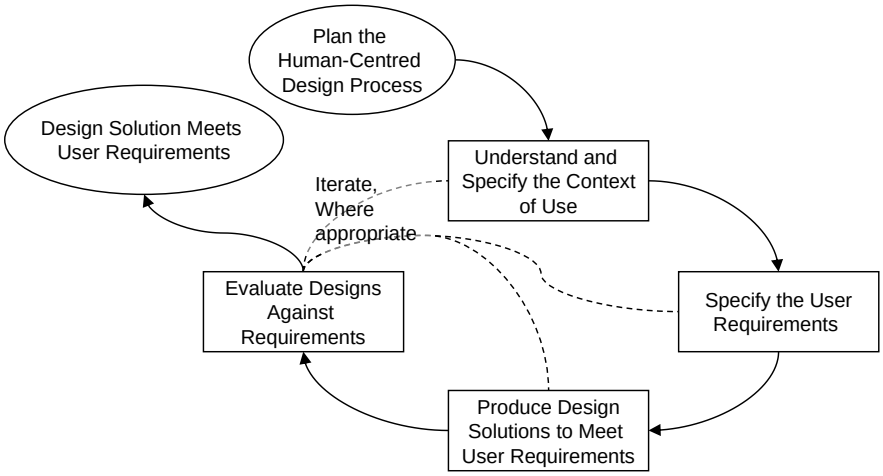

Fig. 1. ISO 9241-210:2019: Ergonomics of Human-System Interaction - Part 210: Human-Centred Design for Interactive Systems. Based on: [31].

3.3 Advanced Process Models in HCI

Two great advanced process models that have been widely used by academics and practitioners in interaction research and interaction design are the Wheel of UX Processes, Lifecycles, Methods, and Techniques, and the Goal-Directed Design Process. Here, I want to bring them together to benefit from the great details that both add to each process of the Human-Centred Design for Interactive Systems process model above.

The Wheel of UX Processes, Lifecycles, Methods, and Techniques has processes similar to those of Human-Centred Design for Interactive Systems and provides various levels of relevant details. It distinguishes Understand User Work and Needs (comparable to Understand and Specify the Context of Use above), Create Design Concepts (comparable to Specify the User Requirements above), Realise Design Alternatives

(comparable to Produce Design Solutions above), and Verify and Refine Designs (comparable to Evaluate Designs) [27].

The Goal-Directed Design Process also provides relevant extensions. It foresees the processes Research (comparable to Understand and Specify the Context of Use above); Modelling, and Requirements Definition (both together comparable to Specify the User Requirements above); Design Framework, Design Refinement, and Design Support (together comparable to Produce Design Solutions above, but also including Evaluate Designs in the Design Refinement process) [10].

Subsequently, we go through all processes of the Human-Centred Design for Interactive Systems process model and introduce relevant details and extensions provided by the two models mentioned above.

The process Understand and Specify the Context of Use involves considerable interaction research in a very broad sense to scope the project with its goals and schedule. It starts top down and looks at objectives, timelines, financial matters, markets, and branding opportunities. It also includes interaction with stakeholders and future users to understand their real goals and objectives for using a system. For this purpose, qualitative methods such as ethnographic studies and contextual inquiries provide valuable input [10]. In order to understand the future users as well as their tasks and their requirements and wishes for the future system, it is crucial to elicit data (e.g., in user interviews or user observations) and to analyse and document them [27].

The process of Specify the User Requirements provides further details by modelling future users and activities as well as specifying requirements. Users can be modelled in personas representing clusters of user groups based on highly relevant criteria concerning their motivation for using the future system. Personas come in various flavours—in this stage, it is advisable to use personas that not only characterise future users and their goals but also their behaviour towards reaching their goals. The requirements characterise the functionality and other aspects of the future system. Here, future usage scenarios are often created [10]. Here, it can also be relevant to model other aspects, such as user tasks in task models [27].

The process of Produce Design Solutions to Meet User Requirements is the stage at which the interaction research converges towards interaction design. It also starts top-down, where a design framework is typically created that characterises the overall intended user experience and user interaction with the future system. What follows after the design framework are typically interaction design patterns. The design is then refined stepwise. Refining here can have two different meanings: it can either mean adding details, or it can mean testing designs, getting feedback on designs, and revising and optimising designs [10]. Different design activities and outcomes exist: Generative design aims to ideate and sketch new ideas and produce low-fidelity prototypes of the future system. Conceptual design creates storyboards of the future interaction between the users and the system. Intermediate designs already specify and prototype the look and feel of the future system but typically leave out a lot of the final functionality [27].

The process of Evaluate Design against Requirements can be seen as the link between one iteration and the next iteration. In a narrow sense, it includes testing designs against established requirements. In a broader sense, it can have small iterative cycles that sometimes even short periods include activities evaluating a prototype, optimising

a prototype, re-evaluating a prototype, and so forth [10]. Similar to the interaction research in the first process, it is essential to have a clear top-down strategy for the evaluation where the overall goals of the evaluation are specified, and metrics are defined accordingly. Also, the evaluation methods and techniques are chosen. It is also essential to adequately collect and analyse data and document and report the evaluation results [27].

Some design techniques are essential skills that can be useful throughout all processes. It should also be noted that the term design can be used in a narrower or broader sense. In a narrow sense, design and design techniques refer to innovation—to envision and produce new things. In a broader sense, the terms design and design techniques have been used to denote the overall process covered by the whole process model. In this latter sense, not all activities include crafting new things, but ultimately, they all contribute to the final design of the interactive system in one way or another. So, techniques for design in a broader sense include skills that help with interaction research, such as observing users and situations, abstracting the data captured, note-taking, and organising the data (e.g., in affinity diagrams, card sorting, or concept maps). Other skills that can be applied to interaction design are brainstorming, sketching, drawing, reasoning, and deducing. Having those skills for interaction research and interaction design and dynamically applying them when necessary (e.g., in case of internal or external changes to the project) contributes to an agile lifecycle. Doing it in small steps in an iterative, incremental process also contributes to agile working. [27].

4 Process Models and Methods with Generative AI

Plenty of Generative AI tools can be used to support the process model, including all its processes and respective methods. Several Generative AI tools support the general design techniques. As we will see, they all have great potential to contribute to successful interaction research and design. This section presents an up-to-date compilation of interaction research and integration design methods as well as their support through Generative AI tools throughout all processes of the human-centred development of interactive systems process model.

4.1 Generative AI Tools Throughout all Processes of the Process Model

The multifarious Generative AI Tools have the potential to provide flexible support for all of the above process models' processes as well as their specific methods. Some guides are available but spread across the literature [16, 30, 56]. **Table 1** below summarises the subsequent elaboration on processes, methods, and options for Generative AI tool support.

Table 1. Summary of the processes, methods, and suggestions for Generative AI tools.

Process	Methods (Examples)	Generative AI Tools (Examples)

Plan the Human-Centred Design Process		
Understand and Specify the Context of Use	• Ethnographic studies and contextual inquiries, including user interviews and user observations • Background literature research.	• ChatGPT for planning studies and inquiries • ChatGPT for searching and identifying relevant literature • ChatGPT with code for statistical analysis • Generative agents to simulate human behaviour
Specify the User Requirements	• Personas • Requirement specifications	• ChatGPT to generate personas • Generative agents to simulate dynamic personas • ChatGPT to perform helper roles such as research assistant, peer reviewer
Produce Design Solutions to Meet User Requirements	• Ideation • Sketching • Storyboarding • Low-fidelity prototyping	• ChatGPT to help brainstorming • Text-to-image models (e.g., DALL-E, Midjourney, Stable Diffusion) to generate sketches • ChatGPT to write storyboards • Combinations of Generative AI tools to foster divergent thinking
Evaluate Designs Against Requirements	• Planning the evaluation and choosing evaluation methods and techniques • Performing evaluation • Documenting the results	• ChatGPT to generate study designs • ChatGPT to suggest evaluation methods and techniques • GPT-3 to generate responses to questionnaires • ChatGPT with code for statistical analysis

The process Understand and Specify the Context of Use involves considerable interaction research concerning the stakeholders and future users and their goals and objectives. The methods used here are of a qualitative nature and include ethnographic studies and contextual inquiries including user interviews and user observations. They are complemented with background research in the existing literature. The tools that I suggest for use here are: (1) ChatGPT or similar tools for supporting the search for literature and identifying the relevant literature. (2) ChatGPT can also help in planning ethnographic studies and contextual inquiries. (3) It can help interaction researchers analyse data by providing code for statistical analysis (e.g., in the statistics package R, or in the programming language Python). (4) Generative agents can simulate human behaviour and contribute to a better understanding of users and their behaviour [52].

The process Specify the User Requirements documents details on future users and their tasks as well as the functional and non-functional requirements for the future systems. The methods used here are personas and requirements specifications, amongst others. The tools that I suggest here are ChatGPT or similar tools, for instance, to generate personas. These personas can be dynamic—based on generative agents [52]—and allow researchers and designers to converse with them. The tools can thereby generate answers from diverse user groups, particularly those that researchers and designers do not have access to. Those tools can also be used as support when writing requirements documentation. ChatGPT can perform various roles that can be helpful when writing such documents—for instance, it can act as a research assistant, senior researcher, peer reviewer, or research librarian [1]. However, it should always be clear—even if ChatGPT mimics a senior role—that a human expert is absolutely required here who can judge the quality of the ChatGPT contributions.

The process Produce Design Solutions to Meet User Requirements is where interaction research converges towards interaction design and where the interaction is designed in a top-down manner. The methods used here are ideation and sketching, storyboarding, and low-fidelity prototyping. The tools that I suggest to be used here are ChatGPT or similar tools that can help with brainstorming (e.g., letting the tool generate some initial ideas). Text-to-image models can output images based on users' text inputs. They typically combine language models with generative image models. For instance, DALL-E [49], Midjourney [45], and Stable Diffusion [4] can generate sketches of future designs. ChatGPT can also write storyboards and sketch low-fidelity prototypes. Generative AI tools have been combined in order to foster divergent thinking. For instance, Midjourney was combined with Stable Diffusion to generate innovative product ideas [15]. Midjourney is a Generative AI tool; it was used to generate an image of an animal that is half elephant and half butterfly [45]. The result was then fed as prompts into Stable Diffusion, a deep-learning text-to-image model [4]. Stable Diffusion generated multifarious product ideas ranging from chairs to chocolate. In an analogous way, such a tool combination could be used to fuse separate parts of different designs into a new combined design.

The process Evaluate Design against Requirements assesses the effectiveness, efficiency, and satisfaction of the interaction between the users and the system. The methods used here are planning the evaluation and choosing evaluation methods and techniques as well as performing the evaluation and documenting the results. The tools I

suggest to be used here are ChatGPT and similar tools that can support the creation of study designs. They can also suggest evaluation methods and techniques. The data can then be gathered empirically or generated automatically (e.g., generating responses to questionnaires with GPT-3 [26]). The tools can then help analyse the data as described above. They can support producing written evaluation reports and presentation material with evaluation results.

4.2 Generative AI Tools for General Design Techniques

As pointed out above, designers need special skills—design techniques—throughout all processes and stages. Augmenting human creativity can complement the skills of designers.

Augmenting human creativity aims to use Generative AI tools to improve and increase creativity by generating many ideas, identifying novel ideas, and improving the quality of ideas. Five ways can be suggested how Generative AI tools can do this. Generative AI tools can: Promote divergent thinking by coming up with new connections between existing concepts; challenge expertise bias by coming up with uncommon ideas that are hard to imagine by human innovators, particularly in early design phases; assist in idea evaluation by assessing an idea's novelty, feasibility, specificity, impact, and workability; support idea refinement by handling large numbers of ideas resulting in new combinations; and facilitate collaboration with and among users by providing end users with generative AI tools, allowing them to specify their personalised versions. Furthermore, Generative AI tools can help designers who are suffering from design fixation. Design fixation refers to situations in which designers stick with ideas and consciously or unconsciously do not follow new ideas, even if they have the potential to be better than the existing ideas. Design fixation can be due to designers relying too much on existing design forms or consciously blocking new approaches. Depending on the feedback and input the designers wish, different Generative AI tools have been used in the literature (e.g., ChatGPT for text, Midjourney for images) [15, 60].

4.3 Evaluating Generative AI Tools for Interaction Research and Interaction Design

Generative AI tools have considerable potential for supporting and profoundly changing how interaction research and interaction design are done throughout all processes and methods. However, they require thorough evaluations.

Generative AI tools entail risks for individuals and society. For instance, they can create make up the contents of answers ('hallucinate'), and they run the risk of generating harmful and toxic answers. Therefore, responsible evaluation and auditing have been asked for—however, Generative AI tools are challenging to evaluate and audit for the following reasons. Previously, in AI and natural language processing (NLP), benchmarks could be used for automatic evaluations of models for machine translation, or text summarisation could be used. However, they do not work for large language models since they provide less validity and quality, which led to an 'evaluation crisis' [62].

Complementary to the preliminary evaluations and auditing required before the tools are disseminated, longitudinal studies should accompany the long-term use of Generative AI tools and the long-term effect on the creativity of individuals and society at large. So far, such longitudinal studies are missing [42, 43].

An interesting recent study that analysed the effect of the use of creativity support tools has, for instance, shown that their use led to homogenisation. The study compared the artefacts that were generated by participants with the help of an AI tool and by participants without. The group of participants without the tool produced a more diverse set of artefacts, whereas the group with the tool produced a more homogenous set [2].

Overall, Generative AI tools have been suggested and used in all processes and for supporting diverse methods. So, things look promising. However, systematic evaluation and auditing are missing, and first evaluation studies show that the creative output might be less diverse than expected. Recently, the role of the users—that is, the interaction researchers and interaction designers, but also the end-users—has been addressed. In the future, it will be necessary to understand better how those users adopt Generative AI tools to support creativity [51]. Likewise, a responsible integration of Generative AI tools into the everyday practice of interaction researchers and interaction designers will play an essential role towards the effect of Generative AI tools on individuals and society at large [37].

5 Discussion

Undoubtedly, Generative AI tools have great potential to contribute to the quality and quantity of the interaction research and interaction design outcomes of human-centred design processes. Currently, most guides on Generative AI tools in HCI and beyond focus on where and how those tools can be used, sometimes on a somewhat operational level with respect to perfectionising writing prompts. While this is very important and very helpful for both novice and expert users of Generative AI tools, questions remain with respect to the fit of the tools to the interaction research and interaction design practice, with respect to the complexity of the design situations, and with respect to the role of design on a global level.

5.1 Design Practice

The interaction research and interaction design practice in user-centred design needs to combine engineering design-like aspects of structured processes and methods with creative design-like aspects of an open and dynamic process of developing innovative solutions that have the potential to alter the original design problem. Here, different paradigms that seem incompatible at first sight need to be combined. On the one hand, a thorough process with a clear and discrete structure, as well as discrete activities and methods, is required. On the other hand, designers with adequate knowledge and experience, as well as much freedom to follow their intuition, are required. Interaction research and interaction design should basically follow strict processes while at the same

time allowing for an ongoing building and evolution of models and prototypes through which meaning is created. Those models and prototypes and their meanings then feed forward into future models and prototypes. This process is not always linear and follows the designers' judgement [17, 59].

5.2 Design Situation

The design practice will often need to be adopted to the design situation and its characteristics. In the literature, tame problems are distinguished from wicked problems. Tame problems are typically easy to describe and communicate to the person who later needs to solve the problem. In contrast, wicked problems are typically quite complex and challenging to describe and formalise. Tame problems have a definable goal, whereas, for wicked problems, it is typically unclear when the project is finished since there is no stopping rule, as in many design situations. Tame design situations typically encounter design problems that have similarities with past design problems and where a transfer is possible. Wicked design situations typically have no precedents. So, in wicked design situations, new and unique design solutions must be found [11, 54]. Also, aesthetics and different perspectives of diverse stakeholders in the design process can increase the complexity of the design situation [18].

5.3 Design Circumstances

Design situations per se can be wicked and challenging, even if we only consider the design project per se. The complexity and challenges can drastically increase when considering the design project's circumstances. In one way or another, interaction research and interaction design have a political dimension [12, 34, 40]. When we look at interaction research and interaction design on a larger scale, it is vital to see design as a 'political and ideological activity' because 'every design affects our possibilities for actions and our way of being in the world… With designed artefacts, processes, systems, and structures we decide our relations with each other, society, and nature. Each design is carrying a set of basic assumptions about what it means to be human, to live in a society, to work, and to play' [40, p. 10].

Overall, Generative AI tools potentially face considerable challenges to align with stakeholders' requirements, wishes, and values. They must respect the ambivalence of the processes, which sometimes oscillate between a clear structure and sometimes meandering between evolving and changing design solutions followed by evolving and changing design problems. They will need to work in tame design situations and, particularly, in wicked design situations. Also, we will need to address the 'new challenges to the core ethical AI principles including fairness, transparency, accountability, privacy, and so on' [46]. Finally, assessing the overall success and the fit of Generative AI tools for creative activities in interaction research and interaction design will strongly depend on a clear definition of creativity. In the current literature, there seems to be no agreement on the notion of creativity in HCI [29]

6 Conclusions

This paper has characterised the evolution of process models until today. It has analysed and discussed how Generative AI tools can be used throughout all processes and their specific methods, as well as for general design techniques. It has presented a compilation of the process model for the Human-Centred Design of Interactive Systems with various extensions for methods bridging the historical gap between interaction research and interaction design in each individual process and suggestions for generative AI tools to support those methods. Finally, it has discussed the role and fit of generative AI tools for current design practice for diverse design situations, and for design at large.

This paper took the process model for Human-Centred Design of Interactive Systems and its extensions as a point of departure. Other process models have not been considered, such as design thinking, lean startup or agile development. Furthermore, the paper only gave some examples of Generative AI tools for the different processes and some examples of methods. It could not cover the diversity of current Generic AI tools, nor did it address the impressive improvements many individual Generic AI tools are going through. Systematic—and particularly long-term—evaluations of these tools still need to be conducted. The paper focussed on interaction research and design—while the software development and testing are beyond the scope of this paper, Generative AI certainly also has the potential to support processes there.

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