Adapting IMOI for Information Systems: Toward a Cyclical and Mediated View of System Design

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ABSTRACT

The Input–Process–Output (IPO) framework has long guided organizational and Information Systems (IS) research. While valued for its clarity, IPO reduces process to a black box and treats outputs as final rather than cyclical, limiting its usefulness in dynamic IS environments where iteration and socio-technical integration are essential. This paper conceptually adapts the Input–Mediator–Output–Input (IMOI) model, first developed in organizational science, for IS system design. A layered comparison with IPO, data flow diagrams (DFDs), and CRUD logic situates IMOI within the IS development stack, and the conceptual analysis is supported by a case vignette of a university mobile system. IMOI reframes process into three families of mediators (technical, cognitive, and affective) that can be observed, measured, and adjusted across cycles. Outputs, including prototypes, user analytics, and stakeholder feedback, are explicitly treated as inputs for subsequent iterations. The findings suggest that IMOI preserves IPO's clarity while adding diagnostic depth and cyclical adaptability. By emphasizing mediators and feedback, IMOI offers a stronger conceptual foundation for designing, evaluating, and governing modern information systems.

***Keywords**: Information Systems, IMOI, IPO, socio-technical systems, system development*

1. INTRODUCTION

Since the mid-20th century, the Input–Process–Output (IPO) model has been a cornerstone in organizational science and Information Systems (IS). First formalized by McGrath in 1964 [1], IPO provided a neat way to think about how groups function: resources and conditions enter as inputs, interactions occur as processes, and results emerge as outputs. In the early years of IS development, where data followed predictable paths through analysis, design, coding, and implementation, IPO felt like a natural fit. The model mirrored the logic of Waterfall style system development life cycles, where requirements were gathered, processed, and transformed into final deliverables [2-3].

IPO set the standard for decades on how researchers and practitioners explained success and failure in IS projects. It was used in studies to relate resources and team composition to project success [4-5], or to measure the effect of technical and organizational inputs on user satisfaction and system quality [6-7]. In practice and theory, IPO remained a standard model for illustrating the logic of computing itself: inputs fed into processes and yielding outputs, reflecting how computer programs execute instructions.

Yet the very simplicity that made IPO appealing also created blind spots. Researchers increasingly pointed out that IPO assumes a linear chain of causality. Processes were often treated as a "black box," hiding the rich mix of cognitive, behavioural, and emotional dynamics that determine whether teams succeed. More critically, IPO tends to present outputs as an end state, even though in real projects those outputs frequently cycle back to reshape inputs. User feedback, bug reports, changing technologies, and shifting organizational priorities rarely mark the end of a system's life which trigger the next iteration [8-10]. In this sense, IPO is better at explaining static, one-shot projects than the evolving, adaptive work that defines most IS environments today.

To address these weaknesses, Ilgen, Hollenbeck, Johnson, and Jundt (2005) introduced the Input–Mediator–Output–Input (IMOI) model. Instead of treating everything in the middle as "process," IMOI emphasizes mediators; cognitive mechanisms such as shared mental models, behavioural mechanisms such as coordination routines, and affective mechanisms such as trust and motivation. Just as important, IMOI explicitly closes the loop: outputs become inputs for the next cycle, capturing how systems and teams adapt over time. This shift acknowledges that performance and outcomes are rarely terminal. They are dynamic, shaped by continuous feedback and contextual change.

While IMOI has become influential in organizational psychology and team research [11-12], it has not been widely adopted in Information Systems. That gap represents a missed opportunity. Modern IS development is rarely linear. Projects face shifting user requirements, rapid technology cycles, and socio-technical complexity where human interaction is as decisive as technical precision. Agile and iterative methods are popular precisely because they embrace feedback and adaptation, yet the underlying conceptual models often remain grounded in IPO logic.

This article argues that IMOI deserves to be repositioned as a conceptual framework for IS system design. Doing so does not discard IPO's value which still provides clarity for describing inputs, processes, and outputs, but acknowledges that IPO is insufficient for contemporary contexts. IMOI offers a richer lens, one that integrates feedback, recognizes emergent states, and situates technical processes within their human and organizational environment.

The aim here is threefold. First, to revisit IPO's influence in IS and show its strengths and limitations. Second, to adapt IMOI's mediators to IS-specific categories such as technical iteration, cognitive alignment, and affective engagement. Third, to illustrate how IMOI can guide system design more effectively than IPO, including comparisons with technical tools like CRUD and Data Flow Diagrams. The article proposes IMOI as a layered framework that sits above these models,

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providing the conceptual structure within which technical modelling can operate. By the end, readers will see IMOI not as a management theory imported into IS, but as a natural evolution of system design thinking, one that better reflects the adaptive, cyclical, and socio-technical realities of IS development today.

Information Systems promised order in a messy space. DeLone and McLean's IS Success model organized the field's "dependent variable" around quality and use constructs that unfold from inputs to outcomes, and it quickly became the de facto frame for evaluating systems. Their 2003 update, building on the 1992 original, reinforced a broadly processual view of how systems create value. Follow-on work both critiqued and validated parts of the model, including Seddon's re-specification [13] and Rai, Lang, and Welker's empirical tests [14], which kept the input-to-impact logic at the centre of IS assessment. Together, these streams cemented IPO-style thinking in IS curricula and research designs [6, 7, 13].

By the late 1990s and early 2000s, team science began to document limits of a straight, one-pass pipeline. Marks, Mathieu, and Zaccaro showed that teams operate in episodes with shifting goals where "process" is not one thing but a bundle of transition and action processes that wax and wane over time. Kozlowski and Ilgen argued for multilevel, dynamic views of teams and highlighted emergent states such as trust or shared mental models that both shape and are shaped by interaction. These critiques converged on the same point: if you treat process as a black box between inputs and outputs, you miss the real engine of performance [8, 11].

Ilgen and colleagues crystallized that shift with IMOI. Instead of "process," they propose "mediators" that include both processes and emergent states, and they make the loop explicit: outputs feed back into the next cycle's inputs. This small change of letters does heavy conceptual lifting, because it legitimizes learning effects, changes in affect, and cognitive alignment as first-class constructs rather than side notes [15].

IS is a socio-technical domain. Systems work or fail not only because of code and data but because structures, incentives, and user practices fit (or don't fit) together. That framing has deep roots in MIS research. Bostrom and Heinen's socio-technical perspective in MIS Quarterly highlighted how behavioural misfits and design choices interact to create success or failure, which already hints at feedback and mediation rather than a one-direction pipeline [16-18]. The whole development process is described in Figure 1 below.

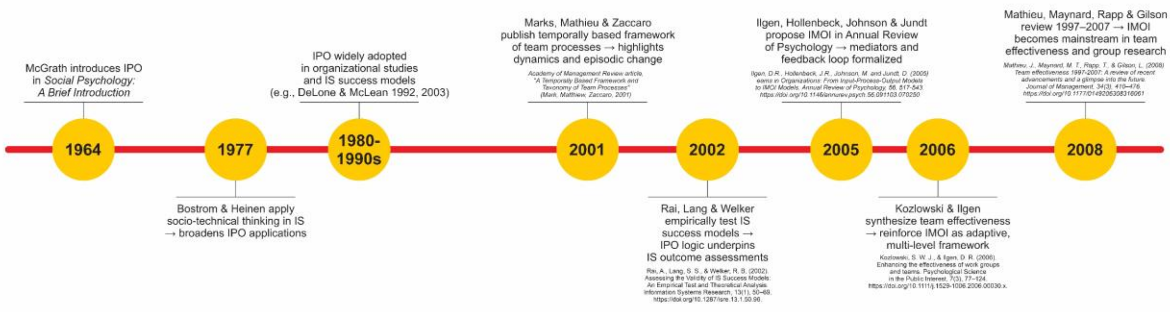

Figure 1. Timeline of IPO to IMOI Development (1964–2008)

IMOI does three things that matter to IS:

1. It widens the "middle." Mediators include technical activities such as iteration and testing, but they also include cognitive variables like shared understanding and affective variables like trust. IS projects routinely rise or fall on these elements, yet IPO offers little guidance on how to

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incorporate them into the model. IMOI names them and puts them on the main path to outcomes [11, 15].
2. It legitimizes feedback. Outputs in one cycle become inputs in the next. In IS terms, quality metrics, defect logs, and user behaviour analytics are not endpoints. They are raw material for the next round of requirements, design choices, and team routines. The model itself tells you to expect that loop [15].
3. It invites multilevel analysis. Team and organizational states coevolve with artifacts. That is a better match to socio-technical findings in MIS and to development research showing that organizational readiness and culture mediate system adoption and outcomes [16, 19].

Pulling these threads together suggests a practical path. At the conceptual layer, IMOI frames each iteration as a hypothesis about how a system should work. Inputs bundle requirements, resources, and constraints. Mediators then split into three families that teams can operationalize: technical (design, build, test), cognitive (shared understanding, mental models), and affective or social (trust, commitment, readiness). Outputs include both artifacts and effects, from features shipped to changes in user behaviour. Those outputs feed the next cycle's inputs through analytics, bug reports, and organizational feedback, which closes the loop without forcing a return to project start. That is faithful to the team science behind IMOI and to the socio-technical picture that MIS has documented for decades [11, 13, 15-16].

To summarize, IPO helped IS make progress by putting a clean storyline around how systems create value. The last thirty years of team and MIS research tell us that storyline is incomplete for the problems we face today. IMOI keeps the clarity while adding the pieces that matter for living systems: mediators you can target, and feedback you can harness. It lets researchers and practitioners connect people, process, and product in one frame, and it matches the iterative reality of modern IS work [7, 15].

2. METHODOLOGY

This is a conceptual paper with a method oriented toward model adaptation and empirical readiness. The guiding idea is simple: follow Ilgen and colleagues' logic for moving beyond IPO, then translate and operationalize IMOI for Information Systems research and design. The method has four linked steps: targeted literature synthesis, model adaptation and specification, artifact/prototype development (design science), and a multi-method empirical validation strategy, as described in Figure 2.

First, the literature synthesis. We surveyed two literatures in parallel: (a) team and organizational work that motivated IMOI, and (b) Information Systems work that continues to rely on IPO-style frames. The team literature review follows Ilgen et al.'s framing about mediators and cyclical feedback (cognitive, behavioural, affective) and their recommendation to treat outputs as potential inputs to later cycles [7, 20-22].

The purpose of the synthesis was not exhaustive bibliometrics but selective, theory-driven sampling: peer-reviewed, Scopus/WoS-indexed studies that either (a) explicitly used IPO, (b) tested IS success factors, or (c) operationalized emergent socio-technical mediators.

Second, model adaptation and specification. Building on Ilgen et al., we replace the opaque "process" box with three mediator families tailored to IS practice:

- Technical mediators: measurable development activities and artifacts (iteration frequency, test coverage, prototype fidelity, code churn).

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- Cognitive mediators: shared mental models, transactive memory, and collective understanding of requirements. Measurement approaches here can draw on validated team cognition scales (for example, transactive memory measures) [23-25].
- Affective/social mediators: trust, psychological safety, and team engagement; constructs with established measures in organizational research. For example, psychological safety and trust have robust operationalizations that link to learning behaviours and team adaptation [26-28].

Outputs are defined both technically (system quality, information quality) and organizationally (user satisfaction, adoption, net benefits) using well-established IS success constructs so researchers can connect with extant measures [7]. The model explicitly reincorporates outputs as inputs to the next cycle: analytics, bug reports, user feedback, and organizational policy changes become new inputs for re-specifying requirements.

Third, artifact development and design-science framing. To make IMOI actionable for system designers we recommend a design science approach: build lightweight artifacts (templates, dashboards, iteration checklists, mediator-measure dashboards) and evaluate them in situ. Design science provides a structured path to generate prescriptive artifacts and to evaluate their utility and rigor in realistic settings. Hevner et al.'s guidelines for design-science research are a natural fit for this step [29-30].

Fourth, empirical validation strategies. IMOI is inherently dynamic and multilevel, so a single method won't suffice. We propose a mixed-method program of work:

- **Field-longitudinal studies** that sample multiple development teams across releases, allowing multilevel modelling (team episodes nested within projects) and cross-lagged tests of mediator → outcome → mediator dynamics. Team science reviews recommend multilevel and time-sensitive methods when studying mediators and emergent states [11-12, 31].
- **Structural equation modelling** and measurement validation for mediator constructs and for mapping mediators to DeLone–McLean style outcomes; SEM has been used successfully in IS validation studies [20-21].
- **Design-science case studies and action research** to evaluate artifact usefulness, refine mediator operationalizations, and capture rich qualitative dynamics. Hevner's design science guidance supports coupling artifact development with field evaluation [29-30].
- **Computational or simulation models** (agent-based or system dynamics) to explore boundary conditions, nonlinearities, and timing effects that are difficult to observe empirically; Ilgen et al. note the growing role of computational methods for dynamic systems.

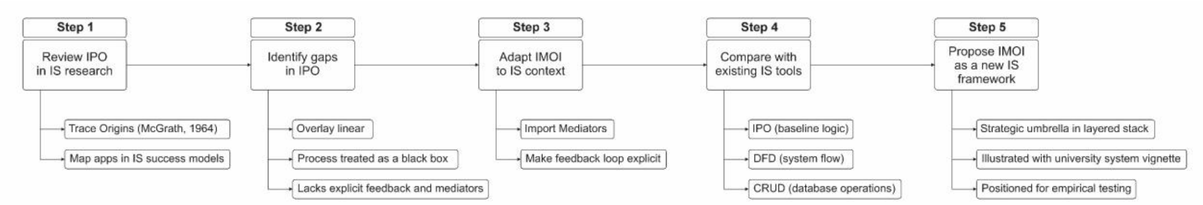

Figure 2. Research design flowchart

On measurement and analysis specifics: cognitive mediators can use validated team cognition scales (for example, Lewis's transactive memory scale), affective mediators use trust and psychological safety scales, and technical mediators can be operationalized with project analytics (commits, CI test pass rate, cycle time) [23-28]. Analytically, multilevel structural equation models

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or dynamic SEM (where available) are appropriate to test mediated, time-lagged effects; when sample sizes are limited, mixed methods triangulation remain valuable.

Finally, limitations and rigor. Because IMOI emphasizes dynamics and multilevel causation, studies must attend to timing, sampling across episodes, and construct clarity. That requires careful instrument adaptation and, where possible, triangulation across behavioural traces (tool logs), surveys, and qualitative observation. The methodology above balances conceptual clarity with multiple empirical paths so IMOI can be operationalized, measured, and tested in IS settings.

3. RESULTS AND DISCUSSION

We adapt the Input–Mediator–Output–Input (IMOI) logic to the needs of system design in Information Systems. The goal is simple: preserve IPO's clarity about what enters and what leaves a system, while replacing the opaque middle box (process) with a set of mediators that explicitly represent the technical, cognitive, and affective mechanisms that drive outcomes. We then treat outputs as resources for the next cycle, closing the loop and making feedback a first-class element of the model (Figure 3). This is not a cosmetic change: it reframes design episodes as iterative hypotheses about how a system will work, to be tested, learned from, and revised. The original IMOI formulation and the argument for mediators and feedback come from Ilgen and colleagues [15].

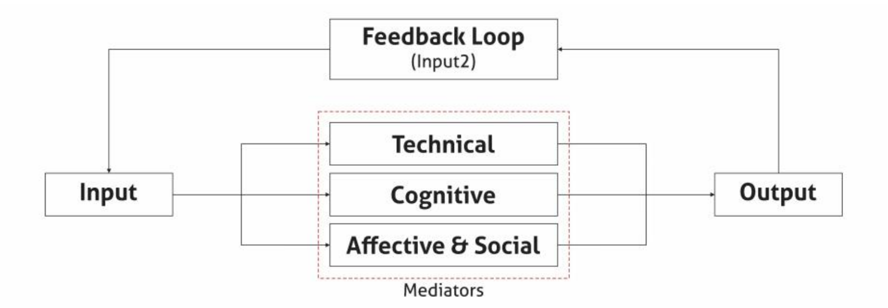

Figure 3. IMOI in IS Development (Cyclical Model)

The IMOI cycle adapted for Information Systems. Inputs (requirements, resources, constraints) flow into mediators (technical practices, cognitive states, affective/social dynamics). Outputs (artifacts, system quality, user effects) loop back into inputs, highlighting continuous feedback, as featured in Table 1 below.

Table 1. Suggested Measurements for IMOI in IS Development

Component	Construct	Example Scale / Source	Data Source
Inputs	Requirements clarity and resource adequacy	Requirement Completeness Checklist [32]	Document analysis; stakeholder surveys
Technical Mediators	Iteration frequency & prototyping	Project analytics, Agile metrics (e.g., cycle time)	Tool logs (Jira, GitHub, CI/CD pipelines)
	Testing & quality control	ISO/IEC 25010 Quality Model [33]; defect density	CI/CD logs, QA reports
	Code churn & stability	software evolution metrics [34-36]	Version control logs (Git, SVN)
Cognitive Mediators	Shared mental models	Team Mental Model scale [31]	Surveys (Likert 1–7)

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Component	Construct	Example Scale / Source	Data Source
Inputs	Requirements clarity and resource adequacy	Requirement Completeness Checklist [32]	Document analysis; stakeholder surveys
	Transactive memory	Transactive Memory System (TMS) scale [23-25]	Surveys; interview protocols
	Requirements clarity	Adapted from ISD requirement uncertainty scales [37]	Surveys; document analysis
Affective/ Social Mediators	Trust	Interpersonal Trust scale [38-40]	Surveys
	Psychological safety	Team Psychological Safety scale [27-28]	Surveys; focus groups
	Engagement/motivation	Utrecht Work Engagement Scale [5, 41-42]	Surveys
Outputs	System quality	DeLone & McLean IS Success [6-7]	Surveys; technical audit
	Information quality		User surveys; analytics
	User satisfaction		Surveys (Likert); app ratings
	Net benefits / organizational learning	IS effectiveness scales [14]	Surveys; interviews; organizational reports
	Adoption & usage	UTAUT model [43]	User analytics (login frequency, feature usage)
Feedback (New Inputs)	Feedback incorporation and responsiveness	Change Request Management Metrics [44]	Change logs, requirement documents, analytics

In practice, Inputs bundle four kinds of material that matter for an IS project: (1) problem definitions and requirements (including user stories and subject-matter constraints); (2) technical resources (platforms, existing databases, legacy interfaces); (3) organizational context (governance, time and budget constraints, stakeholder mandates); and (4) data artifacts (existing datasets, schemas, sensor feeds). These inputs are the raw hypotheses: they express what designers expect the system to achieve and the environment in which it must operate. In IS, the DeLone and McLean success tradition gives us a ready vocabulary for many outputs and some inputs (system quality, information quality, use), which helps connect IMOI's inputs-outputs to established measures [7].

The critical contribution of our adaptation is unpacking mediators into three interacting families. Each family contains mechanisms that are measurable, actionable, and meaningfully distinct from one another.

1. **Technical mediators** describe the engineering practices and artifacts that transform inputs into deliverables. Examples include frequency of iteration, prototype fidelity, test coverage, build pass rates, and code churn. These mediators are traceable in tool logs (version control, CI/CD, issue trackers) and have established predictive relationships with quality outcomes in software engineering research (for instance, churn and dependency metrics predict post-release failures and defect density).

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2. **Cognitive mediators** capture shared understanding and knowledge distribution in the team. Transactive memory, shared mental models, and requirements clarity are core examples. These variables influence how rapidly and correctly teams convert ambiguous requirements into concrete designs. Team cognition is empirically well documented as a driver of performance; meta-analyses show that shared understanding predicts coordination quality and outcomes. Operationally, cognitive mediators can be measured via validated team cognition scales and by trace evidence such as consistent documentation, similarity of task representations in design artifacts, and reduced rework.
3. **Affective and social mediators** reflect trust, psychological safety, engagement, and leadership climate. These mediators shape learning behaviour: whether team members volunteer negative feedback, raise usability concerns, or experiment with risky technical options. Psychological safety and interpersonal trust have been repeatedly linked to learning and team adaptation across organizational studies; in IS projects they can determine whether user feedback is surfaced, or ignored, and whether a team is willing to pivot when needed.

These mediator families are not independent. Technical practices affect cognitive alignment (for example, frequent demos improve shared understanding), and affective states influence technical behaviour (low trust reduces issue reporting). The IMOI model treats these mediators as interacting mechanisms rather than separate levers, which is why the model lends itself to multilevel, time-sensitive analysis (see Measurement Table and Methodology).

IMOI is best understood as episodic. Each development episode (sprint, release, prototype cycle) begins with a set of inputs and a set of hypotheses about which mediators will be activated and how. Technical mediators produce immediate observable outputs (a build, a test report), while cognitive and affective mediators may have delayed effects (shared understanding reduces defects in later releases; trust increases the rate at which risky but valuable changes are proposed). Temporal frameworks for team processes emphasize that different process types dominate at different phases (transition vs action processes), and IMOI makes that explicit: mediators vary in importance across episodes and should be measured with time-sensitive designs.

From an empirical standpoint, IMOI predicts that: (1) technical mediator quality (low churn, high test coverage) will predict near-term system quality; (2) cognitive mediators (high transactive memory, clear requirements) will predict reduced rework and faster convergence across releases; and (3) affective mediators (psychological safety, trust) will predict higher rates of valuable user-driven change being proposed and implemented. Crucially, the model predicts dynamic cross-lagged relationships: outputs at time t (usage patterns, defect reports) will shape inputs at t+1, which will alter mediators and subsequent outputs.

Our results position IMOI as a practical bridge between the social dynamics that shape development work and the technical artifacts that emerge from it. In team science, IMOI reframed decades of research by emphasizing mediating mechanisms and recursive feedback rather than a single pass from inputs to outputs. Bringing those insights into IS design helps us treat process metrics and human states as first-class design variables, not afterthoughts.

The first contribution is a clearer socio-technical throughline. Early IS work reminded us that failures often trace to social design, not only technical specs. Bostrom and Heinen's classic socio-technical perspective argued that information systems succeed when technical and social subsystems are jointly optimized. IMOI operationalizes that idea by naming specific mediators that link the two subsystems and by making the feedback loop explicit so that outputs can re-enter as new inputs.

Second, IMOI clarifies how "process" works. IPO treats process as a black box. IMOI separates cognitive, affective, and behavioural mediators and expects them to fluctuate across cycles of work. That expectation fits the evidence that team processes are episodic, and time bound rather than uniform, a point developed in Marks, Mathieu, and Zaccaro's temporally based framework and reinforced by broad reviews of team effectiveness. For IS, this means we should plan for ebbs and flows in shared understanding, coordination, and energy, and we should instrument projects to detect and respond to those changes.

The main strength is that IMOI makes adaptation systematic. It tells us what to watch between input and output, and it builds the return loop into the framework. That improves diagnostic power when projects drift. If code quality drops while psychological safety is low and coordination frays, the model suggests interventions that target mediator repair, not only technical fixes. It also supports multi-level reasoning. Cognitive mediators like shared mental models can be measured at the team level, while behavioural mediators like defect response time live at the artifact level, and the loop connects them over time.

There are limits. IMOI is conceptually rich, which can make it harder to operationalize than simple flow diagrams. Construct clarity matters. For example, psychological safety is not job satisfaction, and transactive memory is not just a skills inventory. Validated measures exist, but they require careful administration and interpretation. There is also a risk of measurement burden. Teams that try to collect every mediator signal every week may drown in data and slow delivery. Finally, external validity is not guaranteed. These are researchable questions, but they caution against naive one-size-fits-all deployment.

4. CONCLUSION

This paper set out to do one thing clearly: show why the Input–Mediator–Output–Input model deserves a place as a conceptual foundation for Information Systems design. We did not argue that IPO is worthless. IPO brought needed clarity to both organizational science and early IS work, and it remains useful when projects are small and requirements stable. What IMOI offers is not replacement for clarity but an expansion of it, one that recognizes the mechanisms that move projects forward, and the ways outputs loop back to reshape future work.

Three practical contributions emerge from positioning IMOI at the strategic layer of IS work. First, naming mediators as technical, cognitive, and affective forces makes the "black box" of process observable. That visibility matters because it creates diagnostic leverage: when a release underperforms, teams can ask whether the issue is tooling and tests, ambiguous requirements and mental models, or low trust and poor feedback loops. Second, making feedback explicit reframes outputs such as usage analytics, defect logs, and stakeholder requests as raw inputs for the next cycle, not as afterthoughts to be fixed later. Third, IMOI enables multilevel measurement and intervention. By combining validated social measures with artifact telemetry, researchers and practitioners can test which mediators predict which outcomes, and at what times.

There are limitations to be honest about. The model is more complex than a single-line flow, and that complexity requires disciplined operationalization. Mediator constructs must be measured carefully using validated instruments, and researchers should avoid measurement overload that slows teams down. Moreover, the relevance of mediators may vary by domain; what matters for a fast-moving consumer app may differ from what matters for a safety-critical clinical system. These issues point to an empirical agenda rather than fatal flaws.

In closing, IMOI gives Information Systems a way to speak coherently about iteration, human dynamics, and feedback, while still integrating with the technical language engineers use. It is not a replacement for technical modelling, but it is a useful umbrella that makes the reasons behind success and failure visible and actionable. If IS aims to design systems that learn the way their users do, IMOI is a sensible starting point.

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