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INTEGRATING DESIGN THINKING WITH VALUE SENSITIVE DESIGN THROUGH A SYSTEMS THINKING APPROACH.

**Rafail Andrianos Pappas^{*a}, Katerina Malisova^a, Modestos Stavrakis^a,
Spyros Bofylatos^b**

a University of the Aegean, Greece

b Royal College of Art, UK

* adrianpappas@aegean.gr

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ABSTRACT | The Value Sensitive Design Thinking model (VSDT) is a hybrid conceptual model proposed in this research paper. It integrates the Design Thinking (DT) and Value Sensitive Design (VSD) frameworks by adopting a Systems Thinking (ST) perspective. DT is a human-centered design approach that emphasizes users' needs through empathy, ideation, prototyping and testing. VSD focuses on discovering and addressing value tensions that arise in complex design scenarios. With this proposed hybrid approach, we address some of the shortcomings of the two frameworks, by viewing their differences as an opportunity for VSDT to be informed and complemented by both. VSDT relies on a systemic perspective for uncovering relationships, feedback loops and emergent properties of systems which, for which and within which we design. We argue that both DT and VSD are systemic in nature, albeit implicitly. By making the importance of ST more explicit, DT and VSD can be combined using ST as a common ground. Based on the fundamentals of systems theory, our suggested model expands upon the current knowledge and toolkits of these two frameworks. We suggest a structured approach for VSDT as a design process, with defined stages and tools, achieved through a comparative analysis and integration of DT and VSD. The potential of VSDT in addressing complex issues is discussed, especially in relation to abstract concepts such as wellbeing, sustainability, and ethics. Finally, we explore the applicability of VSDT offering guidance for researchers and design practitioners who might incorporate our model into their practices.

1. Introduction

The world is confronted with a multitude of complex issues in all aspects of life, from the global challenges of our era to the intricacies of individual wellbeing and societal progress. These are often characterized as “wicked problems” (Coyne, 2005; Rittel & Webber, 1973), as their complexity makes them unresolvable using traditional epistemological and analytical approaches relying on a modernist/positivist view, which has been the mainstream way of thinking in the western world for the last two centuries. Our position is that most of these wicked problems are in fact challenges that are the result of human action. They are the consequences (whether intended or unintended) of planned and goal-oriented human action. Design, in the broad sense of the word, as the creation of plans for new things, plays a pivotal role in this. The role of design in contributing to the onset of the Anthropocene has gained mainstream momentum in recent years (Chan, 2018), although it has been recognised throughout the modern history of the design discipline. A design mindset is often presented as a useful approach to tackling wicked problems for people who design referring both to professional designers and to people of other professions who end up designing/planning, such as policy-makers, managers, and engineers. Various tools and methods have been developed to assist designers in doing so. This paper focuses on two design approaches related to tackling complex issues: Design Thinking and Value Sensitive Design.

Design Thinking (DT) is a human-centered design methodology that emphasizes understanding user needs through empathy, redefinition of problems, ideation, prototyping and testing. Its origins can be traced back to the 1950s and 60s, stemming from research on design methods. It encompasses an effort to lay out “designerly ways of knowing and thinking” (Cross, 1982, 2012), meaning tools, methods and mental models that designers typically use in their practice. Over the years, DT has proven to be adaptable to various contexts, making it relevant not only in design but also in other fields, embracing the zeitgeist of each era. Its capacity in dealing with complex issues and wicked problems has been noted (Buchanan, 1992; Cross, 1982; Matthews et al., 2023), and its application extends beyond design domains.

Value Sensitive Design (VSD), on the other hand, is an approach to design that puts values in the forefront of the design process. Similarly to DT, it offers a methodology with three stages of conceptual, empirical, and technical investigations (Friedman et al., 2008), supplemented by a rich set of methodological tools (Friedman et al., 2017). With its roots in technology development and human-computer interaction (HCI), over the years VSD has matured and has proven itself as a versatile design tool in various use cases across the broader design discipline. VSD, as a tool for taking values into account in design, is faced with what is arguably one of the most complex issues of design; the question of design ethics (Fenn & Hobbs, 2015; Sweeting, 2018).

We recognize the significance of both these design approaches in advancing design and empowering designers with new tools, however both have received varied valid criticism. In this paper, we claim that a Systems Thinking approach both to VSD and DT can help alleviate some of the issues highlighted by such criticism. We present our case for synthesizing VSD and DT into a new hybrid model we call Value Sensitive Design Thinking (VSDT), building upon foundations of Systems Thinking and systems theory.

2. DT and VSD Explored

Design Thinking (DT) has become increasingly popular in management and business over the past two decades. It is often pitched as a corporate tool for harnessing innovation and creativity. Several flavours of DT have been proposed (Dam & Siang, 2020), which are typically intended for individuals in leadership and management roles rather than design professionals. According to a relevant literature review (Micheli et al., 2019, p. 131), the most notable of these applied models of design thinking are IDEO’s design thinking approach (Kelley & Littman, 2001), d.school’s 5-step design thinking process (Hasso Plattner Institute of Design, 2010) and IBM’s Enterprise Design Thinking (Lucena et al., 2017). This has led to a fork/schism in the design thinking discourse, one maintaining its roots in design process, practice and academic design research/theory, and another embracing its business-oriented direction. Some argue that there are three or

four types of design thinking (Dell’Era et al., 2020; Love, 2021), but for the intents of this paper, we focus on this diptych approach of academic/designerly design thinking versus a technocratic/managerial Design Thinking (see Cross, 2023).

Corporate Design Thinking indicates design processes and methods to be used by non-designers, such as managers, consultants, and educators. It aims to help companies design better products, gain a competitive advantage, and increase business revenue, prioritising efficiency, scalability, and business outcomes (Liedtka, 2018). Designerly thinking, on the other hand, is a practice-based approach to problem-solving, making sense of things, and developing new knowledge. It is rooted in understanding design practice and establishing itself as a discipline focused on solving problems and improving people’s wellbeing. The two concepts, design thinking and designerly thinking, have different focuses, but they also influence each other. The design community cannot ignore the interrelatedness of these two fields (Laursen & Haase, 2019).

Despite its widespread adoption, Design Thinking faces several criticisms (Kolko, 2018). First, it tends to oversimplify complex challenges by focusing solely on users’ experiences without considering the situational context dynamics. Furthermore, corporate Design Thinking lacks a clear theoretical foundation, leading critics to view it as superficial compared to its academic / designerly theory-based counterpart (Johansson-Sköldberg et al., 2013). Design Thinking seems to foster homogenous solutionism in the form of a one-size-fits-all managerial toolkit (Woudhuysen, 2011) based on a western philosophical perspective (Gordley-Smith & Hackett, 2023). DT seems to be emphasizing a checkbox mentality, iteration and rapid prototyping that appeals as a go-to tool for innovation (Hernández-Ramírez, 2018), at the expense of diverse perspectives, meaningful empathizing, and consideration for social systems (Lee, 2021). DT, portrayed as a tool that can offer a competitive advantage to companies, can lead to situations where the ethical considerations and societal impacts of the solutions and ideas generated is overlooked (or at least not prioritized), potentially contributing to unintended and/or unanticipated consequences (Parvin & Pollock, 2020).

In the grand scheme of things, design tools like Design Thinking, intended for non-designers, are valuable in that they provide a more accessible and practical approach to design that can be applied by a wider range of people. However, these tools often oversimplify complex design issues and prioritize efficiency and scalability over empathy and reflection. On the other hand, designerly thinking provides a more comprehensive and nuanced approach to design, but it can be criticized for being too abstract and out-of-sync with practical realities of designing for the modern era. Nevertheless, we believe that these two directions of DT have the capacity to complement each other, and knowledge and tools from both should be used in design undogmatically.

Value Sensitive Design, on the other hand, is a widely recognized framework for integrating ethics in the design process of technology. Despite its widespread use, VSD has faced several criticisms. One major concern is the lack of a normative, ethical commitment, making it challenging to justify the implementation of values in design (Manders-Huits & Zimmer, 2009). Additionally, VSD has been criticized for its “positivist problem,” which presupposes a connection between the design and use contexts (Albrechtslund, 2007). Furthermore, VSD’s lack of commitment to a specific ethical philosophy has led to the proposal of complementary theories and approaches, such as virtue ethics (Reijers & Gordijn, 2019), norms-based approaches (Martin et al., 2023), and procedural ethics fostering wellbeing (Cenci & Cawthorne, 2020).

The criticisms of VSD’s theoretical grounding could be interpreted as indicators of crucial ontological issues within the framework. However, we interpret them as an indicator that VSD has the ability to take in new ideas and alternative approaches both to its theory and to its methodologies, making it easily adaptable to new needs. As such, VSD as a framework is meant to be flexible and open to change, which allows it to grow and evolve over time. The incorporation of various theories as ethical lenses is a good example of how VSD can be adapted to address complex design challenges.

2.1 DT and Complex World Issues

Researchers have investigated the application of design thinking in diverse domains dealing with complex issues such as improving well-being and sustainability. Dorst and Tietz (2011) explore an original approach to analysis within the context of design for social wellbeing, aiming to enrich the traditional focus on the creative and generative elements of design thinking. ElSayary (2023) investigates the impact of incorporating design thinking processes in interdisciplinary courses to improve students' wellbeing, employing a modified PERMA-PH model. Thomas et al. (2020) explore the application of design thinking techniques in addressing organizational factors and individual needs to improve the wellbeing of residents, yet the effectiveness of these approaches in complex organizational contexts remains uncertain. Kreitzer et al. (2019) discuss the integration of design thinking and systems thinking to develop strategies for addressing stress and burnout among health professionals, highlighting the potential synergy but also the complexities in implementation. Buhl et al. (2019) explore the potential of design thinking in promoting sustainability-oriented innovation development. By examining key principles of design thinking and proposing a research framework, the research highlights the applicability of design thinking in addressing complex socio-ecological problems and driving sustainable innovation. Shapira et al. (2017) examine the integration of design thinking and strategic sustainable development to achieve more strategic and sustainable outcomes. Through action research and expert feedback, their study proposes a prototype for Sustainable Design Thinking (SDT) aimed at addressing complex socio-ecological challenges. Wilkerson and Trellevik (2021) present a combined methodology that integrates design thinking with systems mapping to improve problem definition in sustainability-oriented innovation processes. By employing systems mapping in problem definition, the study aims to provide a holistic understanding of sustainability challenges and enhance empathetic design thinking approaches. Kagan et al. (2020) analyze the potentials and limitations of design thinking in sustainability jams through an in-depth case study. They explore how design thinking, when applied within sustainability jams, can generate solutions for sustainable futures. However, the study also identifies limitations such as user-orientation and insufficient complexity, suggesting directions for improving the effectiveness of sustainability jams in addressing complicated sustainability problems. While these studies emphasize the potential benefits of DT for complex global issues, challenges still arise regarding the subjective interpretation of values and the scalability of interventions throughout the design process.

2.2 VSD and Complex World Issues

Furthermore, various researchers have attempted to address ethical implications and plural values in technological development within the field of Value Sensitive Design (VSD). In their work, Friedman and Kahn (2000) introduce VSD to assess the ethical implications of augmented reality (AR). They examine seven core values—psychological well-being, physical well-being, privacy, deception, informed consent, ownership and property, and trust—in the context of AR. Additionally, they outline their application of VSD to AR technology focused on natural environments. Ballard et al. (2019) introduce Judgment Call, a game for industry product teams to surface ethical concerns using VSD and design fiction, demonstrating its effectiveness in considering technology from multiple perspectives. Cenci and Cawthorne (2020) discuss the challenges of integrating ethical ideals and values in high-tech product design, proposing refining VSD with a capability-based procedural approach to ethics, highlighting the need for a more resilient ethical framework. Mok and Hyysalo (2018) illustrate how conflicting values involved in advancing solar photovoltaics in heritage can be addressed using the VSD framework, emphasizing the importance of finding a working compromise among conflicting values. B. Barn and R. Barn (2016) introduce a refinement of the Value-sensitive Action-reflection model used in co-design to address the tension between values and resilience, acknowledging the ambiguity created during the co-design process and its impact on resilience building. Cawthorne and Cenci (2019) describe the application of VSD methods to the technological development of a specific drone platform, demonstrating how VSD can be used to develop ethical drones but also highlighting the complexity of balancing human welfare and environmental sustainability. Through a VSD approach, Prieto et al. (2023) investigate how technology can support doctoral students' progress, well-being, and persistence, revealing promising insights but also underscoring the need for effective evaluative frameworks. Finally, Ishmaev et al. (2023) focus on ethical design frameworks for self-

sovereign identity (SSI) solutions, presenting a case study of VSD applied to the uNLock medical credential sharing platform. They evaluate VSD's applicability and quality, revealing challenges such as “value branching” in SSI solutions and the need for context-specific evaluative frameworks in ethical design. While all these studies offer valuable insights, they fall short in fully assessing the validity of all components of the VSD approach in practice, conveying the need for a systematic approach that includes tools for stakeholders to reflect on their own values during the design process.

2.3 DT and VSD Tools

Both DT and VSD offer a rich toolbox of methods that can be used in the design process, each tailored for a particular design stage (Friedman et al., 2017; Friedman & Hendry, 2019; Hasso Plattner Institute of Design, 2018; IDEO, 2003; Lewrick et al., 2020; Liedtka & Ogilvie, 2017). DT has a set of tools for each design stage. Some of the most widespread are: 30 shapes, What? How? Why?, Use Scenarios, How Could We, Route Map, Powers of 10, 2x2 Matrix, Point of View (POV), Five “Whys?”, Affinity Diagrams, Interviews aimed at Empathy, Interviews with Extreme Users, Photo Diary, Card Sorting, User Personas, Fly on the Wall, 6-3-5, Questions “How could we...”, Brainstorming, I like it - I would like it - What if, Prototyping for Empathy, Wizard of Oz prototyping, and Video Prototyping (Hasso Plattner Institute of Design, 2018; IDEO, 2003; Lewrick et al., 2020). VSD's tools include: Stakeholder Analysis, Stakeholder Tokens, Value Source Analysis, Co-evolution of Technology and Social Structure, Value Scenario, Value Sketch, Value-oriented Semi-structured Interview, Scalable Information Dimensions, Value-oriented Coding Manual, Value-oriented Mockup, Prototype or Field Deployment, Ethnographically Informed Inquiry regarding Values and Technology, Model for Informed Consent Online, Value Dams and Flows, Value Sensitive Action-Reflection Model, Multi-lifespan timeline, Multi-lifespan co-design, and Envisioning Cards (Friedman & Hendry, 2019)

Comparing some indicative tools from the two frameworks (see Table 1) will help us decide which toolboxes to recommend for practical application of our new model. Tools of DT and VSD each complement the respective framework and attempt to fulfil its goals. More specifically, DT tools are more focused on the user and their experiences, while VSD tools are centered around the values of different stakeholders. However, both sets of tools share a common goal of understanding and addressing complex design scenarios. Their complementarity allows for the creation of hybrid tools in the intersection of both, that take into account both the user's needs and the values of diverse stakeholders.

Table 1. Comparative presentation of DT and VSD tools. Sources: 1) Hasso Plattner Institute of Design (2018), 2) IDEO (2003), 3 Lewrick et al. (2020), 4) Friedman and Hendry (2019).

Design Thinking tools	Value Sensitive Design tools	Comparison
Journey map (1)	Value Scenario (4)	Both of these tools build a narrative of the user journey, as a means to gain insight on the contexts of use of the design in question.
Five Whys (2)	Scalable Information Dimensions (4)	In these tools, a series of prying questions are used as a method to peel through the layers of complexity and understand core issues pertaining to the design context.
Interviews for empathy (1)	Value-oriented Semi-structured Interview (4)	Interviewing is a common tool for involving users and other stakeholders in the design process, used by both VSD and DT. In each of these cases, the orientation of the interview is being steered to better serve the needs of each methodology.
Card sorting (2)	Envisioning Cards (4)	Physical tools are often useful for the design process. Cards, in this case, offer a tactile, versatile and gamified method to steer the design process. Tools involving cards and other props can be used either during user research or as tools for the designers.
Prototyping for empathy (1)	Value-oriented Mockup, Prototype or Field Deployment (4)	Rapid prototyping of ideas is invaluable for gaining quick insight that can uncover aspects that could not be foreseen just with interviews and drawings of concepts.
Stakeholder map (3)	Stakeholder Analysis (4)	Having a clear overview of the involved stakeholders in a design project is a crucial step and both methodologies use such tools to map the design context and pin-point direct and indirect stakeholders.
Empathy map (3)	Value Source Analysis (4)	Both methodologies employ tools that specialize in a specific aspect that they focus on; empathy for DT and values for VSD. Such analyses at the early stages of a design process are critical both for gaining insight on the project itself, and for steering the next steps of the design process effectively, picking tools and methods that best fit the situation.

3. Systems Thinking for Design

Systems Thinking (ST) is a well-established way of understanding and analyzing complex systems and their interactions (Checkland, 1999; Kim, 1999; Meadows & Wright, 2011). It is a perspective that views the world as a set of interconnected systems, rather than as a collection of individual parts, based on the principles of systems theories such as the general systems theory, complex systems and second-order cybernetics (Laszlo, 1972; Luhmann et al., 2013; Thurner et al., 2018). ST posits that all systems, whether natural or human-made, share certain fundamental characteristics, such as interconnectedness, feedback loops, and emergence. By utilizing various tools and methods, like system mapping, causal loop diagrams, and system dynamics modeling, to analyze and understand complex systems, ST offers an alternative perspective to approaching and tackling wicked problems (Wang & Song, 2023; Zellner & Campbell, 2015).

ST and systems theory have found application in the field of design, offering a comprehensive approach to understanding and addressing complex design issues (Banathy, 1996; Johnson et al., 2010; Norman & Stappers, 2015), leading to the proposal of approaches such as systems oriented design (Sevaldson, 2013) and systemic design (Jones, 2014, 2020; Peruccio, 2017). Academic platforms dedicated to exploring the relationship between ST and design, such as the Systemic Design Association and their annual Relating Systems Thinking and Design Symposium, alongside the rich bibliography on the topic indicate that this combination has proven compatible with and helpful for the design discipline. By adopting a systems perspective, the interconnectedness and interdependencies between various stakeholders, systems, and

contexts become more easily detectable. Understanding the importance of a complex systems perspective for ensuring better design outcomes has been recognized as a necessity for ensuring better outcomes for the world (Escobar, 2018).

Following a similar line of thought, the integration of ST and DT is an existing idea that has been suggested by several academics (Buchanan, 2019; Jonas, 2018; Li, 2002; Mononen, 2017; Pourdehnad et al., 2011b, 2011a) and has been operationalized in design practice (Pohl et al., 2020; Sevaldson, 2019). This combination offers the key benefit of balancing analysis and synthesis for effective problem-solving. Design thinking is used for generating new ideas and solutions through experimentation, iteration, and prototyping, while systems thinking focuses on the importance of understanding the system and its interactions as a whole. These combined benefits have been identified and harnessed by the Design Council, proponents of the Double Diamond design thinking tool (Design Council, 2019; Elmansy, 2021), in their most recent publications on systemic design (Design Council, 2021; Design Council & The Point People, 2021).

Furthermore, a systemic approach appears to be a valid approach for gaining stronger insight on one of the most complex philosophical issues of humanity; that of ethics (Tuan & Shaw, 2016). The field of design ethics deals with the ethical implications of design, both pertaining to its outcomes and to design as a process. A systemic perspective to design ethics offers a promising new direction for design (Pappas, 2023), especially considering design as a discipline that is faced with wicked problems (Sweeting, 2018). VSD, as one of the most impactful methodologies of design ethics (Donia & Shaw, 2021), can benefit from such a systemic perspective. Such an integration has been hinted at in previous works (Pappas, 2023; Umbrello & Gambelin, 2023) but has not been fully implemented yet.

A systemic approach, as offered by ST, seems to have a significant impact in giving design a new holistic perspective and equipping it with tools for tackling complex issues and wicked problems that it often faces. We have indicated that DT and VSD, separately, can have benefits from such an approach. The integration of DT and VSD is a new idea that has been framed as a "design thinking perspective on human rights" (van Zeeland-van der Holst, 2023). Taking all this into consideration, and in order to address the limitations of DT and VSD, we propose the integration of these two frameworks through a ST perspective. Such an approach can equip designers with tools to better understand the complex relationships and feedback loops that exist within the systems in hand. Potential unintended consequences can be better anticipated, and more informed decisions about the trade-offs and value tensions that arise in complex design scenarios can be made (Miller et al., 2007).

4. VSDT: A Hybrid Conceptual Model

In this section, we present the Value-Sensitive Design Thinking (VSDT) model, our proposal for a hybrid conceptual model that integrates the Design Thinking and Value Sensitive Design approaches based on a Systems Thinking perspective (Figure 1). The design process that led to the development of the VSDT model started with the comparative analysis and critique presented above. It was then followed by brainstorming sessions amongst our research team, in order to conceptualize the direction which VSDT should follow. As a starting point, we view the following points as main principles of VSDT, which also act as design requirements for our proposed model.

- Communication - VSDT should emphasize effective communication between all stakeholders throughout the design process. This includes fostering empathy and understanding of diversity. The designer gets a facilitator role in the design process.
- Documentation - VSDT should recognize the importance of documenting the design process, such as research findings, design decisions, justifying the rationale and decision-making processes behind those decisions.
- Iterative process - VSDT should adopt an iterative design process based on user feedback and emerging insights as the design process progresses. The design process should not be rigid, but

- flexible and responsive to these new insights, seeking better understanding towards achieving good design outcomes.
- Systemic approach - VSDT should be based on a systems perspective that acknowledges relationships, feedback loops, interconnectedness and emergence in the design process and the complex systems involved.
- Focus on values - VSDT should consider values and value tensions throughout the design process, ensuring that the final design outcomes align with the stakeholders' diverse conceptualization of ethical values, offering an ethically balanced and acceptable outcome, while potential unintended consequences are better anticipated.
- Human-centered and Humanity-centered approach - VSDT should focus on understanding and addressing the needs and wants of users and other stakeholders, while at the same time adopting a humanity-centered perspective that considers the broader social, cultural, and environmental contexts within which the design is situated.
- Collaborative mindset - VSDT should promote a collaborative mindset that encourages everyone involved to work together throughout the design process, building upon co-design and participatory design practices.

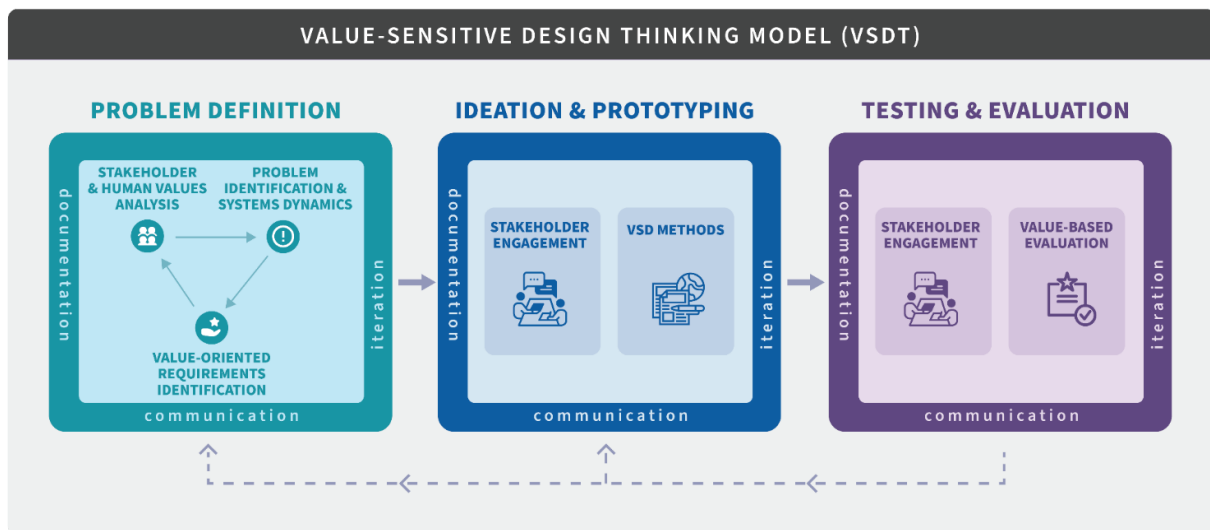


Figure 1. The VSDT conceptual model.

The suggested structure of the VSDT model, resulting from the previous insight and design requirements, involves the following design phases:

1. Problem Definition
 - Clearly articulate the design problem, understanding context, end users, and stakeholders.
 - Identify and prioritize human values as part of the design brief, considering cultural and ethical dimensions
 - Identify value-oriented user requirements
2. Ideation and Prototyping
 - Engage in ideation and rapid prototyping. / participatory elements
 - Extend ideation and prototyping techniques to visualize and test ethical considerations within the design, iteratively refining the integration of ethical principles.
 - Involve stakeholders for comprehensive insights.
 - Implement an iterative design process, adapting to evolving needs and dynamics while continually refining the integration of ethical principles.

3. Testing and Evaluation

- Involve stakeholders and end users in a value-based evaluation process.
- Document design decisions and ethical integrations.
- Communicate the process and outcomes to stakeholders.
- Continuously evaluate and iterate based on feedback.

Subsequently, we examine each phase of the model in greater detail, developing the VSDT model by offering practical guidance on how to apply it, through indicative examples of how designers can combine the tools that these two approaches have already used. The rationale behind providing the recommended combinations of Value-Sensitive Design (VSD) and Design Thinking (DT) tools lies in their complementary nature and their ability to address different aspects of the design process, while prioritizing ethical considerations and stakeholder values. In order to achieve a systemic perspective, we posit that it is a prerequisite for each combination to take into consideration both the users and stakeholders, and the broader design context, as per the design requirements mentioned above.

4.1 Problem Definition

During the initial phase of Problem definition, thorough analysis is conducted by engaging with stakeholders directly to identify their needs and human values at play. Through grounding problem definition in stakeholder perspectives, systemic analysis, and value-driven criteria, designers can acquire a deeper understanding of the wider context within which the issues are situated. Furthermore, understanding systems dynamics allows designers to better comprehend the interdependencies and complexities present in the problem space. Finally, value-oriented requirements identification ensures that the design process is consistent with the overarching goals and values of stakeholders.

Practical Examples:

- **Stakeholder Analysis (VSD) paired with Point of View (DT)**
Designers begin by conducting a stakeholder analysis to identify all parties affected by a proposed design solution. Then, they make use of the Point of View tool to empathize more deeply with users and stakeholders, understanding their needs, desires, and concerns. After gaining an understanding of the wide range of stakeholders and their values, designers can inform the identification of value-oriented requirements.
- **Stakeholder Analysis (VSD) and User Personas (DT)**
Designers start by conducting stakeholder analysis to identify key individuals or groups affected by the design. Then, they can create User personas based on the Stakeholder Analysis in order to develop a deeper understanding of the diverse needs, values, and perspectives present within the stakeholder community.
- **Stakeholder Tokens (VSD) with Affinity Diagrams (DT)**
Designers use Stakeholder Tokens as a versatile toolkit for identifying stakeholders and their interactions. These tokens are then used in sessions of Affinity Diagrams where stakeholders collectively group and categorize their concerns, aspirations, and values regarding the system's functionalities and features. Through this process, designers can gain insights into the diverse perspectives and priorities of stakeholders and ensure that the design process is grounded in the real-world needs and values of those impacted by the system.

4.2 Ideation and Prototyping

In the ideation and prototyping phase, designers collaborate closely with stakeholders to generate and refine potential solutions iteratively. This participatory approach ensures that diverse perspectives are incorporated into the design process, leading to more inclusive and contextually relevant solutions.

Moreover, VSD methods are integrated into ideation and prototyping techniques to incorporate ethical considerations from the outset. Thus, designers can visualize and test the implications of design decisions on various stakeholders. This process allows for the refinement of systems ensuring that the final solution is ethically sound.

Practical Examples:

- **Value Sketch (VSD) integrated with Prototyping for Empathy (DT)**
Value sketches can be used to visually represent design concepts while also taking into account ethical considerations and values. Then, Prototyping for Empathy can be used to create tangible prototypes that allow stakeholders to experience and interact with the design firsthand. By combining those tools, designers can elicit feedback from stakeholders on the ethical implications of design decisions, leading to a better understanding of value trade-offs and preferences.
- **Brainstorming (DT) paired with Value Dams and Flows (VSD)**
During the ideation phase, designers facilitate Brainstorming sessions where multidisciplinary teams generate innovative ideas and solutions. Afterwards, they use the Value Dams and Flows method to make design decisions in terms of value tensions. Value tensions may arise when different conceptualizations of values or their design implications conflict among the various stakeholders. Once a tension has been identified, designers have the option to investigate it or report it for further consideration later in the design process.
- **Multi-lifespan Co-design (VSD) alongside Bodystorming (DT)**
Designers apply the Multi-lifespan Co-design approach, which considers the long-term implications of technology across multiple generations, involving stakeholders. After gaining insights from this participatory process, designers can then conduct Bodystorming sessions as a roleplaying technique among researchers. By integrating these tools, designers can explore how different value perspectives evolve over time, ensuring that the resulting design solutions are sustainable and culturally sensitive across generations.
- **Envisioning Cards (VSD) with Fly on the Wall (DT)**
Designers use Envisioning Cards to depict future scenarios and demonstrate how the proposed design aligns with different stakeholder values and societal goals. This tool acts as an initiator for participatory ideation sessions, prompting designers and stakeholders to imagine and discuss potential features, functionalities, and implications. Additionally, designers can adopt a Fly on the Wall approach, observing users' interactions and reactions on the proposed designs, especially pertaining to the issues identified by the envisioning cards.

4.3 Testing and Evaluation

In the phase of Testing and Evaluation, stakeholders and end users actively engage in a value-based assessment of the proposed design. This participatory process ensures that the opinions of those affected by the design are heard and taken into account. Designers can identify areas of strength, weakness, and improvement that are in line with the values and broader goals of stakeholders by prioritizing value-driven criteria. Through this ongoing engagement and iterative refinement, designers can ensure that the proposed design solutions are ethically and socially responsible. In the VSDT framework, we suggest that the iterative evaluation process should continue until the system meets the predefined value-oriented requirements, and stakeholders are satisfied with the design outcomes.

Practical Examples:

- **Prototyping for Empathy (DT) paired with Ethnographically Informed Inquiry on Values and Technology (VSD), followed up by a Cognitive Walkthrough**
Designers simulate user tasks and scenarios using the Prototyping for Empathy tool. Then they employ the Ethnographically Informed Inquiry on Values and Technology method to collect data about emergent complex relationships between various stakeholders. Additionally, designers use the Cognitive walkthrough method (Wharton et al., 1994), following step-by-step procedures and interacting with the prototypes as users would, in order to understand the cognitive processes involved in task completion. Based on the findings from both the Ethnographically Informed Inquiry on Values and Technology and the Cognitive walkthrough, designers iteratively refine the prototypes to address identified cognitive barriers and improve the overall user experience. Design adjustments are made to streamline task flows, enhance clarity and comprehension, and reduce cognitive load on users.
- **Value-oriented Mockup, Prototype, or Field Deployment (VSD) paired with In-Person Focus Groups, followed up by a Think-Aloud Protocol**
Designers create mockups, prototypes, or deploy the system in real-world settings using the Value-oriented Mockup, Prototype, or Field Deployment method, focusing on incorporating value-oriented design features and addressing stakeholder values and ethical considerations. Additionally, they moderate in-person focus group sessions with a diverse group of stakeholders who represent different perspectives and interests relevant to the project. During these sessions, participants are presented with the Value-oriented mockups, prototypes, or the deployed system and engage in group discussions, facilitated by a moderator, to share their opinions, insights, and suggestions. Finally, designers organize Usability testing sessions following the Think-Aloud Protocol (Jääskeläinen, 2010), where participants are asked to verbalize their thoughts, feelings, and reactions as they interact with the prototypes.

5. Discussion

VSDT can benefit from the examination of its applicability in real-world use cases. As we have pointed out, VSDT is geared towards complex socio-technological challenges, some examples of which would be the design of equitable healthcare systems, the introduction of inclusive educational technologies, urban sustainability, social media and online community design, and so on. Future research into the practical applicability of the VSDT model must be conducted, with the aim to evaluate the model's performance in such practical settings, comparing its outcomes to those achieved through more typical DT and VSD approaches. To achieve this, potential users of VSDT should be identified and included in further testing and validation of the model. A comparative empirical analysis and field research between VSDT and other competing and/or complementary design frameworks should also be conducted, in order to further assess VSDT's capacity to deal with real world issues. During these further studies, values and value tensions that might arise should also be explicitly investigated and recorded. These further investigations and use cases will demonstrate the versatility of the VSDT model and its potential for application in diverse contexts.

The integration of the systemic thinking perspective is implemented in all of the key phases of the Value-Sensitive Design Thinking (VSDT) model. In defining the problem, understanding users, and prioritizing ethical values of stakeholders, designers are prompted to adopt a holistic viewpoint, recognizing the complex relationships, feedback loops, and potential emergent properties of systems. During ideation consideration of interconnected ideas is encouraged, while prototyping extends beyond visualizing concepts to actively integrating and testing ethical considerations iteratively. Stakeholder engagement emphasizes insights that transcend individual preferences exploring greater impacts, especially in relation to abstract concepts such as wellbeing, sustainability, and ethics. The iterative evaluation process ensures that design outcomes align with the broader context and ethical principles based on stakeholder feedback. Our research indicates that the Documentation - Communication - Iteration tripartite proposed throughout

the design process can significantly enhance the efficacy of VSDT as a tool for addressing the challenges of conflicting, dynamically changing, and ambiguous values encountered when designing systems for humanitarian, social, and environmental change and innovation.

Furthermore, while DT and VSD are tools that envision to be applicable to design as widely as possible, being global frameworks of design, the ability of both to be informed by varied design and philosophical theories, and to accommodate local, situational and cultural sensibilities is a feature that we believe is passed on to VSDT. To further enhance the responsiveness of VSDT towards such questions of locality and inclusion, VSDT can be informed by relevant approaches such as defuturing (Fry, 2020), pluriversal design (Escobar, 2018) and design justice (Costanza-Chock, 2020). We also recognize that VSDT could further benefit from the inclusion of non-western philosophies and from the examination of values beyond their typical human-centredness towards more-than-human perspectives, as a point for further development and expansion VSDT's philosophical foundation in the future.

6. Conclusions

The Value Sensitive Design Thinking framework advances the field of design by integrating Design Thinking and Value Sensitive Design through a Systems Thinking perspective. This approach equips designers with a tool for addressing complex socio-technological challenges, by prioritizing stakeholder values and fostering a collaborative mindset. Grounded on the design theories of DT, VSD and systems theory, the VSDT model remains adaptable and versatile for practical application in diverse contexts, demonstrating its potential to promote more responsible and sustainable design outcomes. The versatility of the VSDT model and its ability to accommodate local or regional preferences of design creates a capacity for more inclusive, contextually relevant and ethical design outcomes.

Future research should continue to further enhance VSDT's theoretical grounding, to explore the effectiveness of VSDT in real-world design scenarios, to evaluate its strength compared to other design tools and frameworks, and to refine the recommended combinations of DT and VSD tools. Still, the current state of the VSDT framework already offers a valuable resource for designers and researchers alike, becoming an available tool for designers dealing with complexity. As the design profession continues to evolve and confront complex challenges, the VSDT model stands as a testament to the potential of interdisciplinary collaboration and shared understanding in promoting more responsible and sustainable design outcomes, through the adaptation of existing and well-established methodologies for the needs of today and tomorrow.

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About the Authors:

Rafail Andrianos Pappas is a PhD candidate and researcher in the Department of Product and Systems Design Engineering at the University of the Aegean, studying issues of theories and methods of ethics in/of design through a systemic lens.

Katerina Malisova is a PhD candidate in the Department of Product and Systems Design Engineering at the University of the Aegean. Her research is related to the contribution of sustainable interactions in shaping humane technologies that promote user wellbeing.

Modestos Stavarakis is an Assistant Professor in Interaction Design within the Department of Product and Systems Design Engineering, and an Adjunct Professor at the Hellenic Open University, leading the Informatics and Multimedia master's course. His research focuses on interaction design, user experience, design theory / methodologies, wearable systems design, tangible interaction, assistive technologies, digital media design, and digital arts.

Spyros Bofylatos is a Tutor (Research) in the Design Products MA and an executive director of the European Academy of Design. He has worked in various research projects dealing with design as an agent of change. His research sprawls around design for sustainability, craft, material driven design and social innovation.

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