Accountable Design for Individual, Societal, and Regulated Values in the UAV Domain

Agnieszka Marczak-Czajka
Computer Science and Engineering
University of Notre Dame
South Bend, USA
amarczak@nd.edu

Jarek Nabrzyski
Center for Research Computing
University of Notre Dame
South Bend, USA
jnabrzyski@nd.edu

Jane Cleland-Huang
Computer Science and Engineering
University of Notre Dame
South Bend, USA
JaneClelandHuang@nd.edu

***Abstract*—Software systems are increasingly expected to address a broad range of stakeholder values representing both personal and societal values as well as values ensconced as laws and regulations. Whereas laws and regulations must be fully addressed, other human values need to be carefully analyzed and prioritized within the context of candidate architectural designs. The majority of prior work has investigated requirements engineering techniques for either regulatory compliance or for human-values, we take an integrated approach which simultaneously considers laws and regulations as well as societal and personal human values throughout the system analysis, specification, and design process. We illustrate our approach through detailed examples drawn from a multi-drone system regulated by the USA Federal Aviation Authority (FAA) and operating in a domain rich with human and societal values. We then discuss requirements engineering challenges and solutions unique to identifying analyzing, and prioritizing human, societal, and regulatory requirements, and ultimately for designing accountable software systems.**

***Index Terms*—human values, traceability, regulations, design decisions, accountable design**

I. Introduction

Software systems, especially those operating in safety-critical domains or holding responsibility for personal data are required to meet a broad range of relevant laws and regulations. For example, the European Union's General Data Protection Regulation (GDPR), Family Educational Rights and Privacy Act (FERPA), and the Health Insurance Portability and Accountability Act of 1996 (HIPAA), encode values related to privacy, transparency, and security [1], while a number of other standards in domains such as automotive, avionics, and medical devices address safety and reliability concerns. However, other types of human-values, such as social justice, equity, trust, honesty, and humility, if considered in the design of software systems, could lead to richer and more profound user experiences. Unfortunately, they are often either ignored or glossed over during the requirements elicitation process [2]. Developing effective solutions for managing the full spectrum of laws, societal values, and human personal values can be highly challenging yet incredibly important [3].

While degrees of accountability differ for regulations versus human values, they share many commonalities in how they are validated in the design. Furthermore, by considering them in tandem, we are better positioned to explore their trade-offs and to design a solution that balances potentially competing human values while satisfying regulations. In this paper we present a case-study to evaluate candidate design solutions with respect to human and societal values and regulations within the context of the DroneResponse system, a Cyber-Physical System that deploys multiple small unmanned aerial systems (sUAS) for search and rescue missions. We then discuss how traceability can be used to achieve accountability for various levels of design decisions. The primary contributions of this paper are therefore as follows. First, our exploration of human values in an emergent Cyber-Physical System, represents the beginning of an extensive case-study which we plan to place into the public domain to support future research. Second, we apply an approach for evaluating value-based design decisions across a spectrum of values ranging from personal to societal to regulatory. Finally, we show how distributed design decisions can be visualized as individual value-slices to provide accountability to system stakeholders.

The remainder of the paper is laid out as follows. In Section II we discuss the spectrum of values and then in Section III provide illustrative examples from DroneResponse. Sections IV and V provide concrete examples of designing for these varied levels of requirements and the impact upon different requirements engineering activities. Sections VI to VIII conclude with threats to validity, related work, and a brief discussion of open challenges and conclusions.

II. The Spectrum of Human Values

Human values have been described through diverse theories and frameworks. Based on his belief that the psychology of values may play a significant role in social change, Rokeach defined values as preferable behaviors from personal or societal perspectives [4]. Some classification schemes emphasisze personal perspectives [5], [6], while others extend values to organizational [7], [8] or cultural contexts [9]. However, in this paper, instead of focusing on values derived from these theories, we explore the cross-cutting spectrum of personal, societal, and regulated values. *Human values*, which refer to the beliefs, principles, and ideals that individuals hold to be important and meaningful in their lives, range from personal qualities such as honesty and compassion, to broader societal goals such as justice and equality. These values often serve as guiding principles that influence individuals' attitudes and behaviors, and are often shaped by culture, religion, upbringing, and personal experiences [4], [10]. *Societal values* represent the shared beliefs, norms, and principles that guide the behavior of individuals within a society or culture. They shape the way people interact with one another, contribute to the overall identity of the group, and encompass a wide range of topics related to family, religion, morality, work ethics, social responsibilities, and attitudes toward authority [11], [10]. *Laws and regulations* are highly influenced by societal values including cultural, political, and economic factors, and even personal values when advocacy groups lobby for specific sectors of society. They often evolve to address changes in societal values (e.g., environment protection) and emergent technologies (e.g., recent urgent calls for legislation to address sea-changes in AI). The values spectrum, composed of human, societal, and regulated values, impacts every part of the requirements engineering process.

III. DroneResponse: An Illustrative Example

We provide a rich context for our discussion through examples drawn from the DroneResponse Emergency Response system. We selected this domain primarily because small Uncrewed Aerial Systems (sUAS) are governed in most countries by a clear and growing set of regulations and laws, and secondly because their use for diverse tasks, such as package delivery and emergency response, touches upon diverse human values such as social justice, peacefulness, and privacy, which lead to requirements that reflect clear and compelling human values. We first present examples of relevant human and societal values, and then introduce the USA's Part 107 regulations for the operation of sUAS. We then explore the interactions between values and regulations through an example based on regulations and human values associated with sUAS BVLOS (Beyond Visual Line of Sight) flights in the USA.

A. Human Values in DroneResponse

To understand stakeholders' human values for the DroneResponse system, we developed a survey and sent it to 20 stakeholders from our network of developers, pilots, and business associates related to DroneResponse's commercialization. The participants had diverse backgrounds, with some individuals having experience in multiple domains, including research (N=8), drone software and hardware engineering (N=7), certified drone piloting (N=7), mountaineering (N=3), business innovation within the drone domain (N=4), and cyber-security (N=1). We received 17 responses. The survey provided a brief overview of the DroneResponse system and examples of two value-enhanced requirements (e.g., 'When video is used during a rescue event it must be kept private.'). Users were asked to select a stakeholder role that most closely aligned with the way they might engage with the DroneResponse system, and to respond to two prompts: (Q1) 'What values do you think are important for DroneResponse?' and (Q2) 'List any concerns that you might have about the use of DroneResponse'. The first author of this paper applied a card sorting technique [12] to codify and group responses. Results were reviewed and discussed with a second author, resulting in the identification of 11 key values as briefly summarized below.

− *Trust (TS):* Stakeholders highlighted the potential for mistrust with statements such as 'Drone operation technologies are not yet sufficiently reliable for the proposed use case operations to be carried out reliably and safely without an operator being assigned to each individual drone'.

− *Privacy (PR)* was also frequently mentioned with respect to rescue-victims, and community members, with comments such as all video data 'should be analyzed in-flight and discarded unless relevant to the safety of the person being rescued'.

− *Safety (SF)* was a key concern. For example, one respondent stated that 'Drones should avoid ... harming humans.', while another pointed out that 'UAVs could cause accidents'.

− *Transparency (TP)* was also considered important, with one stakeholder highlighting the need for auditable mission outcomes, and another pointing out the need to acknowledge limitations because 'AI and many current technologies are far from perfect' and therefore 'over-hyping their capabilities can be a bad idea.'

− *Efficiency (EF)* focused on the importance of the sUAS executing their mission speedily and effectively. One respondent stated that 'Speed and efficiency are critical to a search and rescue', and yet another said that 'hardware and software should always be immediately ready for deployment.'

− *Accuracy and Fairness (AF)* was emphasized by several respondents. For example, one respondent stated that 'Computer vision systems should detect with equal efficiency different participants (regardless of) skin tone'.

− *Common good (CG)* was mentioned by several participants who wanted DroneResponse to be used for 'positive community and/or for societal impact, not for personal interests.'

− *Security (SC)* was mentioned by a few participants with comments such as 'misoperation (sic) of drones may result in more catastrophic consequences than in other scenarios' and that 'robustness of the drone networks/systems is important.'

− *Fair treatment (FT)* as described by our respondents, focused on concerns for 'personal liability when something goes wrong' and designing the software to 'forgive pilot's mistakes in stressful situations.'

− *Comfort of life (CL)* relates to a person's perception of their own personal situation, and covered topics such as minimizing noise pollution and avoiding flying over peoples' backyards.

− *Sense of Control (CT)* was particularly important to the drone pilots who emphasized the importance for pilots to be able to 'seamlessly deactivate .. automatic controls, and control the drone manually' when needed.

B. Regulatory Compliance in DroneResponse

As previously discussed, laws and regulations tend to encode values that have been deemed important for society as a whole [1] and are typically issued by governmental agencies, boards, and commissions, often through discussions with domain experts, community members, and through examining prior case-law. They tend to embody a number of key human values, many of which overlap with values that individual stakeholders express independently. For example, while FAA Part 107 regulations [13] focus on functional safety, capabilities of the operator, and accident reporting and penalties for offenders, they are clearly driven by a rich assortment of underlying human values. For example, Part 107 Section 4.4 includes the text that "The FAA *relies on information provided by owners* and remote pilots of sUAS when it authorizes operations", which implies values of honesty and transparency; and "the FAA may take appropriate action against ... anyone who *fraudulently or knowingly provides false records* or reports", which implies *accountability*. There are clear examples of other values such as timeliness, respect for lines of authority, sense of responsibility, safety, awareness of surroundings, and sense of control to name a few. While many values overlap, our survey respondents also discussed or emphasized values such as *comfort of life* or *personal indemnity*, which were not covered by the Part 107 regulations, suggesting the importance of not relying solely on values embedded in regulations.

C. *The Synergy between Laws and Values: A Mini-Case Study*

New regulations are often established as a result of complex decision making-processes that involve societal, legal, technical, economic, and political factors. We illustrate this with the example of how BVLOS (Beyond Visual Line of Sight) regulations emerged in the USA for commercial drones. In 2016, the FAA established the Part 107 regulations for the operation of Small Unmanned Aerial Systems (sUAS) allowing only VLOS (Visual Line of Sight operations), and then in 2018 they established the Integration Pilot Program (IPP) to test regulations for new operations, including BVLOS, into the national airspace system. During this time, there were numerous opportunities for pilots and public to speak up about their needs or concerns related to BVLOS, meaning that human-values were considered in the process. New regulations governing BVLOS flights of sUAS were released in 2021 and provided strict rules of operation associated with sUAS size limits, pilot training, robust safety plans with full risk assessment and mitigations, and remote ID systems that broadcast identification and location.

The societal values that ultimately influenced the BVLOS laws are only partially covered by the actual laws. For example, Schwartz-classified human values [14] that are of particular relevance included *Security* to ensure safe operations, *achievement* to increase efficiency and reduce costs, *self-direction* to enable sUAS operators to innovate and experiment with new solutions, *power* for commercial operators to leverage the airspace, and *universalism* or *benevolence* when sUAS are deployed for purposes of justice or fairness in contexts such as emergency response or environmental monitoring.

IV. Designing for Regulations, Laws, and Values

Human values, like many other quality concerns, exhibit trade-offs against each other in the overall design of the system [15]. For example *accountability* has trade-offs with *privacy*, *sense of control* with *efficiency*, and *trust* with *performance* as building trust requires information to be continually generated to keep the user in the loop. In this section, we examine design solutions related to three regulatory constraints and two additional architecturally significant decisions. For each of these we assess the impact of design decisions against human values identified from our survey. We then determine whether each design solution strongly helps (++), weakly helps (+), weakly hurts (–), or strongly hurts(--) each value. The legend for human values (e.g., 'TR' = Trust,'PR' = Privacy) is provided in Section III-A. Design decisions ultimately taken in DroneResponse are highlighted in blue. Key design options are marked as ♦ and supporting options as ◊.

A. *Regulatory Compliance*

Part 107 regulations create hard constraints on the system and its operating environment. However, as the regulations do not specify how the system should meet each constraint, it is important to evaluate candidate design decisions against the regulations themselves as well as against other potentially impacted human values. We illustrate this using three FAA Part 107 regulations as examples.

1) Accident Reporting:: (Part § 107.9) This regulation states that any accident causing personal injury or property damage over $500 must be reported within 10 calendar days. We consider two alternative design options.

◊ **1a:** Upon completion of each flight, the system automatically opens a reporting window in the GUI and prompts the user to check either 'nothing to report' or 'initiate incident report'. If a report is initiated, the operator checks from a list of options, and an offline reporting process is then initiated.

◊ **1b:** Reporting is not integrated into the system. The operator is expected to analyse the saved log file and generate their own report using offline tools.

Integrating 1a into the system improves safety, transparency, and common good, whilst option 1b hurts transparency as shown in the following table:

	Design Option	TS	PR	SF	TP	EF	AF	CG	CT	CL	FT	SC
1a	Integrated report			+	++			++				
1b	No integrated report				–							

2) Operating Limitations: (Part § 107.51) This regulation has several sub-parts, including the visibility aspect which states that 'the minimum flight visibility, as observed from the location of the control station must be no less than 3 statute miles...'. We considered the following design options:

♦ **2a:** During preflight checks a microservice on the ground control system (GCS) shall check weather conditions to ensure that among other things, the visibility is 3 statute miles or greater.

◊ **2b:** The operator can override the visibility constraint by logging a flight exception.

◊ **2c:** Overrides are not allowed. The sUAS will not take-off unless visibility is above the legal threshold.

Automated weather checks increase safety and efficiency; however, allowing the operator to override weather constraints hurts safety (the primary objective of Part 107) whilst increasing the user's sense of Control. The impact on safety is partially alleviated through compulsory logging which supports transparency.

Design Option		TS	PR	SF	TP	EF	AF	CG	CT	CL	FT	SC
2	Weather check			++		++						
2a	Override with log			−	+				++			
2b	Flight prohibited			++					--			

3) Operation of multiple sUAS: Part § 107.35: This regulation states that 'a person may not manipulate flight controls or act as a remote pilot in command or visual observer in the operation of more than one unmanned aircraft at the same time'. However, this is a waiverable constraint. Designing a system that supports multiple sUAS is a critical design decision which impacts the core architecture of the system in addition to having impact upon human values. We evaluate the impact of three design decisions -- all of which are currently implemented in DroneResponse.

♦ **3a :** DroneResponse will support the operation of Multiple sUAS under waiver # 107W-2022-01268.

♦ **3b:** sUAS must lease dedicated airspace from ATC for each flight-leg or maneuver whenever it is in the air.

♦ **3c:** Flight status for each active sUAS is displayed in GUI. Non-critical alerts are triaged to avoid information overload.

Deploying multiple sUAS has clear impacts upon safety and we therefore operate multiple sUAS under an FAA Waiver (Ref: 107W-2022-01268) which required a full safety assurance case including solutions 3b and 3c below.

Design Option		TS	PR	SF	TP	EF	AF	CG	CT	CL	FT	SC
3a	Multi-sUAS Ops			−		++			- -			
3b	Required airleasing			++					+			
3c	Triaged alerts	++							++			

B. Non-regulated Human and Societal Values

We also explore two design options that are architecturally significant [15] but not directly addressed by any regulations.

1) Computer Vision (CV) Pipeline Deployment: Each sUAS is equipped with a camera, gimbal, and an onboard computer (Jetson NX). The CV pipeline processes streamed video to detect a person, compute their GPS coordinates, and raise an alert. One key design decision involves where CV components should be deployed. Onboard CV requires space, processing cycles, and power in a severely resource-constrained environment. It drains the battery and the generated heat requires cooling mechanisms, which drain additional power. However, it enables the sUAS to react quickly to a detected victim, and to perform responsive maneuvers without the increased latency that would be incurred if the CV pipeline required processing on a ground-based computer. Design options include the following:

♦ **4a:** Deploy the CV Pipeline onboard the sUAS to reduce latency. Imbue the sUAS with sufficient autonomy to make decisions such as determining when to track a person.

◇ **4b:** Raise an alert when a candidate victim is detected and allow the human operator to override sUAS decision.

◇ **4c:**Deploy the CV Pipeline onto the Ground Control System. Stream video to the ground and perform all victim detection on the GCS. Raise an alert for the operator when a victim is detected. The sUAS only adapts its behavior when it receives command from human operator.

Design Option		TS	PR	SF	TP	EF	AF	CG	CT	CL	FT	SC
4a	CV pipeline onboard					++	+		-			
4b	Operator overrides					++	++		++			
4c	Offboard CV	+				- -	++					

These design options had relatively cross-cutting impacts upon human values. For example, offboard CV (4c) could increase trust as a human operator makes all vision-based determinations; however, it is less efficient due to latency in transmitting imagery to the ground, and the sUAS is unable to make fast decisions or maneuvers in response to detected objects. We ultimately placed key elements of the CV pipeline onboard (4a), but also ran more computationally intensive CV algorithms offboard to provide more accurate results and to allow human operators to provide interactive feedback.

2) Autonomy Permissions: Robotics based systems, such as DroneResponse can be designed as "Human-in-the-Loop" systems where humans are the primary decision makers, versus "Human-on-the-loop" (HotL) systems in which the machine performs tasks independently under the supervision of a human. Design decisions are shown below:

♦ **5a:** The onboard pilot supports HoTL through autonomous decision making.

♦ **5b:** The onboard pilot requests input from the human every time a significant decision needs to be made. Autonomy is limited to simple failsafes (e.g., RTL on low battery).

◇ **5c:** Explanations are generated for all autonomous actions and can be displayed upon request by the user.

◇ **5d :** The user can take control of the sUAS at any time by issuing a halt and hover command.

We selected HoTL (5a) which is more efficient, makes multi-sUAS deployment viable, but potentially weakens the users sense of control. We compensated for this by allowing humans to intervene (5d), and generating explanations for autonomous decisions (5c) despite some loss in efficiency due to additional processing of explanations.

Design Option		TS	PR	SF	TP	EF	AF	CG	CT	CL	FT	SC
5a	Human-on-the-loop					++			- -			
5b	Human-in-the-loop					- -			++			
5c	Autonomy explained	++				- -			+			
6d	Human can control			+					++			

V. The Values Spectrum in Requirements

Now that we have provided concrete examples of both regulated and human values, we briefly explore whether existing requirements engineering practices are sufficient for supporting the entire spectrum of human, societal, and regulated requirements. We then discuss open challenges.

A. Requirements Elicitation, analysis, and design

Analysts need to identify relevant laws and regulations to determine which individual elements are relevant to the system-under-development [13]. This involves working with diverse stakeholders with differing perspectives and motivations to conduct interviews, surveys, and focus groups, in ordr to gain a broad understanding of stakeholder's values and expectations [16]. Furthermore, product scope needs to be managed through clear decisions about the target audience and through assessing the impact of prioritizing specific values upon marketability and product uptake.

During the requirements prioritization, analysis, and design process, the fundamental principles underlying values ensconced as regulations *must be satisfied*. We posit that mapping each regulation to its associated human values, could make it easier for software developers to understand and interpret the laws and regulations as they apply to the current software product. In addition, unregulated human values provide a rich space of design options. Well-proven prioritization techniques, such as Win-Win requirements negotiation methods [17], can be used to explore the relative importance of individual values across groups of diverse stakeholders. However, all values must be considered in the context of candidate design options [15], to understand their implementation costs and to explore design trade-offs. By incrementally exploring requirements and design, developers can identify the best solution for delivering required functionality, meeting key quality of service requirements, whilst addressing regulations and balancing other important personal and societal human values.

B. Accountability to Values

Different types of human values require different degrees of accountability. A system must demonstrably satisfy its regulated requirements if called to do so in a court of law, while systems deployed in regulated domains are often compelled via process regulations to provide trace links demonstrating that the regulations have been satisfied in the system to either design, test, or code levels [18]. In current practice there is little in way of accountability to unregulated human values; however, given the current emphasis on human-values, developers could employ traceability solutions to connect both regulated and non-regulated requirements to system components. For example, Figure 1 illustrates how the value 'sense of control' is realized through requirements and design in the DroneResponse system.

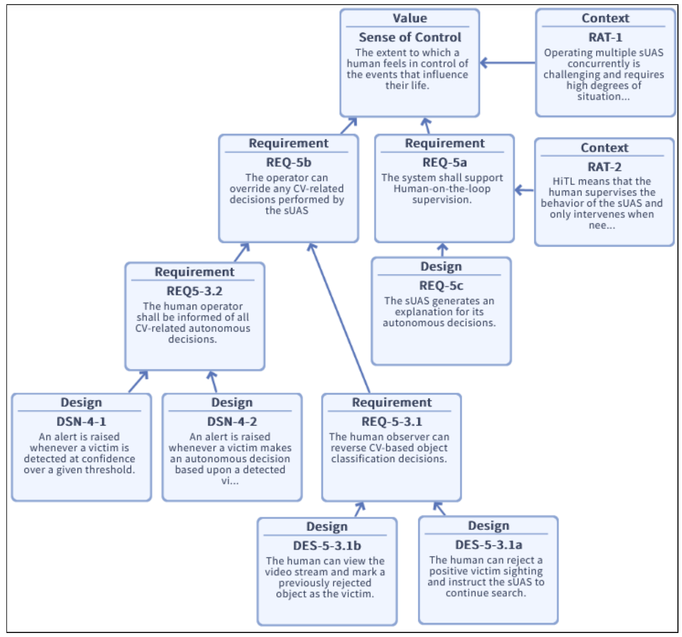

Fig. 1: Value slice showing how aspects of the human value related to 'Sense of Control' is realized in the requirements (REQ), design (DES), and contexts/rationales (RAT) of DroneResponse.

VI. Threats to Validity

This short paper has three primary validity threats. First, we did not use a specific theory or framework to elicit values for DroneResponse (e.g., [4], [5], [6], [7], [8], [9]), and it is likely that we would have identified different human values if we had done so. However, as our goal was to provide examples of personal and societal values, we do not consider the lack of a framework, and the more systematic analysis this enables, to be an issue for this study. Second, our examples were drawn from a single application within a domain that is rich with human and societal values as well as valued encoded into regulations. Nevertheless, this exercise led to some interesting observations about specific risks and open challenges as summarized below. Third, while we provided definitions of personal and societal values, we did not draw a clear distinction between examples for DroneResponse because the line is often blurry, and space constraints did not allow for a more extensive discussion.

VII. Related Work

Researchers have emphasized challenges faced by software practitioners in incorporating value-consciousness into software development, primarily exacerbated by the absence of explicit guidelines in development methodologies and regulatory frameworks such as GDPR and AI ethics guidelines [19]. Very few studies have attempted to map legal regulations to human values. In one exception, Perera et al., mapped GDPR to a wide spectrum of values identified in Schwartz's theory, including power, security, self-direction, and universalism. Notably, fairness and transparency emerged as the most 'value-conscious' principles, each connected to five distinct values, demonstrating that compliance with these principles facilitates the realized of multiple human values covered by Schwartz's theory [20]. Traditionally, the requirements engineering process has focused on a limited set of values such as usability, security, reliability, performance etc.; however, recent work has expanded this thinking by exploring additional values using taxonomies and frameworks such as the Schwartz framework [9] [2] [21], and their integration into the software engineering process [2]. For example, Mougouei created a general roadmap of existing techniques and open challenges [22], and Ferrario et al., proposed Values-First Software Engineering that used action research techniques to create maps between requirements and values [23], while Guizzardi et al., followed ethical principles to derive requirements for a driverless car system [24].

In the Requirements Engineering domain, Kheirandish developed the HuValu tool to support the exploration of human values [25], Perera et al., integrated human values into the upfront requirements elicitation and analysis process [26] and showed that the values could then be integrated into the design using feature driven values-mapping, or value-driven features mapping. Thew et al., proposed a taxonomy for guiding value-based requirements engineering [21], while Duboc et al., explored ethics, power, politics, and values using critical thinking within the requirements engineering process [27]. In our case, we took a feature-based approach and explored the impact of features upon human and societal values.

VIII. Conclusions

Recent research efforts have either focused on designing for human values or designing for regulatory compliance. Apart from mapping regulations to values (e.g., [20]), this paper is one of the first to explore the synergies between these two areas. We have explored the co-design of personal and societal values alongside values ensconsed in laws and regulations, and have discussed how societal and personal values related to qualities such as privacy, security, safety, fairness, and accessibility, may become regulated over time. However, we have also shown that many other important personal and human values are unregulated, requiring significant effort to elicit from targeted stakeholders, analyze with respect to candidate designs, and ultimately integrate into the delivered system. Viewing regulations through the perspective of human values offers a legally required starting position; however, a better approach explores the entire spectrum of values, supported by systematic and strategic exploration of additional values not covered by regulations. In future work, we will continue our exploration of both theoretical and practical solutions for eliciting and analyzing requirements, and for delivering accountable design solutions that intersect personal, societal, and regulated values.

IX. Acknowledgement

The work described in this paper is partially funded by USA National Science Foundation Grant #2131515.

References

[1] H. Perera, W. Hussain, D. Mougouei, R. A. Shams, A. Nurwidyantoro, and J. Whittle, "Towards integrating human values into software: Mapping principles and rights of gdpr to values," in IEEE Intn'l Requirements Engineering Conference (RE), 2019, pp. 404–409.

[2] J. Whittle, M. A. Ferrario, W. Simm, and W. Hussain, "A case for human values in software engineering," IEEE Software, vol. 38, no. 1, pp. 106–113, 2021.

[3] E. Winter, S. Forshaw, and M. A. Ferrario, "Measuring human values in software engineering," in Proceedings of the 12th ACM/IEEE International Symposium on Empirical Software Engineering and Measurement, ser. ESEM '18. New York, NY, USA: ACM, 2018.

[4] M. Rokeach, The nature of human values. Free press, 1973.

[5] W. A. Scott and R. Scott, Values and organizations: A study of fraternities and sororities. Rand McNally, 1965.

[6] G. W. England, "Personal value systems of american managers," Academy of Management journal, vol. 10, no. 1, pp. 53–68, 1967.

[7] P. McDonald and J. Gandz, "Identification of values relevant to business research," Human Resource Management, vol. 30, no. 2, pp. 217–236, 1991. [Online]. Available: https://doi.org/10.1002%2Fhrm.3930300205

[8] C. L. Jurkiewicz and R. A. Giacalone, "A values framework for measuring the impact of workplace spirituality on organizational performance," Journal of business ethics, vol. 49, pp. 129–142, 2004.

[9] j. . J. Shalom H. Schwartz et.al., title = Refining the theory of basic individual values., vol. 103, no. 4, pp. 663–688, oct 2012.

[10] S. H. Schwartz, "Universals in the content and structure of values: Theoretical advances and empirical tests in 20 countries," Advances in Experimental Social Psychology, vol. 25, pp. 1–65, 1992.

[11] R. Inglehart and W. E. Baker, "Modernization, cultural change, and the persistence of traditional values," American Sociological Review, vol. 65, no. 1, pp. 19–51, 2000.

[12] E. de Quincey and J. Mitchell, "Card sorting for user experience design," Interact. Comput., vol. 33, no. 4, pp. 442–457, 2021.

[13] "USA Code of Federal Regulations, Part 107 - Small Unmanned Aircraft Systems," 2016, [Accessed 20-Nov-2022]. [Online]. Available: https://www.ecfr.gov/current/title-14/chapter-I/subchapter-F/part-107

[14] S. H. Schwartz, "An overview of the schwartz theory of basic values," Online Readings in Psychology and Culture, vol. 2, no. 1, Dec. 2012. [Online]. Available: https://doi.org/10.9707/2307-0919.1116

[15] L. Chen, M. A. Babar, and B. Nuseibeh, "Characterizing architecturally significant requirements," IEEE Softw., vol. 30, no. 2, pp. 38–45, 2013. [Online]. Available: https://doi.org/10.1109/MS.2012.174

[16] C. L. Pacheco, I. A. García, and M. R. S. Reyes, "Requirements elicitation techniques: a systematic literature review based on the maturity of the techniques," IET Softw., vol. 12, pp. 365–378, 2018.

[17] B. W. Boehm, A. Egyed, D. Port, A. Shah, J. Kwan, and R. J. Madachy, "A stakeholder win-win approach to software engineering education," Ann. Softw. Eng., vol. 6, pp. 295–321, 1998. [Online]. Available: https://doi.org/10.1023/A:1018988827405

[18] P. Rempel, P. Mäder, T. Kuschke, and J. Cleland-Huang, "Mind the gap: assessing the conformance of software traceability to relevant guidelines," in Intn'l Conf.on Software Engineering, ICSE. ACM, 2014. [Online]. Available: https://doi.org/10.1145/2568225.2568290

[19] W. Hussain, M. Shahin, R. Hoda, J. Whittle, H. Perera, A. Nurwidyantoro, R. A. Shams, and G. Oliver, "How can human values be addressed in AgileMethods a case study on SAFe," IEEE Transactions on Software Engineering, pp. 1–1, 2022. [Online]. Available: https://doi.org/10.1109/tse.2022.3140230

[20] H. Perera, W. Hussain, D. Mougouei, R. A. Shams, A. Nurwidyantoro, and J. Whittle, "Towards integrating human values into software: Mapping principles and rights of GDPR to values," in 2019 IEEE International Requirements Engineering Conference (RE). IEEE, Sep. 2019. [Online]. Available: https://doi.org/10.1109/re.2019.00053

[21] S. Thew and A. Sutcliffe, "Value-based requirements engineering: Method and experience," Requir. Eng., vol. 23, no. 4, nov 2018.

[22] D. Mougouei, H. Perera, W. Hussain, R. Shams, and J. Whittle, "Operationalizing human values in software: A research roadmap," in ESEC/FSE, ser. ESEC/FSE 2018. New York, NY, USA: Association for Computing Machinery, 2018, p. 780–784.

[23] M. A. Ferrario, W. Simm, S. Forshaw, A. Gradinar, M. T. Smith, and I. Smith, "Values-first se: Research principles in practice," in International Conference on Software Engineering Companion, ser. ICSE '16. New York, NY, USA: ACM, 2016, p. 553–562.

[24] R. Guizzardi, G. Amaral, G. Guizzardi, and J. Mylopoulos, "Eliciting ethicality requirements using the ontology-based requirements engineering method," in Enterprise, Business-Process and Information Systems Modeling. Springer International Publishing, 2022, pp. 221–236. [Online]. Available: https://doi.org/10.1007/978-3-031-07475-2_15

[25] S. Kheirandish and M. Rauterberg, "How to utilize the HuValue tool for daily life product design," in Culture and Computing. Springer International Publishing, 2020, pp. 338–357.

[26] H. Perera, R. Hoda, R. A. Shams, A. Nurwidyantoro, M. Shahin, W. Hussain, and J. Whittle, "The impact of considering human values during requirements engineering activities," CoRR, vol. abs/2111.15293, 2021. [Online]. Available: https://arxiv.org/abs/2111.15293

[27] L. Duboc, C. McCord, C. Becker, and S. I. Ahmed, "Critical requirements engineering in practice," IEEE Software, vol. 37, no. 1, pp. 17–24, 2020.