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From Ethical Values to Process Quality in Agile Software Engineering: The Quality Value Driver (QVD) Framework

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Abstract

Software-intensive organizations increasingly face the challenge of integrating ethical considerations into routine work practices while maintaining process quality and organizational performance. This study develops the Quality Value Driver (QVD) framework, a managerial approach for embedding ethical reflection into everyday organizational processes. The framework links ethical values, organizational drivers, and observable quality indicators, providing a structured mechanism through which ethical values can be operationalized and evaluated. Following constructive research methodology, the study introduces the framework and illustrates its application through a proof-of-concept case involving an Agile team developing an AI-based facial palsy classification system. In the demonstrated application, collaboration was selected as the target value, Balint Groups served as the organizational driver, and process-quality indicators were used to assess development outcomes. The findings do not establish causal effectiveness but illustrate the feasibility of operationalizing ethical values through routine organizational practices within the specific context examined. The study contributes a software-engineering perspective that conceptualizes ethical values as potential process-quality drivers and advances the Ethics by Design approach by integrating ethical reflection into everyday software-development decision-making.

Keywords: agile software-development; software engineering management; human factors in software engineering; software quality; software process improvement; ethics by design; ethical software engineering; ethical reflection; quality value driver (QVD); constructive research

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1. Introduction

Managing quality in software-intensive organizations requires attention not only to product outcomes but also to the organizational processes through which teams make decisions. Accordingly, two fundamental approaches guide quality assessment in software development [1,2]: the product-based approach evaluates quality through measurable attributes of the delivered artifact, whereas the process-based approach holds that product quality emerges from the quality of the development process itself: when development activities, methodologies, and organizational routines are well-designed and consistently executed, the quality of the resulting product reflects this [3,4]. This perspective positions managerial practices as potential contributors to process quality and, indirectly, to product quality. Among the many dimensions of process quality, ethical reflection represents a promising managerial practice that may support more informed collective decision-making. Prior work has reported correlations between the inclusion of ethical tools in software development planning and improvements in time-to-market, defect rates, and total cost of ownership [5]. This suggests that ethical practice should be understood not only as a normative concern but also as a process-quality factor.

Agile, which originated in software development and has since been adopted across diverse organizational domains, is not a single methodology but a set of values and principles articulated in the Agile Manifesto [6,7]. Agile provides a particularly useful context for examining the integration of ethical reflection into routine work practices because decision-making is distributed across team members and continuously shaped through interaction, negotiation, and adaptation. Agile is not value-neutral. Its practices actively promote organizational values such as transparency, collaboration, shared ownership, and responsiveness, which carry ethical significance beyond their operational function [6,8].

More broadly, organizations operating under conditions of uncertainty depend not only on formal procedures but also on shared assumptions, recurring practices, and collective sensemaking processes that guide how members interpret situations and coordinate action [9–11]. This organizational perspective is particularly relevant in Agile environments, where collective sensemaking shapes how teams interpret challenges and coordinate action. Agile explicitly places the human factor at the center of the development process: team dynamics, interpersonal norms, and individual judgment are not background conditions but primary determinants of process quality [12–14]. Consequently, understanding how ethical reflection can be embedded within these human interactions becomes a central managerial challenge. Such distributed decision-making creates frequent situations in which teams must negotiate priorities, trade-offs, and stakeholder interests [8,12,13]. Routine development activities inevitably involve value judgments concerning priorities, trade-offs, and stakeholder impact [15,16]. Ethical considerations are therefore not isolated dilemmas but continuously present in everyday decisions such as backlog prioritization, data selection, and model interpretation [6,8]. Despite their frequency, the ethical dimensions of such decisions often remain implicit within development processes, limiting their visibility to organizational oversight and reducing opportunities for systematic reflection, negotiation, and measurement across development cycles [5].

Research on ethics in technology and organizational decision-making has evolved along three complementary streams, each of which addresses part of the challenge but leaves a critical gap unresolved. Pierce and Henry [17] demonstrated that software professionals' ethical behavior is shaped simultaneously by individual values, workplace norms, and formal organizational codes. This observation gave rise to research examining ethical challenges at different levels of analysis. The literature that emerged from this work can be broadly organized into three streams: (a) philosophical frameworks that examine the sources of ethical problems in technology and promote ethical awareness [18–21]; (b) product-oriented approaches that address issues such as algorithmic bias, data privacy, and value-sensitive design [15,22–24]; and (c) organizational and managerial approaches that focus on governance structures, codes of conduct, and management cultures in technology organizations [25–27]. While stream (a) promotes ethical awareness and stream (b) embeds ethics into technological artifacts, neither directly addresses the development process itself as a site of ethical practice. Stream (c), in turn, operates primarily at the governance level rather than within routine team activities. Consequently, the literature provides only limited guidance regarding the organizational mechanisms through which ethical reflection can become part of everyday team practices and contribute to process-quality outcomes. The challenge, therefore, is not only identifying ethical values but also understanding how such values can be systematically embedded within routine organizational processes.

Dignum [28] offers a typology grounded in the insight that technology is not value-neutral but actively embodies values [15,16]. The central issue is therefore not whether ethical values shape a technological artifact, but when in the design process those values enter, and whether they are introduced from within the engineering process or through external constraints [28,29]. This distinction is particularly important for process-oriented approaches to ethics. Seen in this light, the four approaches differ in both timing and locus of intervention. Ethics for Design relies on external normative frameworks, such as regulations and professional codes of conduct, to constrain the design space from outside the engineering process [25,30]. Ethics at Design introduces structured ethical review once the design concept already exists [20,24]. Ethics in Design integrates ethical reflection during design through theoretically grounded methods that address human values in a principled and comprehensive manner [31]. Ethics by Design represents the most robust position, treating ethical values as foundational inputs from the outset and embedding them in the organization of development itself. From this perspective, ethical review after deployment may be insufficient, and ethical considerations should be incorporated from the earliest stages of development [28].

The challenge, however, lies in translating this principle into routine organizational practice. While Ethics by Design emphasizes the early integration of ethical values into development activities, the question remains how such values can become part of everyday organizational processes and contribute to quality outcomes.

Accordingly, this study develops a managerial framework designed to operationalize the Ethics by Design position by embedding ethical reflection into the routine management practices of development teams through concrete drivers and measurable quality indicators. The resulting framework, termed the Quality Value Driver (QVD) framework, links ethical values, organizational drivers, and observable quality indicators within a single managerial structure.

Within this framework, the present study proposes the Balint Group method [32] as an organizational driver and illustrates its application through a medical AI development case. The case involves an AI-based facial palsy classification system in which three Balint Group sessions shifted the team's problem framing; classification accuracy subsequently improved by 21.5 percentage points (from 72.0% to 93.5%) across the three development iterations, though the study does not establish that ethical reflection directly caused this outcome.

The study follows the constructive research approach [33,34], which focuses on developing innovative managerial constructions intended to address practical organizational problems while contributing to theoretical knowledge. Consistent with constructive research standards [35], the primary contribution lies in the proposed managerial extension and its demonstrated feasibility; broader empirical validation across diverse contexts remains an important direction for future research.

The process-based conception of quality holds that the development process itself is a key lever of quality improvement: organizations that invest in the quality of their development process, such as team practices, decision-making routines, and management methods, tend to produce better outcomes than those focused exclusively on product attributes [25]. Within this conception, ethical team practices constitute a specific and underutilized process dimension: they govern how teams deliberate, whose concerns are surfaced, and how value-laden trade-offs are resolved. The QVD framework operationalizes this process dimension through explicit links between ethical values, team practices, and quality outcomes [5].

Agile development places the social dimension of process quality at the center of organizational management, as team collaboration serves as a key mechanism through which development outcomes are achieved [8,36]. Teams vary considerably in their collaboration patterns, ranging from weak coordination and social loafing to strong teamwork and commitment [25]. Such variability highlights the need for deliberate management interventions.

Two strands of management theory provide the basis for understanding why reflective team practices are an appropriate form of such intervention. Argyris and Schön [37] distinguished between single-loop learning, which corrects errors within existing assumptions, and double-loop learning, which questions those assumptions themselves. The Balint Group may therefore be understood as a double-loop learning mechanism because it encourages teams to question underlying assumptions, as illustrated by the paradigm shift reported in Section 8.3. Edmondson [38] identified a second precondition: teams surface errors, minority viewpoints, and ethical concerns only when members feel psychologically safe to speak without fear of judgment. The Balint Group protocol creates this condition by design through its structured format, neutral facilitation, and explicit no-judgment norm.

Ethics in organizational contexts extends beyond individual moral choice: it encompasses the norms, practices, and institutional structures through which collective decisions are made and justified [39,40]. Ethical values therefore influence organizational behavior most effectively when they are translated into recurring practices that shape how teams deliberate, collaborate, and resolve competing concerns. Unlike abstract ethical principles, operational ethical tools create shared behavioral norms that embed responsible conduct into routine organizational practice [39,40]. By designing, implementing, and measuring such practices as management interventions, organizations can make ethical process quality an observable and improvable dimension of development work.

These theoretical foundations converge on a shared gap. Agile management research highlights the human factor and collaboration as central determinants of success, while research on organizational learning and psychological safety explains why reflective team practices matter. Taken together, these perspectives support the Ethics by Design position adopted in this paper: organizations should move beyond primarily reactive compliance responses toward the proactive integration of ethical practices into the daily routines of development teams, with process quality improvement as an intended outcome. This, in turn, suggests the need for practical team-level mechanisms through which ethical reflection can be embedded in everyday organizational routines and translated into observable process-quality outcomes.

The QVD framework operationalizes ethical values through a three-component chain: a nominated Value (V), such as collaboration, openness, caution, or transparency, motivates a team Driver (D), a practice embedded in the development workflow, whose effect is tracked through measurable Quality indicators (Q). Unlike approaches that treat ethics as product requirements, QVD embeds ethical values directly into development practices [5,41]. The present paper extends this prior work in several substantive respects. Whereas the 2021 paper introduced QVD through the specific example of user stories as a technical quality driver, the present paper formalizes QVD as a general three-component framework in which ethical values serve as the explicit starting point, organizational drivers serve as the mechanism through which those values are operationalized, and measurable quality indicators serve as the evaluation mechanism. The framework introduced here is intentionally driver-independent: rather than prescribing a specific technical artifact, it accommodates any organizational practice that promotes ethical reflection and can be linked to observable quality outcomes. The present paper also situates QVD within the

Ethics by Design tradition, develops a full measurement framework including the Knowledge Sharing Index and associated quality indicators, and demonstrates the framework's application through a medical AI development case involving genuine ethical complexity. As the framework's organizational driver, we adapt the Balint Group method [32,42,43], a structured reflective practice from medical professional development in which practitioners present difficult professional cases for facilitated group deliberation. As a QVD driver, the Balint Group promotes ethical values such as meaningful cooperation, group cohesion, and shared responsibility, values that the Agile process is designed to encourage and that are expected to yield measurable quality improvements over time [5]. This driver was selected because its structured protocol, including the facilitator's neutral role and the presenter's silence during group discussion, creates the psychological safety needed [38] that ethical deliberation requires: a condition in which team members feel safe to raise concerns without fear of judgment.

This paper contributes to software engineering and software management research in three ways. First, it develops the Quality Value Driver (QVD) framework, a managerial mechanism that links ethical values, organizational drivers, and observable process-quality outcomes. In doing so, it extends prior work that has examined ethics as a contributor to process quality [5,41,44] by providing a structured framework through which ethical values can be operationalized, embedded in organizational practices, and assessed through quality indicators. Second, the paper illustrates the framework through the Balint Group method, demonstrating how ethical reflection can be embedded within routine team management practices through a concrete organizational driver. In this respect, the study provides a systematic adaptation of the Balint Group approach from healthcare professional development to software team management and establishes an initial rationale for its use in Agile development environments. Third, the study generates proof-of-concept design knowledge [35] by demonstrating the feasibility of applying the QVD framework in a real development setting. The case provides practical insights for software team managers seeking to integrate ethical reflection into routine development practices and offers a foundation for future comparative, longitudinal, and multi-case validation studies in software engineering contexts.

Research Question: How can ethical values be operationalized as process-quality drivers within the routine management practices of Agile development teams?

This question is examined with specific attention to how organizational drivers can be designed and embedded to support collaboration and responsible decision-making, and how their contribution to process quality can be assessed through observable indicators.

The remainder of the paper is structured as follows: Section 2 presents the research methodology; Section 3 introduces the QVD framework; Section 4 discusses Balint Groups as a QVD driver; Section 5 presents the quality measurement framework; Sections 6–8 report the proof-of-concept case, the development process, and the application of QVD; Section 9 discusses the findings, implications, and limitations; and Section 10 concludes.

2. Materials and Methods

Following established constructive and design science research methodology [33,35,45], this study distinguishes between construction of the QVD framework, which is the focus of this paper, and its future empirical evaluation, across software-development settings. While the case demonstrates feasibility rather than statistical efficacy, it provides rich qualitative evidence of how embedding applied ethics practices within Agile team management [46] can influence development decisions and stakeholder collaboration [17], with initial observations consistent with a link to measurable quality outcomes [5].

We employ a single instrumental case study to illustrate the QVD framework's application. The case was selected on substantive grounds: the medical AI domain presents genuine ethical complexity, especially because the most consequential ethical challenges arise within the development team itself, where everyday decisions and trade-offs shape both the system under construction and the responsibilities attached to it [47]. The team composition combined technical, clinical, and ethical expertise representative of high-stakes software projects, and the availability of pre- and post-intervention quality metrics provided an opportunity to observe changes in team processes and quality indicators following the framework's implementation. The use of a single case is consistent with established case-study methodology. Yin [48] notes that single-case designs can be methodologically justified under specific conditions, including revelatory cases in which the researcher gains access to a phenomenon previously unavailable for systematic study, and distinguishes the analytic generalization supported by case studies from the statistical generalization associated with sampling-based research. Flyvbjerg [49] rejects the claim that one cannot generalize from a single case, arguing that this objection reflects a misunderstanding of the purpose of case-study research. Within constructive research, a carefully selected case provides the standard form of empirical grounding for a newly proposed artifact [33]. Consistent with this rationale, the case was selected for its richness rather than its representativeness, and the analysis draws on triangulation across multiple data sources, including observation notes, development artifacts, post-intervention quality metrics, and informal interviews. Although the study design involves a single case, the Quality indicators were tracked across four sequential measurement points (baseline and three iterations), providing a within-case longitudinal structure rather than a single cross-sectional observation.

Data collection comprised observation notes from three 90 min Balint Group sessions, development artifacts including decision logs and documentation, post-implementation quality metrics, and informal interviews with team members. The first author served as Balint Group facilitator and observer, introducing potential bias that we acknowledge explicitly in our discussion of limitations. Observation notes and artifacts were analyzed using thematic analysis [50] to identify ethical issues surfaced, development decisions associated with the discussions, and patterns of team deliberation observed across the three sessions.

Following design science research guidelines [35,45], we evaluate our contribution against constructive research criteria: novelty of the QVD framework construction, practical relevance to real management problems, theoretical grounding in existing knowledge, initial feasibility demonstrated through illustrative application, and clear communication of the QVD framework and its organizational drivers.

3. The Quality Value Driver (QVD) Framework

As the primary artifact of this constructive research, this section presents the Quality Value Driver (QVD) framework, a conceptual model for embedding ethical reflection into routine team management practices. The framework addresses the gap between ethical principles and their systematic integration into organizational development processes by linking values, drivers, and measurable quality indicators. Within the process-based conception of quality, development activities, interactions, and decisions, rather than product attributes alone, are central determinants of organizational outcomes [1,2]. In Agile environments, where human collaboration, distributed decision-making, and iterative adaptation shape development work [12–14], many routine decisions involve implicit value judgments concerning priorities, trade-offs, acceptable risks, and stakeholder interests [18–20].

Projects involving complex technologies are characterized by uncertainty, interdependence, and intensive collaboration among diverse stakeholders, making development processes dynamic and human-centered [51,52]. In such settings, the consequences of professional software-development activities may be difficult to foresee, strengthening the need for explicit ethical reflection within the development process [53]. From a process-quality perspective, the managerial challenge lies not only in defining activities to implement but also in establishing methods for assessing each activity's contribution to overall process quality [25].

Prior studies investigating the integration of ethical tools into organizational and technology-development processes have established three relevant findings: ethical tools can bridge the gap between professional and ethical standards in software development [25]; ethical actions do not appear to negatively affect innovation performance, and professional ethics may foster quality [5]; and adding ethical considerations to planning processes within Agile methodologies correlates with improved quality performance across time-to-market, functional defects, and total cost of ownership [5,44]. These studies also suggest that professional ethical tools should be integrated as components of the development process and that teams value processes that enable shared responsibility among members [25]. Building on these findings, the Quality Value Driver (QVD) approach provides an operational framework for embedding ethical values into organizational and development processes by positioning ethical values as drivers that can be incorporated through specific activities, procedures, and mechanisms and evaluated through observable quality indicators. In this way, QVD does not introduce ethics as a separate organizational activity, but integrates ethical reflection into routine work practices in a manner that supports both responsible decision-making and process quality improvement.

3.1. The QVD Process Model

The QVD approach rests on four foundational assumptions: (a) process quality is context dependent and requires operational definition; (b) quality is measurable and requires relevant metrics; (c) quality also emerges from ethical management processes; and (d) drivers designed to promote ethical values must be evaluated for their contribution to quality outcomes.

The QVD framework comprises three interrelated components: Value (V), Driver (D), and Quality (Q), operationalized through a structured three-step process:

Step 1: Identify Target Values (V). The organization identifies ethical values it seeks to promote based on specific organizational needs and strategic goals. This step involves making implicit organizational values explicit so that they can guide everyday decision-making and team practices. These may include professional values (e.g., knowledge improvement, technical excellence), relational values (e.g., transparency, trust, meaningful cooperation), or process values (e.g., team collaboration, group cohesion, shared responsibility). In Agile contexts, values such as collaboration, openness, and collective ownership align naturally with Agile principles while addressing quality objectives.

Step 2: Design or Adopt Drivers (D). The organization designs or adapts an ethical framework, an activity, procedure, or process that can be incorporated into the development process to promote the identified values. These drivers function as what can be termed 'ethical agents' [54], namely human-led practices that mediate between ethical intent and technical execution within routine work processes. Drivers may take various forms, including structured reflection sessions, collaborative decision-making protocols, or communication practices that foster psychological safety and knowledge sharing.

Step 3: Define Quality Metrics (Q). The organization specifies metrics and methods for monitoring and quantifying improvements in the development process that result from the drivers. These metrics should capture observable changes in process quality, such as defect rates, rework patterns, delivery predictability, and team interaction indicators, enabling an empirical assessment of the driver's contribution to quality outcomes.

The QVD framework conceptualizes drivers as organizational routines: repeatable, adaptable patterns, such as practices, roles, ceremonies, and artifacts, that organizations use to address recurring challenges [55]. By making ethical values operational through concrete drivers and evaluating their impact through quality metrics, the QVD approach offers a systematic mechanism for integrating ethical reflection into everyday organizational routines. Figure 1 illustrates the three-component structure of the QVD framework and the relationships among its components: Value motivates Driver, Driver is tracked through Quality indicators, and Quality outcomes inform continuous improvement of Value.

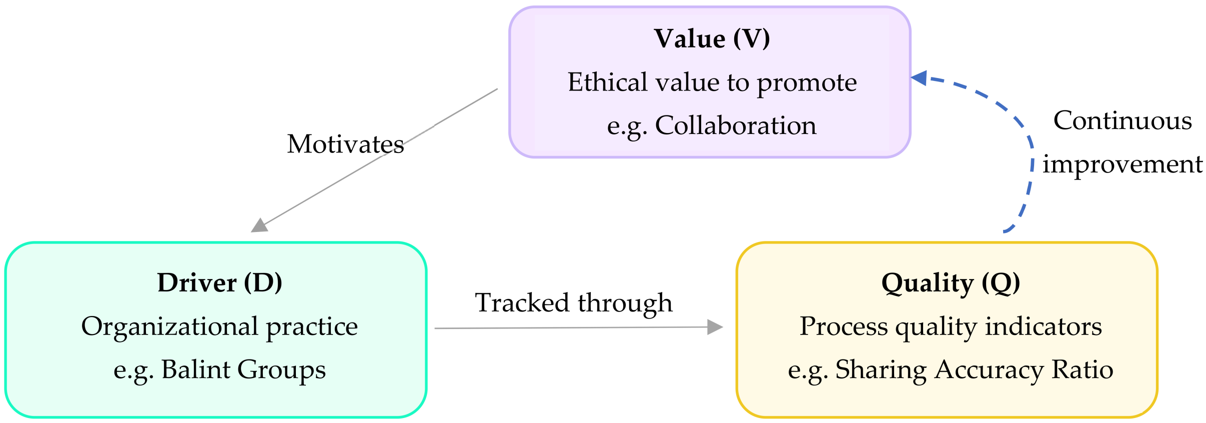

Figure 1. The Quality Value Driver (QVD) framework.

3.2. Collaboration as an Illustrative Target Value

Collaboration serves as a particularly salient example of a QVD target value in Agile contexts. Research consistently identifies collaboration as a critical determinant of software quality [5,44,56]. Effective collaboration requires shared understanding, psychological safety, and mechanisms for constructive disagreement resolution [57]. In Agile development, collaboration is essential not only between customers and developers [8] but also among team members navigating complex interdependencies [39].

From a QVD perspective, collaboration is treated as an operational capability rather than a team sentiment. It can be supported through specific drivers and evaluated through indicators such as interaction frequency, knowledge-sharing patterns, decision-making efficiency, and rework reduction. Improving team collaboration through structured techniques and frameworks thus becomes a quality value driver for enhancing software quality in Agile processes. The QVD framework treats collaboration as a relational ethical value rather than merely an operational process condition. Research in professional ethics and information systems has established that collaboration carries ethical dimensions: participants bear obligations to share knowledge honestly, surface concerns openly, and exercise shared accountability for outcomes, obligations that are duty-based rather than merely instrumental [39]. The ACM/IEEE software engineering code of ethics explicitly includes collaborative responsibilities among its core professional principles [30]. Improving collaboration within a development team is therefore not only an organizational goal but an ethical one, involving a change in the epistemic responsibilities and relational commitments of team members toward one another and toward the consequences of their collective work.

The need to promote collaboration generates several derivative value objectives that QVD drivers can address:

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1. Knowledge sharing and transparency: Sharing professional experience and exposure to new ideas improves team knowledge, reduces information asymmetries, and overcomes power relationships stemming from knowledge differences.
2. Team cohesion and cooperation: Strengthening connections among team members, increasing cooperative behaviors, and implementing effective teamwork practices enhance collective problem-solving capacity.
3. Psychological well-being: Reducing employee burnout and increasing motivation sustains long-term team performance and quality commitment.
4. Open expression of concerns: Creating safe spaces for sharing difficulties, conflicts, and stresses allows teams to surface and address quality risks before they manifest as defects. Agile work environments generate professional and emotional experiences that, if not openly discussed, can negatively impact process quality.
5. Shared responsibility: Distributing quality ownership across all team members, regardless of role or task, fosters collective commitment to process integrity.

These value objectives highlight the need for drivers that bring implicit concerns to explicit awareness and promote understanding that investing in relational capabilities and social commitments is as essential as investing in technical knowledge and professional skills. The following section describes how Balint Groups, adapted from medical professional development, can serve as such a driver within Agile software development contexts.

4. Balint Groups as a QVD Driver

The QVD framework is intentionally intervention-independent. Any structured practice that promotes ethical reflection and can be linked to observable quality outcomes may function as a Driver within the framework. Balint Groups are used in the present study as an illustrative implementation because their reflective structure aligns particularly well with the values examined in this case. The selection of Balint Groups should therefore be understood as an example of the QVD logic rather than as a defining feature of the framework itself.

4.1. Origins and Core Principles of Balint Groups

The "Balint Group" method [32,42,43], named after psychoanalyst Michael Balint (1896–1970), was originally developed to support general practitioners (GPs) in addressing psychological aspects of their clinical work. While initially designed for GPs, the technique has since expanded throughout healthcare to deepen practitioners' understanding of professional-patient dynamics. Its relevance to the present study lies not in the clinical setting itself, but in its structured approach to embedding applied ethics practices within professional team routines through reflective practice, collective learning, and the discussion of complex professional dilemmas.

A Balint Group is a facilitated reflective practice in which participants discuss professionally challenging situations involving uncertainty, conflict, or difficult decision-making [58]. Through structured dialogue, collective reflection, and psychological safety, participants explore alternative perspectives, underlying assumptions, and potential courses of action. The method is designed to promote learning, mutual understanding, and more thoughtful professional judgment. The purpose of the method is not to generate immediate solutions, but to facilitate reflection, broaden perspectives, and strengthen professional judgment through collective discussion. The facilitator's role is to establish a secure environment where participants can express perspectives and discuss fears or mistakes without criticism. Effective facilitation requires respect, curiosity, empathy, tolerance for uncertainty, and a strong understanding of procedures [59]. While trained facilitators are preferred, experienced group leaders can also serve this role [60].

Balint Groups are not psychosocial support groups, although they may have supportive effects. Research has documented several benefits, including generating new perspectives, promoting empathy [61] through understanding emotional dynamics, preventing professional burnout [62,63], strengthening professional identity [64] and improving participants' ability to manage difficult professional situations [58]. These characteristics make Balint Groups particularly relevant for Agile teams, where applied ethics concerns, interpersonal tensions, and complex decisions routinely emerge throughout the development process and influence collaboration and process quality. From an Ethics by Design perspective, Balint Groups are particularly valuable because they embed ethical reflection directly within routine team processes rather than relying solely on external review or compliance mechanisms.

4.2. Why Balint Groups Fit the QVD Framework

Balint Groups are presented here as an illustrative implementation of the QVD logic rather than as the focus of the framework itself. It should be noted that the advantages identified below are documented in medical and healthcare professional development settings. Their transferability to software development contexts is an assumption of the present study rather than an empirically demonstrated finding, and constitutes one of the key propositions that future research should examine. Studies on Balint Groups in medical settings [58,59,65] identify six key advantages that support the ethical values closely aligned with the QVD framework: (a) sharing knowledge and experiences to deepen understanding of professional situations; (b) enabling self-reflection through collective discussion; (c) providing a safe environment for raising applied ethics concerns and professional questions without fear of criticism; (d) motivating participant involvement and creating opportunities for dialogue; (e) improving communication skills including listening, trust-building, and constructive conversation; and (f) promoting shared responsibility among participants. Software development teams face similar professional and interpersonal complexities. Team members regularly encounter situations involving uncertainty, competing priorities, conflicting interpretations, and difficult trade-offs. A key challenge for team leaders is identifying mechanisms that address both visible and hidden tensions affecting collaboration, decision-making, and process quality. Effective collaboration requires emotional, interpersonal, and reflective capabilities alongside technical expertise [66]. The Balint Group method provides a structured environment in which such capabilities can be developed and applied. By enabling participants to openly discuss challenges, uncertainties, and professional dilemmas, the method encourages knowledge sharing, collective learning, and deeper mutual understanding. Such environments have been identified as important contributors to team effectiveness and project success.

Within the QVD framework, these characteristics position Balint Groups as a practical mechanism for operationalizing ethical values such as collaboration, transparency, shared responsibility, psychological safety, and reflective decision-making.

4.3. Illustrating the QVD Framework Through Balint Groups

To promote meaningful cooperation and cohesion within software development teams, the Balint Group method is proposed as a Quality Value Driver (QVD) integrated into Agile frameworks. This integration complements existing Agile practices rather than replacing them. Within the QVD framework, Balint Groups function as a Driver (D) targeting values related to collaboration, transparency, psychological safety, and responsible decision-making. By operationalizing these target values (V) through structured reflective practice, teams can generate observable improvements in process quality (Q), including enhanced alignment in decision-making, improved communication, reduced misunderstandings, and

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more effective management of interpersonal and applied ethics tensions. When embedded within Agile development cycles, Balint Groups operate as recurring reflective practices that enable teams to surface implicit assumptions, align interpretations, and collectively examine the applied ethics dimensions of technical and organizational decisions while preserving core Agile principles. Viewed through the Ethics by Design perspective, Balint Groups provide a mechanism for integrating ethical reflection directly into routine work processes. Rather than treating ethical concerns as issues to be addressed only through compliance procedures or external review, the method embeds ethical deliberation within everyday team interactions and decision-making practices.

Importantly, the contribution of the present study does not rest on the Balint Group method itself. Within the QVD framework, Balint Groups represent one possible driver through which ethical values can be operationalized and linked to quality outcomes. The framework is intentionally designed to remain independent of any specific intervention and may accommodate alternative drivers that promote ethical reflection, collaboration, and responsible decision-making within organizational processes. Accordingly, the primary contribution of this research is the QVD framework and its underlying logic for connecting values, drivers, and quality outcomes, while the Balint Group serves as an illustrative implementation of that logic.

4.4. Operationalization of Balint Groups Within Agile Teams

The implementation of Balint Groups within Agile environments addresses three complementary dimensions: structural requirements, session processes, and developmental objectives.

4.4.1. Structural Requirements

Several foundational requirements support the effective implementation of Balint Groups within Agile teams. Participants may include developers, testers, automation specialists, team leaders, product owners, and other stakeholders involved in the development process, reflecting the diverse perspectives that contribute to ethical reflection. The facilitator should possess group facilitation experience and a strong understanding of professional ethics. To preserve psychological safety and encourage open discussion, it is preferable that the facilitator not serve simultaneously as the team's direct manager or product owner. Sessions should be scheduled in advance and integrated into the team's regular work routine. To align with Agile's iterative rhythm, sessions may be conducted at regular intervals, such as the conclusion of a development cycle or at designated reflection points. Participants must attend without computers or mobile phones in order to minimize distractions and strengthen engagement. Prior to implementation, an orientation session should introduce the method's goals, structure, and ground rules. In addition, teams may implement mechanisms for confidential case submissions, allowing the facilitator to prepare cases in advance and optimize session time while reducing potential inhibition among participants.

A detailed operational protocol describing the implementation of Balint Groups within Agile software development teams is provided in Appendix A.

4.4.2. Session Process

The session follows a structured sequence adapted from the healthcare model. Sessions traditionally open with the facilitator inviting participants, seated in a circle, to share a case, echoing the original Balint format's signature opening question, 'Who has a case?' Participants are invited to present situations involving uncertainty, tension, disagreement, or difficulty in decision-making. Following the presentation, the presenter steps back from the circle and refrains from participating in the discussion, allowing the group to explore the case without the presenter's direct influence. Group members ask clarifying questions and engage in collective discussion focused on understanding the situation from multiple perspectives. The facilitator guides the discussion while maintaining psychological safety and encouraging reflection rather than judgment. A distinctive adaptation in software development contexts is the facilitator's translation function: the facilitator bridges technical concerns and applied ethics dimensions by naming the ethical values embedded in the cases presented, connecting specific situations to broader principles of collaboration, transparency, shared responsibility, and accountability. Particular attention is given to surfacing underlying assumptions, interpersonal dynamics, ethical concerns, and alternative interpretations of events. The facilitator may also help connect the discussion to relevant professional and ethical values. At the conclusion of the session, key insights are summarized and reflected upon collectively. The facilitator then integrates these insights and circulates them within the broader organization, transforming individual team experiences into systemic organizational learning that extends beyond the immediate group.

4.4.3. Developmental Objectives and Expected Outcomes

As a driver within the QVD framework, Balint Group sessions support both individual and collective development. Participants strengthen their ability to listen attentively to alternative viewpoints, reflect on their own assumptions, and engage constructively with uncertainty and disagreement. The method promotes collaboration by creating a shared environment in which challenges can be openly discussed and collectively addressed. Over time, this process contributes to stronger interpersonal trust, improved communication, greater shared responsibility, and enhanced team cohesion. Through these mechanisms, Balint Groups operationalize the Ethics by Design position by embedding ethical reflection within routine team practices and linking it to process-quality outcomes.

5. Quality Measurement Framework

Completing the Quality Value Driver framework, this section addresses the Quality (Q) component: the observable indicators used to assess whether the Balint Group driver effectively advances the chosen values of collaboration, transparency, and responsible decision-making. The integration of applied ethics practices into software team routines may generate observable effects, including improvements in collaborative behavior, decision-making quality, and identification of blind spots, which can be tracked through structured measurement frameworks [5]. As a managerial approach embedding applied ethics into development processes, the QVD framework requires defining parameters, indices, and methods for evaluating the quality improvements generated by the Driver.

The measurement framework progresses through five systematic phases. Step 1 (Pre-implementation Baseline Assessment) establishes the starting point by gathering relevant data on the identified ethical value, defining indices and associated parameters essential to the assessment, and evaluating the current state of these parameters. Step 2 (Implementation: Observation and Data Collection) monitors the team's work and gathers relevant data, considering the timing and context of the QVD operation. Step 3 (Post-Implementation Evaluation) systematically evaluates predetermined indices and parameters, measures the effectiveness of the measurement process, and assesses the situation in a controlled manner. Step 4 (Post-Implementation Comparison and Analysis) continuously monitors and analyzes collected data to identify trends, patterns, and areas for improvement. Step 5 (Post-Implementation Qualitative Feedback) supplements quantitative measures with qualitative feedback from team members through surveys or interviews, providing valuable insights into team perceptions and experiences. Figure 2 presents the nine-step QVD application workflow, from identifying organizational values through continuous process improvement. Steps are color-coded to reflect the framework's three components: purple for Value-related steps (1 and 9), teal for Driver-related steps (2 and 5), and amber for Quality-related steps (3, 4, 6, 7, and 8).

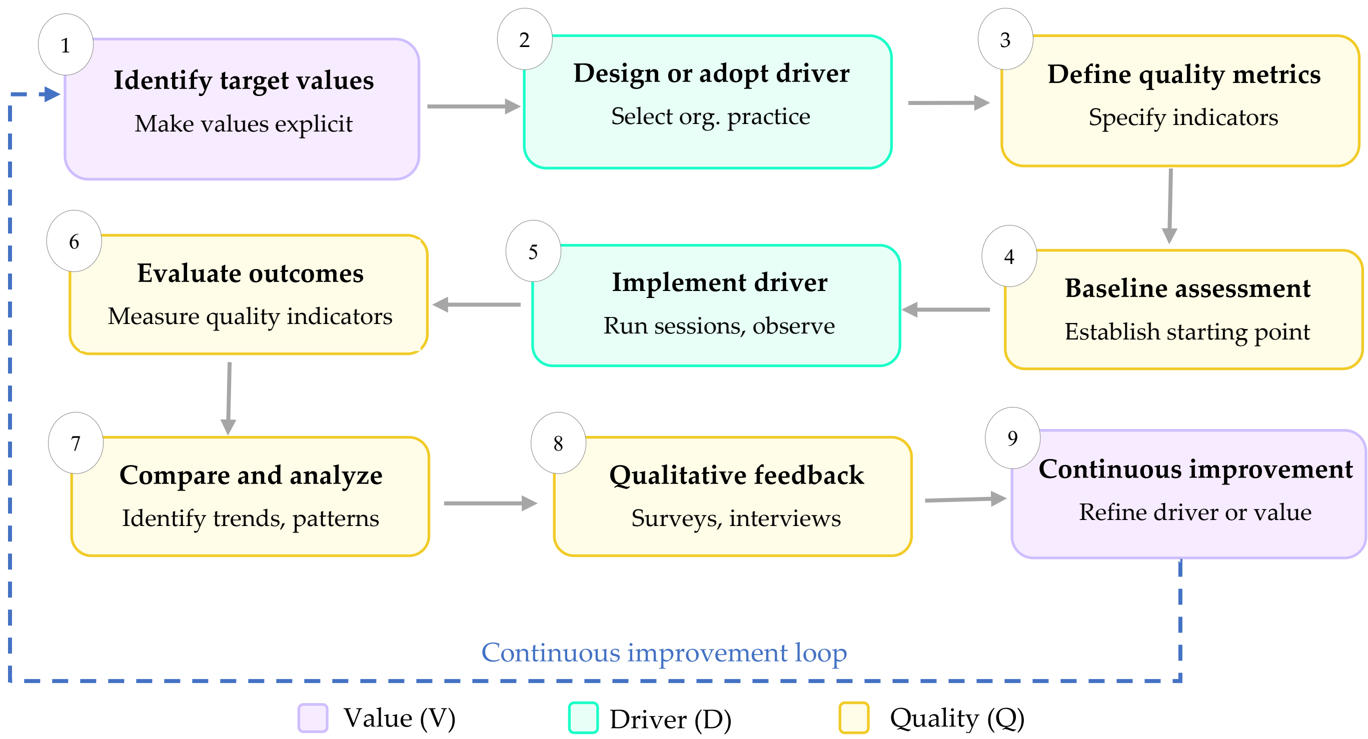

Figure 2. The QVD application workflow.

The framework presents three reusable, extendable indices comprising general components characterizing collaboration as a process quality value. Users have the flexibility to adopt, modify, disregard, or introduce new elements as needed.

The Knowledge Sharing Index assesses the effectiveness and ease of exchanging professional knowledge within the team, evaluating the QVD's impact on fostering transparency, overcoming power dynamics, and strengthening professional ethics. Seven recommended parameters include: frequency of interactions regarding professional topics; participation rate in knowledge-sharing activities; diversity of contributors ensuring broader perspectives; accessibility of knowledge repositories promoting transparency; accessibility to new knowledge acquired through the QVD approach; the knowledge accuracy ratio comparing task requirement modifications to new knowledge accessibility; and feedback on knowledge-sharing effectiveness.

The Team Cohesion Index assesses the strength of interconnectedness and cooperation, evaluating the QVD's impact on fostering unity, collaboration, and mutual support. Four recommended parameters include: social bonds through informal gatherings and communication outside work tasks; collaborative efforts in problem-solving, decision-making, and task execution; communication effectiveness, including responsiveness, active listening, and open feedback mechanisms; and conflict resolution capabilities for maintaining positive relationships during disagreements.

The Employee Well-being and Motivation Index assesses burnout levels and motivation, evaluating the QVD's impact on employee well-being and job satisfaction to create healthier, more effective work environments. Five recommended parameters include: burnout assessment using established instruments such as the Maslach Burnout Inventory [67] to measure emotional exhaustion, depersonalization, and reduced personal accomplishment; motivation indicators [68] including intrinsic motivation, work satisfaction, accomplishment, and task engagement; job satisfaction [69] with work environment and sense of meaningful contribution; work–life balance perceptions, as improvements reduce burnout and increase motivation; and perceived organizational support positively influencing motivation and well-being.

Finally, questionnaires can gauge team familiarity with applied ethics practices and their organizational impact [70], effectively assessing the overall effect of the QVD implementation. While these indices and parameters measure specific values, various alternative approaches such as interviews, surveys, observation, or quantitative metrics can be employed depending on specific objectives, priorities, and desired outcomes.

6. Case Context: AI-Based Facial Palsy Classification Software

This section demonstrates proof-of-concept for the QVD framework through its application to an AI-based facial palsy classification system. The purpose is to establish initial feasibility rather than to validate effectiveness [35]. We illustrate how Balint Groups can be operationalized in Agile contexts, what types of ethical issues emerge, and how the framework informs development decisions.

6.1. Medical and Scientific Context

The proof-of-concept case involves the development of an AI-based system intended to support the early identification of facial palsy (FP), a neurological condition that causes facial asymmetry and may significantly affect patients' quality of life [71,72]. Accurate diagnosis can be challenging, particularly for less experienced clinicians, and delayed diagnosis may have important clinical consequences [71]. AI-based diagnostic tools therefore offer potential benefits by supporting early assessment, improving accessibility, and assisting clinical decision-making [73,74]. The case provides a suitable context for examining the QVD framework because it combines technical complexity, multidisciplinary collaboration, and ethically significant decisions concerning diagnosis, data quality, system performance, and stakeholder responsibilities.

6.2. The Development Project

An otolaryngology research group approached a multidisciplinary research team to develop a publicly accessible AI tool for the early identification of facial palsy. The development team included expertise in software engineering, AI, medicine, management, and ethics, creating a setting characterized by diverse perspectives, knowledge asymmetries, and competing priorities. The project pursued two objectives: improving early identification of facial palsy and increasing the accessibility of diagnostic support. Because decisions regarding data selection, system design, model performance, and stakeholder responsibilities involved both technical and ethical considerations, the project provided an appropriate setting for illustrating how the QVD framework can support ethical reflection within routine development processes.

7. Software Development Process

7.1. Team Composition

The software-development team comprised a product manager, an ethics expert, two medical practitioners, an AI engineer, and two software engineers. This multidisciplinary composition brought together diverse forms of expertise, perspectives, and assumptions regarding the opportunities, limitations, and risks associated with developing an AI-based diagnostic system. Collaboration among these stakeholders was essential because no single participant possessed all the knowledge required to make informed development decisions. The team adopted the Agile Scrum methodology [12–14], working in two-week sprints with regular delivery cycles and continuous stakeholder feedback. This iterative approach enabled ongoing refinement of both technical and organizational aspects of the project while creating frequent opportunities for collaboration and shared learning.

7.2. System Context

The project involved the development of an AI-based system intended to support the early identification of facial palsy (FP) using medical image analysis. The system integrated medical data, machine-learning models, and a publicly accessible application interface. Consequently, development decisions required the integration of medical, technical, ethical, and managerial knowledge. The adoption of Agile Scrum in this context is consistent with recent work suggesting that Agile methods, because of their iterative and adaptive characteristics, can provide a useful basis for managing the complexity, evolving requirements, and uncertainty associated with AI development projects [75]. Projects involving advanced technologies are characterized by uncertainty, interdependence, and intensive collaboration among diverse stakeholders [51,52]. In such environments, decisions concerning data quality, model performance, reliability, fairness, and user impact carry both technical and ethical significance. As a result, effective collaboration among stakeholders becomes a critical factor influencing development outcomes [5,44].

7.3. Emerging Challenge

During the development process, the team encountered a significant gap between expected and actual system performance. Following standard testing procedures, the trained model achieved approximately 70% classification accuracy, falling below the level required for clinical use [76]. While the initial concern focused on technical performance, subsequent analysis revealed broader organizational and collaborative challenges. Medical practitioners possessed deep domain knowledge regarding diagnosis and patient care but had limited familiarity with machine-learning constraints, training-data requirements, and algorithmic limitations. Conversely, developers and AI specialists possessed technical expertise but did not always fully understand clinical expectations, diagnostic reasoning, and the practical implications of system performance in healthcare settings. These differences did not reflect a lack of competence or commitment. Rather, they reflected the inherent complexity of knowledge-intensive software-development projects, in which multidisciplinary collaboration, uncertainty, and the consequences of professional decisions are difficult to manage in advance [51–53]. The situation highlighted the need for mechanisms capable of supporting knowledge sharing, mutual understanding, and constructive dialogue among stakeholders.

7.4. Illustrative Ethical Challenge: Class Imbalance

One example of the challenges identified during development involved the issue of class imbalance in the training data. Class imbalance is a well-documented challenge in machine-learning systems and occurs when the distribution of examples across categories is uneven, potentially reducing classification performance and increasing the likelihood of errors [77–79]. Although class imbalance is often viewed as a technical problem, the team recognized that it also carried ethical implications. Decisions regarding data selection, representation, performance thresholds, and acceptable error rates could influence how different groups of users would be affected by the system. Consequently, concerns regarding fairness, bias, and the consequences of incorrect classifications emerged alongside technical concerns. The discussion surrounding this issue revealed substantial differences in stakeholder understanding of AI capabilities, limitations, risks, and quality requirements. What initially appeared to be a technical problem gradually revealed itself as a collaborative and organizational challenge requiring structured reflection and shared learning.

7.5. Strategic Decision

The challenges encountered during development led the team to conclude that improving technical performance alone would not be sufficient. The underlying issue involved the quality of collaboration, communication, and shared understanding among stakeholders participating in the development process. Consequently, the team adopted the QVD framework with collaboration as the target value. The objective was not merely to improve interpersonal relations but to create conditions that would support knowledge sharing, ethical reflection, responsible decision-making, and ultimately higher process quality [5,25,44].

Balint Groups were selected as the operational driver through which these objectives could be embedded within routine Agile practices. From a QVD perspective, the purpose of this intervention was not to introduce ethics as a separate activity within the project, but rather to integrate ethical reflection into existing development routines. The goal was to strengthen the team's capacity to collectively address technical, organizational, and ethical challenges as part of everyday development work.

8. Results: Application of the QVD Approach

8.1. Framework Instantiation

The QVD approach was instantiated within the software-development process as follows: the targeted Value (V) was cultivating knowledge sharing and enriching dialogue among diverse stakeholders to promote transparency, strengthen shared knowledge, and encourage the discussion of difficulties and responsibilities. The Driver (D) was the Balint Group method. The Quality indicators (Q) comprised a Knowledge Sharing Index operationalized through four parameters: (a) Frequency of Interactions- communication events focused on the bias challenge between sessions; (b) Sharing Accuracy Ratio- task requirement modifications relative to interactions, anticipated to decrease; (c) Reducing Bias Ratio-demographic subgroups added relative to interactions, anticipated to decrease; (d) Overall Success- image classification accuracy. Note: the Reducing-Bias Ratio was anticipated to decrease as shared understanding developed and dataset composition stabilized. The observed increase in Iteration 2 (from 0.333 to 0.429) reflects the team's deliberate decision to expand demographic coverage from four to six subgroups in direct response to the fairness concerns raised during Session 2, an ethically motivated development decision rather than a framework failure. The ratio's subsequent decrease in Iteration 3 (to 0.333) reflects increased interactions without further subgroup additions, following the paradigm shift toward an asymmetry-based approach. The indicator was subsequently reconsidered in light of this paradigm shift, as described in Section 8.3. The four indicators were selected to capture complementary facets of collaboration as operationalized in this case. Frequency of Interactions was not treated as a proxy for dialogue quality or ethical collaboration in isolation. Rather, it was used as an enabling process indicator, capturing the shift from the sporadic, primarily bilateral communications observed at baseline toward more structured, multilateral exchanges across the three development sites. An increase in interaction frequency therefore indicated that opportunities for cross-disciplinary collaboration were being activated; it did not, by itself, establish that the exchanges were meaningful, accurate, or ethically informed. The Sharing Accuracy Ratio captured the extent to which knowledge exchanged among participants was communicated and retained accurately, thereby reflecting the quality of shared understanding. The Reducing-Bias Ratio captured the team's collective identification and mitigation of recognized sources of bias, particularly the fairness concerns raised during Session 2. Classification Accuracy was treated as a downstream technical outcome, reflecting the extent to which the team's integrated technical, clinical, and ethical knowledge was expressed in the resulting system performance. Taken together, the indicators provide an exploratory, multidimensional account of collaboration-related process conditions, knowledge-exchange quality, ethical deliberation, and downstream technical performance; they should not be interpreted as a validated standalone measure of ethical collaboration. The purpose of this instantiation was not to evaluate the Balint Group method as an intervention in its own right, but to illustrate how the QVD framework can be operationalized by linking a target value, an organizational driver, and observable quality indicators.

8.2. Baseline Assessment

Before implementation, a kick-off meeting introduced the bias challenge and QVD objectives, with the product manager as facilitator. Three one-hour Balint Group sessions were scheduled bi-weekly on Thursday mornings. The Balint Group sessions were facilitated by the first author, who served independently of line management, consistent with the structural requirements described in Section 4.4.1. The product manager's facilitation role was limited to the kick-off meeting, which introduced the QVD objectives and framework to the team prior to the commencement of Balint Group sessions. Baseline assessment revealed significant collaboration barriers: three development centers in different cities (>50 km apart) with limited face-to-face interaction (only initiation and prototype meetings), sporadic individual communications, and partial Zoom attendance. The training dataset included four demographic subgroups (female/male, light/dark skin color), and classification accuracy was 72%.

8.3. Three Balint Group Sessions: Key Developments

Iteration 1: Initial Knowledge Gaps

The first iteration revealed significant gaps in stakeholder understanding concerning data quality, image classification, and repository reliability. The first session (hospital site, AI engineer presenting) surfaced concerns about the image repository's source, size, and variety. Participants raised concerns regarding the quality, reliability, and suitability of the image repository for the intended diagnostic task. Two action points emerged: examine and improve the image processing algorithm, and have doctors re-examine all training images for classification verification.

Iteration 2: Emergence of Ethical Concerns

The second session broadened the discussion beyond immediate technical concerns to include questions of representation, fairness, and stakeholder responsibility. The ethics expert expressed concern that discussions centered on technology and database quality with insufficient attention to diversity. He argued that the dataset did not adequately represent relevant forms of diversity and that broader questions concerning representation and fairness had received insufficient attention. This discussion represented the first explicit attempt to connect technical decisions with broader concerns regarding fairness, representation, and stakeholder responsibility. Session 2 thus constitutes the most explicitly ethical moment of the intervention. The ethics expert's challenge reframed the composition of the training dataset, previously treated primarily as a technical parameter, as a normative question requiring explicit justification: whose experiences were represented, whose were absent, and what responsibilities the team had toward those populations. This shift from technical optimization to ethical accountability illustrates the mechanism the QVD framework is designed to enable: surfacing implicit value judgments embedded in routine development decisions and bringing them into explicit collective deliberation. The AI engineer countered that focusing solely on quantity/diversity might overlook class imbalance in group sizes—the actual main issue. Three action points emerged: offer additional image databases, expand diversity and classification, and examine group size imbalance.

Iteration 3: Shared Understanding and Reframing

The third session (software development site, system engineer presenting) revealed frustration with the complexity of building demographically diverse databases. Crucially, the product manager revisited a casual statement from the first session: a doctor had mentioned that FP diagnosis compares asymmetry between facial sides. The meeting paused for a doctor phone consultation, revealing this insight's significance. Rather than continuing to optimize demographic diversity within the dataset, participants reconsidered the underlying diagnostic logic and explored an alternative approach based on facial asymmetry. This reframing shifted attention from demographic diversity within the dataset to asymmetry within individual faces as the primary diagnostic signal. The algorithm would divide face images into halves, flip one, superimpose, and train the CNN on dual-layered images.

As shown in Table 1, three of the four indicators demonstrated consistent positive development throughout the intervention. The Reducing-Bias Ratio followed a non-monotonic pattern, increasing in Iteration 2 before decreasing in Iteration 3, a pattern that reflects the team's deliberate ethical response to the representation concerns raised in Session 2 rather than an inconsistency in the framework. The two ratios are calculated only for Iterations 1 through 3, for which formal interaction data were available. The baseline row represents the pre-intervention state: the initial dataset comprised four demographic subgroups and initial classification accuracy was 72.0%; no Balint Group sessions had yet occurred, so interaction-based ratios were not calculated for baseline. Stakeholder interactions increased across iterations; the Sharing Accuracy Ratio consistently decreased, indicating improved mutual understanding and fewer requirement revisions, and overall classification performance improved substantially. Together, these trends are consistent with greater alignment among stakeholders, improved shared understanding, and an enhanced ability to address quality challenges through collaborative reflection. The indicator values reported in Table 1 are descriptive in nature. Given the single-case design with four measurement points, no inferential statistics were performed, and the values should be interpreted as illustrative of the observed pattern rather than as statistically significant findings.

Table 1. Evolution of QVD Quality Indicators Across Iterations.

Stage	Frequency of Interactions (N)	Requirement Modifications (M)	Sharing Accuracy Ratio ($M \backslash N$)	Subgroups (S)	Reducing-Bias Ratio (S/N)	Classification Accuracy
Baseline	–	-	–	4	-	72.0%
Iteration 1	12	7	0.583	4	0.333	84.0%
Iteration 2	14	5	0.357	6	0.429	88.6%
Iteration 3	18	3	0.167	6	0.333	93.5%

Taken together, the three iterations illustrate the logic of the QVD framework. The introduction of a driver designed to promote collaboration and shared reflection contributed to increased stakeholder interaction, improved mutual understanding, and the identification of previously overlooked assumptions. Importantly, the most significant development was not a specific technical modification but the team's ability to collectively reframe the problem through interdisciplinary dialogue, shared reflection, and increased mutual understanding. From a QVD perspective, this shift illustrates how ethical reflection embedded within routine team practices can influence both collaboration processes and development outcomes. While the case does not establish causality or generalizability, it demonstrates the feasibility of applying the QVD framework within a complex development environment.

9. Discussion

This study developed and illustrated the Quality Value Driver (QVD) framework as a managerial mechanism for embedding ethical reflection into routine organizational practices. The central contribution of the study lies in the QVD logic that links ethical values, organizational drivers, and observable quality indicators. The proof-of-concept case illustrates how this logic can be operationalized in a complex Agile development environment involving multidisciplinary collaboration, technical uncertainty, and ethically consequential decisions.

9.1. QVD as a Mechanism for Operationalizing Ethical Values

The findings illustrate how ethical values can be translated into concrete software-engineering management practice. In the case examined, collaboration was selected as the target Value (V), representing the ethical principle to be promoted; Balint Groups served as the Driver (D), the organizational mechanism used to foster that value; and the Knowledge Sharing Index provided observable Quality indicators (Q), capturing measurable outcomes associated with the value in practice. This structure enabled the team to move from a broad ethical aspiration, such as collaboration, to a concrete process through which collaboration could be practiced, observed, and assessed. This reflects the core managerial contribution of the QVD framework. Rather than treating ethics as a separate compliance activity or as an abstract normative layer, QVD embeds ethical reflection within ordinary work routines through quality drivers that are directly linked to observable quality outcomes. In this sense, ethical reflection becomes part of how teams communicate, interpret problems, surface concerns, and make development decisions. This interpretation is consistent with prior studies suggesting that ethical practices can support software quality and that ethical considerations become most influential when integrated into development processes rather than treated as external constraints [5,25,44].

The QVD framework extends this line of work by providing an explicit mechanism that links ethical values, organizational drivers, and observable quality indicators. This represents a substantive extension of prior QVD work, which introduced the concept through the specific example of user stories as a technical quality driver [41]. The present framework generalizes QVD beyond any single driver or artifact by formalizing the three-component Value, Driver, Quality chain, introducing the driver-independent logic that accommodates any organizational practice promoting ethical reflection, and situating the framework explicitly within the Ethics by Design tradition.

9.2. Embedding Ethical Reflection in Routine Team Practices

The broader conceptual framing suggests that ethical reflection may be most useful when it is integrated into existing organizational routines rather than introduced as an external mechanism. The Balint Group sessions did not operate as an ethics committee or post hoc audit. Instead, they created a structured space within the development process in which team members could discuss uncertainty, disagreement, assumptions, and responsibility. While this case study focused on collaboration and knowledge sharing as the target values, the QVD framework is intended to support the identification of context-specific values, drivers, and quality indicators that can be embedded within existing organizational processes. This supports the Ethics by Design position adopted in this paper: ethical considerations should enter the development process through routine organizational practices, not only through external controls or late-stage evaluation. The case illustrates how a structured driver can make ethical reflection actionable without removing it from the everyday context of team decision-making. The observations are also consistent with previous Balint Group research, which has associated structured reflective dialogue with improved communication, shared understanding, and professional learning in complex practice environments [58,59,64,65].

9.3. Collaboration, Shared Understanding, and Problem Reframing

The proof-of-concept case shows that the QVD intervention was associated with changes in collaboration and shared understanding. Across the three iterations, stakeholder interactions increased, the Sharing Accuracy Ratio decreased, and classification accuracy improved. These trends should not be interpreted as causal proof that the Balint Group method produced the observed technical improvement. Rather, they illustrate how a QVD driver may support the conditions under which better development decisions become possible. Accordingly, the case should be read as an illustration of a plausible process mechanism rather than as evidence of causal effectiveness. The most important outcome was not a single technical modification, but the team's collective ability to reframe the problem. Initially, the team focused on improving demographic diversity within the dataset. Through structured reflection and interdisciplinary dialogue, the team reconsidered the diagnostic logic of the system and shifted toward an asymmetry-based approach. This reframing demonstrates how embedded ethical reflection can help teams identify previously overlooked assumptions and connect technical decisions with broader concerns of fairness, representation, and responsibility. It is worth noting that the asymmetry insight that surfaced in Session 3, although technically framed, was supported by the ethically grounded relational conditions established during the preceding sessions. These conditions included the psychological safety to challenge prior assumptions, the cross-disciplinary trust required to pause the meeting and consult a clinician in real time, and a shared sense of responsibility that placed diagnostic accuracy above continued investment in the existing approach. The QVD framework did not directly produce the technical insight; rather, it helped establish the organizational conditions under which such insights could be surfaced, recognized, and acted upon collectively. More broadly, the case suggests that structured reflection can enable teams to revisit information that was previously available but insufficiently recognized, thereby creating opportunities for collective learning and problem reframing. The observed indicator patterns further support the plausibility of this mechanism: increased stakeholder interaction, fewer requirement revisions, and improved classification accuracy are consistent with improved alignment and shared understanding, although they do not establish causality.

9.4. QVD Beyond the Balint Group Method

QVD can also be situated within the broader software process improvement literature. Prescriptive frameworks such as the Capability Maturity Model assess process maturity primarily through conformance to predefined best practices, rather than through an explicit link to organizational values [80]. A broader body of work in value-based software engineering has argued that software practices should be oriented around explicit stakeholder value rather than process conformance alone [81], but this literature has not addressed ethical values specifically, nor proposed a driver comparable to the Balint Group. QVD differs from these approaches in two respects: it treats ethical values, rather than general stakeholder value, as the starting point for process improvement, and it operationalizes those values through a specific, reflective team practice rather than through a maturity-level assessment. A central implication for software engineering management is that QVD is independent of any specific intervention. Within the QVD framework, Balint Groups were selected as the driver because their reflective structure offered a practical mechanism for operationalizing the target values of collaboration, knowledge sharing, and shared responsibility. However, the framework itself is broader. Other organizational drivers may also be used, provided that they promote ethical reflection, can be embedded within routine practices, and can be linked to observable quality indicators. The choice of driver should reflect the specific characteristics, culture, needs, and working practices of the organization. In this sense, QVD is consistent with Agile thinking, which emphasizes adaptation, continuous learning, and the importance of human interactions in shaping development outcomes. This perspective is also consistent with broader organizational theories that view effective action under conditions of uncertainty as emerging through shared assumptions, recurring practices, and collective sensemaking processes [9–11]. From this standpoint, the specific driver is less important than its ability to become part of the organization's routine way of working and to support the ethical values that the organization seeks to cultivate. Rather than prescribing a particular intervention, the framework provides a structured logic through which organizations can integrate ethical reflection into their existing processes. This driver-independent structure strengthens the potential transferability of QVD. The framework may be applicable not only to Agile software teams but also to other organizational contexts in which ethical values influence collaborative decision-making and process quality. Future studies should therefore examine alternative drivers and compare their contribution to process-quality outcomes across different organizational settings.

9.5. Limitations and Future Research

This study is limited by its constructive and proof-of-concept design. Consistent with constructive research methodology [33], the primary objective was to develop and illustrate a new artifact rather than to empirically validate its effectiveness. Accordingly, the case demonstrates the feasibility of the QVD framework but does not establish its generalizability, causal mechanisms, or comparative effectiveness. Several limitations should therefore be acknowledged. First, the framework was illustrated through a single case involving a specific combination of conditions: a multidisciplinary team, an embedded ethics expert, an experienced facilitator, and a medical-AI context with particularly salient ethical and clinical consequences. While suitable for proof-of-concept purposes, these conditions define the scope of the evidence and should not be assumed to characterize ordinary software-development environments. Future research should examine the framework's transferability across a wider range of organizational contexts, project types, and team configurations [48]. Second, we cannot claim that the Balint Group intervention caused the observed outcomes. The observed improvements may also reflect natural learning over time, repeated iteration, technical refinements, or other concurrent influences, including Hawthorne [82] and maturation effects. The absence of a comparison condition means it is not possible to isolate the contribution of the QVD framework from these alternative explanations, and future controlled or comparative studies will be needed to assess the intervention's contribution more precisely. Third, the first author served as both facilitator and observer, creating the potential for researcher and interpretive bias, including the possibility that observations were influenced by expectations concerning the QVD framework. Several features of the study design partially mitigated this risk: classification accuracy is an objective metric less dependent on observer interpretation; the analysis drew on multiple data sources; and observation notes were reviewed by co-authors who were not present during the sessions. Future studies should incorporate independent facilitation or observation and systematic member checking with participants. These limitations reflect the boundaries of constructive research [33], which emphasizes artifact construction, demonstration, and initial feasibility assessment rather than empirical validation. Readers should therefore interpret the QVD framework as a proposed framework requiring further validation rather than as a validated framework. Future research should examine QVD through multi-case studies, longitudinal designs, and comparative evaluations [48,82].

Such studies may compare alternative drivers, assess their relative contribution to process-quality outcomes, and identify the organizational conditions under which the framework is most effective. Additional research should also explore the transferability of QVD beyond software development to broader organizational and management contexts. While the present study examines human-led ethical agents within single-team Agile contexts, this conceptualization may also extend to multiagent development environments involving AI-based collaborators, an avenue for future research [83].

9.6. Practical Implications

Despite its exploratory nature, the case provides several practical insights for software-intensive organizations seeking to embed ethical reflection within routine development practices. First, the findings suggest that ethical reflection can be integrated into existing Agile processes rather than implemented as a separate compliance activity. Second, the case indicates that relatively lightweight interventions, such as structured one-hour reflective sessions incorporated into regular development cycles, may be sufficient to create opportunities for knowledge sharing and collective reflection. Third, the findings suggest that ethical reflection need not slow development processes. In the present case, structured dialogue contributed to problem reframing that simplified the technical solution while simultaneously addressing ethical concerns. Finally, the case highlights the importance of cross-disciplinary participation. The most significant insights emerged not from a single stakeholder group but from interactions among medical practitioners, software engineers, AI specialists, and ethics experts. These observations suggest that the value of QVD may lie not only in the ethical values it promotes but also in its ability to facilitate shared understanding across diverse professional perspectives.

10. Conclusions

This study developed and illustrated the Quality Value Driver (QVD) framework as a software-engineering management approach for embedding ethical reflection into routine development practices. The central contribution of the framework is a shift in perspective regarding the relationship between ethics and quality. Rather than treating ethical values as external constraints, compliance requirements, or abstract normative aspirations, QVD conceptualizes ethical values as potential process-quality drivers that can be intentionally operationalized through organizational practices and evaluated through observable quality indicators. From this perspective, the managerial challenge is not simply identifying which ethical values an organization wishes to promote, but determining how those values can become part of everyday work routines in ways that influence collaboration, decision-making, and organizational learning. The framework therefore proposes a practical logic linking values, drivers, and quality outcomes, providing organizations with a mechanism for translating ethical aspirations into manageable organizational processes.

The proof-of-concept case demonstrated how this logic can be instantiated within an Agile development environment characterized by multidisciplinary collaboration, technical uncertainty, and ethically consequential decisions. Although the study does not establish causality or generalizability, it illustrates the feasibility of embedding ethical reflection directly within routine development activities and suggests how such practices may contribute to improved shared understanding, problem reframing, and process quality.

An important implication of the study is that the contribution of QVD is independent of any specific intervention. Balint Groups served as the organizational driver in the present case because their reflective structure supported the selected values of collaboration, knowledge sharing, and shared responsibility. However, the framework itself remains intentionally driver-independent. Different organizations may adopt different drivers that fit their culture, working practices, and organizational context while preserving the underlying QVD logic.

More broadly, the framework contributes to ongoing discussions regarding Ethics by Design, Agile management, and process-based quality improvement. It suggests that ethical reflection may be most effective not when imposed through external oversight, but when embedded within the organizational routines through which people collaborate, interpret uncertainty, negotiate competing priorities, and make everyday decisions. In this sense, the framework reframes ethics not as a constraint on organizational performance but as a potential source of process quality, organizational learning, and managerial effectiveness.

As organizations increasingly operate in environments characterized by technological complexity, uncertainty, and ethical risk, the ability to systematically integrate ethical values into routine work practices may become an important managerial capability. The QVD framework offers one possible approach for addressing this challenge and provides a foundation for future empirical research examining how ethical values can function as drivers of process software quality across different organizational settings.

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Institutional Review Board Statement: Ethical review and approval were not required for this study. The Balint Group sessions involved only members of the research and development team reflecting on their own professional practice. The facial-image data used to train the proof-of-concept classification model were sourced from publicly available open-access databases. The medical practitioners on the research team contributed their clinical expertise to identify and verify the diagnostic labels. No patient recruitment, data collection, or direct patient contact was conducted as part of this study.

Informed Consent Statement: Not applicable. The study did not involve patient participants or external human subjects. The Balint Group sessions involved only members of the research and development team participating in their professional capacity.

Data Availability Statement: The datasets presented in this article are not readily available due to organizational confidentiality agreements. The source code and image dataset used in the proof-of-concept system are not publicly available due to confidentiality, privacy, and project-specific restrictions.

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Appendix A. Operational Protocol for Balint Groups in Agile Software Teams

Appendix A.1. Purpose

The purpose of Balint Group sessions is to create a structured reflective environment in which software development professionals can examine challenging situations arising during project work. The objective is not to produce immediate solutions but to improve understanding, promote ethical reflection, strengthen collaboration, and support better decision-making within development processes.

Appendix A.2. Participants

Balint Group sessions may include developers, testers, automation specialists, software architects, team leaders, Scrum Masters, product owners, and other stakeholders involved in the development process. The recommended group size is six to twelve participants to ensure meaningful discussion while maintaining diversity of perspectives.

Appendix A.3. Facilitator Responsibilities

The facilitator is responsible for: Maintaining psychological safety; Ensuring respectful and constructive dialogue; Encouraging reflection rather than judgment; Supporting equal participation; Identifying ethical, interpersonal, and organizational dimensions of cases; Translating technical discussion into its underlying ethical and organizational dimensions; Managing time and group dynamics.

To preserve openness, the facilitator should preferably not be the participants' direct manager.

Appendix A.4. Session Preparation

Prior to implementation, participants should receive an orientation explaining: The purpose of the method; Expected participant behavior; Confidentiality principles; Discussion procedures; Session objectives.

Sessions should be scheduled in advance and integrated into routine team activities.

Appendix A.5. Session Structure

Step 1: Case Presentation: The facilitator invites participants to present a professionally challenging situation involving uncertainty, conflict, disagreement, ethical tension, communication difficulties, or complex decision-making.

Step 2: Clarifying Questions: Group members ask factual and clarifying questions to better understand the situation without proposing solutions.

Step 3: Reflective Discussion: The discussion emphasizes exploration rather than evaluation, and the participants discuss the situation collectively, focusing on: Alternative interpretations; Emotional and interpersonal dimensions; Ethical considerations; Organizational factors; and, Possible implications for team collaboration and process quality.

Step 4: Facilitator Reflection: The facilitator highlights recurring themes, ethical tensions, decision-making patterns, and relevant organizational values that emerge during the discussion.

Step 5: Collective Learning: Participants identify insights that may contribute to future practice, collaboration, communication, or decision-making.

Step 6: Session Closure: The session concludes with a brief summary of key observations and lessons learned.

Appendix A.6. Ground Rules

The following principles should guide all discussions: Respect for all participants; Confidentiality; Non-judgmental dialogue; Active listening; Equal opportunity to contribute; Focus on understanding rather than assigning blame.

Appendix A.7. Agile Adaptations

Within Agile environments, Balint Groups may be integrated into existing development rhythms. Sessions can be conducted at regular intervals, such as the conclusion of a sprint, iteration, or development cycle. Balint sessions are intended to complement Agile ceremonies rather than replace them. Unlike retrospectives, which focus primarily on process improvement, Balint Groups emphasize reflection on interpersonal dynamics, ethical concerns, uncertainty, and professional judgment.

Appendix A.8. Organizational Learning

Insights generated during Balint sessions may be aggregated and communicated at the organizational level without revealing personal or confidential information. This process enables recurring ethical concerns, collaboration challenges, and quality-related issues to inform broader organizational learning and continuous improvement efforts.

References

1. Kitchenham, B.; Brereton, O.; Budgen, D.; Turner, M.; Bailey, J.; Linkman, S. Systematic literature reviews in software engineering–a systematic literature review. *Inf. Softw. Technol.* **2009**, *51*, 7–15. [CrossRef]
2. Boegh, J.; Depanfilis, S.; Kitchenham, B.; Pasquini, A. A method for software quality planning, control, and evaluation. *IEEE Softw.* **1999**, *16*, 69–77. [CrossRef]
3. Akbar, M.A.; Sang, J.; Khan, A.A.; Amin, F.E.; Nasrullah; Shafiq, M.; Hussain, S.; Hu, H.; Elahi, M.; Xiang, H. Improving the quality of software development process by introducing a new methodology–AZ-model. *IEEE Access* **2017**, *6*, 4811–4823. [CrossRef]
4. Petrasch, R. The definition of software quality: A practical approach. In *Proceedings of the 10th International Symposium on Software Reliability Engineering*; IEEE Computer Society: Los Alamitos, CA, USA, 1999.
5. Abdulhalim, H.; Lurie, Y.; Mark, S. Ethics as a Quality Driver in Agile Software Projects. *J. Serv. Sci. Manag.* **2018**, *11*, 13–25.
6. Abrahamsson, P.; Salo, O.; Ronkainen, J.; Warsta, J. *Agile Software Development Methods: Review and Analysis*; VTT Publication 478: Espoo, Finland, 2002.
7. Beck, K.; Beedle, M.; Van Bennekum, A.; Cockburn, A.; Cunningham, W.; Fowler, M.; Thomas, D. *Manifesto for Agile Software Development*; Agile Alliance: Newtown Square, PA, USA, 2001.
8. Nerur, S.; Mahapatra, R.; Mangalaraj, G. Challenges of migrating to agile methodologies. *Commun. ACM* **2005**, *48*, 72–78. [CrossRef]
9. Schein, E.H. *Organizational Culture and Leadership*, 4th ed.; Jossey-Bass A Wiley Imprint: Hoboken, NJ, USA, 2010.
10. Schneider, W.E. *The Reengineering Alternative: A Plan for Making Your Current Culture Work*; Richard D Irwin: Homewood, IL, USA, 1994.
11. Weick, K.E.; Sutcliffe, K.M.; Obstfeld, D. Organizing and the process of sensemaking. *Organ. Sci.* **2005**, *16*, 409–421. [CrossRef]
12. Cockburn, A.; Highsmith, J. Agile software development, the people factor. *Computer* **2001**, *34*, 131–133. [CrossRef]
13. Dybå, T.; Dingsøyr, T. Empirical Studies of Agile Software Development: A Systematic Review. *Inf. Softw. Technol.* **2008**, *50*, 833–859. [CrossRef]
14. Recker, J.; Holten, R.; Hummel, M.; Rosenkranz, C. How Agile Practices Impact Customer Responsiveness and Development Success. *Proj. Manag. J.* **2017**, *48*, 99–121. [CrossRef]
15. Van den Hoven, J.; Vermaas, P.E.; Poel, I.V.D. *Handbook of Ethics, Values and Technological Design*; Springer: Dordrecht, The Netherlands, 2015.
16. Friedman, B.; Nissenbaum, H. Bias in computer systems. *ACM Trans. Inf. Syst.* **1996**, *14*, 330–347. [CrossRef]
17. Pierce, M.A.; Henry, J.W. Computer ethics: The role of personal, informal, and formal codes. *J. Bus. Ethics* **1996**, *15*, 425–437. [CrossRef]
18. Floridi, L.; Fresco, N.; Primiero, G. On malfunctioning software. *Synthese* **2015**, *192*, 1199–1220. [CrossRef]
19. Coeckelbergh, M. *Growing Moral Relations: Critique of Moral Status Ascription*; Springer: Berlin/Heidelberg, Germany, 2012.
20. Aydemir, F.B.; Dalpiaz, F. A Roadmap for Ethics-Aware Software Engineering. In *Proceedings of the IEEE/ACM International Workshop on Software Fairness (FairWare)*; IEEE: Piscataway, NJ, USA, 2018; pp. 15–21. [CrossRef]
21. Hanna, R.; Kazim, E. Philosophical foundations for digital ethics and AI Ethics: A dignitarian approach. *AI Ethics* **2021**, *1*, 405–423. [CrossRef]
22. Verbeek, P.-P. *Morality in Design: Design Ethics and the Morality of Technological Artifacts*; Springer: Dordrecht, The Netherlands, 2008; pp. 91–103.
23. Reijers, W.; Gordijn, B. Moving from value sensitive design to virtuous practice design. *J. Inf. Commun. Ethics Soc.* **2019**, *17*, 196–209. [CrossRef]
24. Spiekermann, S. What to Expect from IEEE 7000: The First Standard for Building Ethical Systems. *IEEE Technol. Soc. Mag.* **2021**, *40*, 99–100. [CrossRef]

25. Lurie, Y.; Mark, S. Professional Ethics of Software Engineers: An Ethical Framework. *Sci. Eng. Ethics* **2016**, *22*, 417–434. [CrossRef]
26. Hagendorff, T. The ethics of AI ethics: An evaluation of guidelines. *Minds Mach.* **2020**, *30*, 99–120. [CrossRef]
27. Salah, D.; Paige, R.F.; Cairns, P. A systematic literature review for agile development processes and user centred design integration. In *Proceedings of the 18th International Conference on Evaluation and Assessment in Software Engineering*; ACM Press: New York, NY, USA, 2014; pp. 1–10. [CrossRef]
28. Dignum, V. *Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way (2156)*; Springer: Cham, Switzerland, 2019.
29. Brey, P.A. Anticipatory ethics for emerging technologies. *NanoEthics* **2012**, *6*, 1–13. [CrossRef]
30. Gotterbarn, D.; Miller, K.; Rogerson, S. Software engineering code of ethics is approved. *Commun. ACM* **1999**, *42*, 102–107. [CrossRef]
31. Friedman, B.; Hendry, D.G. *Value Sensitive Design: Shaping Technology with Moral Imagination*; MIT Press: Cambridge, MA, USA, 2019.
32. Balint, E.; Courtenay, M.; Elder, A.; Hull, S.J. *The Doctor, the Patient and the Group: Balint Revisited*; Routledge: London, UK, 1993.
33. Lukka, K. The constructive research approach. Case study research in logistics. In *Publications of the Turku School of Economics and Business Administration, Series B*; Turku School of Economics and Business Administration: Turku, Finland, 2003; Volume 1, pp. 83–101.
34. Oyegoke, A. The constructive research approach in project management research. *Int. J. Manag. Proj. Bus.* **2011**, *4*, 573–595. [CrossRef]
35. Hevner, A.R.; March, S.T.; Park, J.; Ram, S. Design science in information systems research. *MIS Q.* **2004**, *28*, 75–105. [CrossRef]
36. Highsmith, J.; Cockburn, A. Agile Software Development: The Business of Innovation. *Computer* **2001**, *34*, 120–122. [CrossRef]
37. Argyris, C.; Schön, D.A. *Organizational Learning: A Theory of Action Perspective*; Addison-Wesley: Reading, MA, USA, 1978.
38. Edmondson, A. Psychological safety and learning behavior in work teams. *Adm. Sci. Q.* **1999**, *44*, 350–383. [CrossRef]
39. Chatterjee, S.; Sarker, S.; Fuller, M.A. A deontological approach to designing ethical collaboration. *J. Assoc. Inf. Syst.* **2009**, *10*, 138–169. [CrossRef]
40. Moula, P.; Sandin, P. Evaluating ethical tools. *Metaphilosophy* **2015**, *46*, 263–279. [CrossRef]
41. Davidian, M.; Lurie, Y.; Mark, S. QVD: Improving Quality–User Story as a Quality Value Driver (QVD) in Software Development. *WSEAS Trans. Comput.* **2021**, *20*, 217–225. [CrossRef]
42. Balint, M. The doctor, his patient, and the illness. *Lancet* **1955**, *265*, 683–688. [CrossRef]
43. Salinsky, J. A Very Short Introduction to Balint Groups. The Balint Society. 2009. Available online: https://balint.co.uk/about/introduction/ (accessed on 6 September 2026).
44. Mark, S.; Lurie, Y. Customized Project Charter for Computational Scientific Software Products. *J. Comput. Methods Sci. Eng.* **2018**, *18*, 165–176. [CrossRef]
45. Peffers, K.; Tuunanen, T.; Rothenberger, M.A.; Chatterjee, S. A design science research methodology for information systems research. *J. Manag. Inf. Syst.* **2007**, *24*, 45–77. [CrossRef]
46. Winter, E.; Forshaw, S.; Hunt, L.; Ferrario, M.A. Advancing the study of human values in software engineering. In *Proceedings of the 2019 IEEE/ACM 12th International Workshop on Cooperative and Human Aspects of Software Engineering (CHASE)*; IEEE: Piscataway, NJ, USA, 2019.
47. Gogoll, J.; Zuber, N.; Kacianka, S.; Greger, T.; Pretschner, A.; Nida-Rümelin, J. Ethics in the software development process: From codes of conduct to ethical deliberation. *Philos. Technol.* **2021**, *34*, 1085–1108. [CrossRef]
48. Yin, R.K. *Case Study Research and Applications: Design and Methods*, 6th ed.; SAGE Publications, Inc.: Thousand Oaks, CA, USA, 2018.
49. Flyvbjerg, B. Five misunderstandings about case-study research. *Qual. Inq.* **2006**, *12*, 219–245. [CrossRef]
50. Braun, V.; Clarke, V. Using thematic analysis in psychology. *Qual. Res. Psychol.* **2006**, *3*, 77–101. [CrossRef]
51. Rausch, A.; Bartelt, C.; Herold, S.; Klus, H.; Niebuhr, D. From software systems to complex software ecosystems: Model-and constraint-based engineering of ecosystems. In *Perspectives on the Future of Software Engineering*; Springer: Berlin/Heidelberg, Germany, 2013.
52. Brown, T. Design thinking. *Harv. Bus. Rev.* **2008**, *86*, 84–92.
53. Génova, G.; González, M.R.; Fraga, A. Ethical Education in Software Engineering: Responsibility in the Production of Complex Systems. *Sci. Eng. Ethics* **2007**, *13*, 505–522. [CrossRef]
54. Johnson, D.G. Computer systems: Moral entities but not moral agents. *Ethics Inf. Technol.* **2006**, *8*, 195–204. [CrossRef]
55. Feldman, M.S.; Pentland, B.T. Reconceptualizing organizational routines as a source of flexibility and change. *Adm. Sci. Q.* **2003**, *48*, 94–118. [CrossRef]
56. Mnkandla, E. About software engineering frameworks and methodologies. In *Proceedings of the IEEE AFRICON 2009, Nairobi, Kenya*; IEEE: Piscataway, NJ, USA, 2009.

57. Kropp, M.; Meier, A.; Biddle, R. Agile practices, collaboration and experience: An empirical study about the effect of experience in agile software development. In *Proceedings of the International Conference on Product-focused Software Process Improvement*; Springer: Cham, Switzerland, 2016.
58. Mills, T.; Smith, M. Metabolizing difficult doctor–patient relationships: Reflections on a Balint group for higher trainees. *Br. J. Psychother.* **2015**, *31*, 390–400. [CrossRef]
59. Johnson, A.H.; Nease, D.E.; Milberg, L.C.; Addison, R.B. Essential characteristics of effective Balint group leadership. *Fam. Med.-Kans. CITY* **2004**, *36*, 253–259.
60. Leadership Accreditation Pathway. The Balint Society of Australia and New Zealand. 2023. Available online: https://balintanz.org/accredited-leadership/ (accessed on 6 September 2026).
61. Vaure, C.B.D.; Lemogne, C.; Bunge, L.; Catu-Pinault, A.; Hoertel, N.; Ghasarossian, C.; Vincens, M.-E.; Galam, E.; Jaury, P. Promoting empathy among medical students: A two-site randomized controlled study. *J. Psychosom. Res.* **2017**, *103*, 102–107. [CrossRef]
62. Stojanovic-Tasic, M.; Latas, M.; Milosevic, N.; Pribakovic, J.A.; Ljusic, D.; Sapic, R.; Vucurevic, M.; Trajkovic, G.; Grgurevic, A. Is Balint training associated with the reduced burnout among primary health care doctors? *Libyan J. Med.* **2018**, *13*, 1440123. [CrossRef]
63. Calcides, D.A.P.; Didou, R.D.N.; Melo, E.V.D.; Oliva-Costa, E.F.D. Burnout Syndrome in medical internship students and its prevention with Balint Group. *Rev. Assoc. Médica Bras.* **2019**, *65*, 1362–1367. [CrossRef]
64. Ryding, E.L.; Birr, A. Becoming the kind of doctor that you want to be. A qualitative study about participation in Balint group work. *Int. J. Psychiatry Med.* **2022**, *57*, 283–292. [CrossRef]
65. Dahlgren, M.A.; Almquist, A.; Krook, J. Physiotherapists in Balint group training. *Physiother. Res. Int.* **2000**, *5*, 85–95. [CrossRef]
66. Bates, C.C.; Morgan, D.N. Literacy leadership: The importance of soft skills. *Read. Teach.* **2018**, *72*, 412–415. [CrossRef]
67. Maslach, C.; Jackson, S.E.; Leiter, M.P. *Maslach Burnout Inventory*; Scarecrow Education: Lanham, MD, USA, 1997.
68. Zámečník, R. The Measurement of Employee Motivation by Using Multi-factor Statistical Analysis. *Procedia-Soc. Behav. Sci.* **2014**, *109*, 851–857. [CrossRef]
69. Aziri, B. Job satisfaction: A literature review. *Manag. Res. Pract.* **2011**, *3*, 77–86.
70. Mayte Vega, N. A Web Based Questionnaire of Ethical Skills. Master's Thesis, Uppsala University, Uppsala, Sweden, 2008.
71. Baugh, R.F.; Basura, G.J.; Ishii, L.E.; Schwartz, S.R.; Drumheller, C.M.; Burkholder, R.; Deckard, N.A.; Dawson, C.; Driscoll, C.; Gillespie, M.B.; et al. Clinical practice guideline: Bell's palsy. *Otolaryngol.-Head Neck Surg.* **2013**, *149*, S1–S27. [CrossRef]
72. Eviston, T.J.; Croxson, G.R.; Kennedy, P.G.; Hadlock, T.; Krishnan, A.V. Bell's palsy: Aetiology, clinical features and multidisciplinary care. *J. Neurol. Neurosurg. Psychiatry* **2015**, *86*, 1356–1361. [CrossRef]
73. Topol, E.J. High-performance medicine: The convergence of human and artificial intelligence. *Nat. Med.* **2019**, *25*, 44–56. [CrossRef]
74. Esteva, A.; Chou, K.; Yeung, S.; Naik, N.; Madani, A.; Mottaghi, A.; Liu, Y.; Topol, E.; Dean, J.; Socher, R. Deep learning-enabled medical computer vision. *npj Digit. Med.* **2021**, *4*, 5. [CrossRef]
75. Radhakrishnan, P.; Patel, M.; David, S.; Padhiary, M.; Mamatha, C.; Soni, M. Agile Software Engineering in the Age of Artificial Intelligence: Tools and Techniques for AI Projects. In *Proceedings of the 2025 World Skills Conference on Universal Data Analytics and Sciences (WorldSUAS)*; IEEE: Piscataway, NJ, USA, 2025.
76. McKinney, S.M.; Sieniek, M.; Godbole, V.; Godwin, J.; Antropova, N.; Ashrafian, H.; Back, T.; Chesus, M.; Corrado, G.S.; Darzi, A.; et al. International evaluation of an AI system for breast cancer screening. *Nature* **2020**, *577*, 89–94. [CrossRef]
77. Rout, N.; Mishra, D.; Mallick, M.K. Handling imbalanced data: A survey. In *Proceedings of the International Proceedings on Advances in Soft Computing, Intelligent Systems and Applications*; Springer: Singapore, 2018.
78. Wei, Q.; Dunbrack, R.L., Jr. The role of balanced training and testing data sets for binary classifiers in bioinformatics. *PLoS ONE* **2013**, *8*, e67863. [CrossRef]
79. Kaur, H.; Pannu, H.S.; Malhi, A.K. A systematic review on imbalanced data challenges in machine learning: Applications and solutions. *ACM Comput. Surv. (CSUR)* **2019**, *52*, 1–36. [CrossRef]
80. Paulk, M.C.; Curtis, B.; Chrissis, M.B.; Weber, C.V. Capability maturity model, version 1.1. *IEEE Softw.* **1993**, *10*, 18–27. [CrossRef]
81. Biffl, S.; Aurum, A.; Boehm, B.; Erdogmus, H.; Grünbacher, P. *Value-Based Software Engineering*; Springer: Berlin/Heidelberg, Germany, 2006.
82. Shadish, W.R.; Cook, T.D.; Campbell, D.T. *Experimental and Quasi-Experimental Designs for Generalized Causal Inference*; Mifflin and Company: New York, NY, USA, 2002.
83. Cervantes, J.A.; López, S.; Rodríguez, L.F.; Cervantes, S.; Cervantes, F.; Ramos, F. Artificial moral agents: A survey of the current status. *Sci. Eng. Ethics* **2020**, *26*, 501–532. [CrossRef]