

Learnings from the Multidimensional Digital Inclusiveness Index: Centralizing Tool Recommendations for Inclusive Innovations

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Back Cover: Farmer overlooking terraced rice fields. (*photo*: Tavarius/Shutterstock)

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Summary

This brief is part of the Multidimensional Digital Inclusiveness Index (MDII) Learnings Series and presents key insights from the development and application of the Recommendation Repository, a core operational component of MDII ecosystem. The MDII framework has been piloted in 8 WaPOR-based digital tools developed or co-developed by International Water Management Institute (IWMI), covering irrigation performance, crop insurance, drought monitoring, and water and demand use. The evaluations assess how inclusive each tool is across dimensions such as accessibility, usage efficacy, risks, supportive ecosystem, co-creation, and beneficial impact. While these evaluations generate rich diagnostics, the resulting insights can remain descriptive rather than actionable without structured guidance.

The Recommendation Repository addresses this gap by transforming recurring findings from the WaPOR evaluations into low-effort improvements that align with real development constraints. Each recommendation is explicitly linked to an MDII framework component, reinforcing transparency and accountability in how insights inform technical refinement.

Rather than promoting costly redesigns, the repository prioritizes incremental adjustments such as clearer indicators, improved contextual guidance, simplified navigation, enhanced data transparency, and more accessible reporting formats.

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Key Messages

MDII assessments generate detailed diagnostics of digital inclusiveness, but tools only improve when findings can be translated into concrete, and feasible actions.

- Digital inclusiveness needs practical tools, not only evaluation scores. The Recommendation Repository bridges this gap by turning assessments into concrete, usable guidance.
- Common challenges appear across many digital tools, and centralizing recommendations allows teams to learn from patterns rather than starting from zero each time.
- A structured, evidence-based system improves consistency and transparency, ensuring that improvements are guided by clear logic rather than ad-hoc choices.

Introduction

Digital inclusiveness is widely recognized as a critical determinant of whether digital tools in agriculture and water management achieve meaningful uptake, interpretability, and sustained use, particularly in low-connectivity and resource-constrained environments (Heeks, 2017). Despite significant investment in data-driven innovation, many tools continue to present barriers related to access, usability, and trust, limiting their practical value for diverse user groups and institutional settings.

The Multidimensional Digital Inclusiveness Index (MDII) is a structured evaluation framework developed to assess how inclusive digital agrisystem tools are in real-world conditions (Opola et al, 2025). It examines performance across seven interrelated dimensions: accessibility, usage efficacy, beneficial impact, risks and harms, supportive ecosystem, ethical and responsible innovation, and co-creation and governance, placing particular emphasis on how different user groups experience digital systems in practice (Martins et al., 2024).

Within International Water Management Institute (IWMI), the MDII has been applied through WaPOR-based pilot evaluations of digital tools used for irrigation performance, crop monitoring, and agricultural decision support. These evaluations systematically integrate evidence from multiple user groups, including innovators, domain experts, direct users, and downstream beneficiaries, to generate a multidimensional diagnostic profile of digital inclusiveness. In doing so, the MDII provides robust empirical insight into where tools perform well, where they fall short, and where risks of exclusion persist.

The MDII Framework and scoring model

The MDII is a scientific evaluation framework that combines established evaluation methodologies with digital and AI-enabled assessment techniques to systematically examine

how inclusive digital innovations are across agrifood systems (Opola et al, 2025; Martins et al, 2024). Its overarching objective is to ensure that digital tools are not only technically functional, but also accessible, ethical, and beneficial to diverse user groups operating in varied socio-technical contexts.

The framework is designed to support three core outcome areas. First, it promotes evidence-based improvements by standardizing inclusive data collection and evaluation methods, enabling the generation of comparable, empirical insights across digital tools and agrisystems. Second, it strengthens policy and strategy integration by producing actionable, stakeholder informed guidance and recommendations that support alignment with digital inclusion principles and FAIR data practices. Third, it enables scalable and context aware implementation through the development of modular, offline friendly, and interoperable tools and documentation that support its application across diverse agricultural and water management contexts.

Analytically, the framework applies a multidimensional structure to assess how digital innovations perform across different aspects of inclusiveness. It is organized around three megagroups of analysis Innovation Usage, Social Consequences, and Stakeholder Relationships. Together encompass seven dimensions, 27 subdimensions, and a total of 90 indicators (see figure 1). This structure enables a granular assessment of how digital tools function across technical, social, ethical, and governance related domains.



Figure 1: Mega-groups of MDII analysis. Source: Authors

Each digital tool evaluated through MDII receives a score for inclusiveness at both the dimension (macro-level), subdimension (meso-level) and indicator level (micro-level). Subdimension scores are derived from quantitative indicators gathered from innovators, domain experts, direct users, and downstream beneficiaries. These scores identify strengths and constraints in each specific. The MDII outputs scores in 5 tiers, as described on Table 1 below.

Scoring Tier	Score Range	Description
Significantly Below Expectations	0 to 24%	Major deficiencies in inclusiveness, with critical gaps preventing equitable access and use. Requires complete redesign.
Below Expectations	25 to 49%	Partially meets inclusiveness benchmarks but lacks essential elements. Significant improvements needed.
Approaching Expectations	50 to 69%	Meets foundational inclusiveness standards, providing basic access and usability for most intended users.
Meeting Expectations	70 to 89%	Demonstrates strong inclusiveness, addressing diverse user needs effectively, with thoughtful adaptations for marginalized groups.
Exceeding Expectations	90 to 100 %	Models best practices in inclusiveness, fully adaptable and empowering.

Table 1: Scoring tiers of MDII. Source: Authors

Dimension-level scores provide an aggregated view of performance within each megagroup and offer a concise summary of a tool's overall inclusiveness profile. However, it is the subdimension scores that drive diagnostic precision and form the basis for recommendation matching in the Recommendation Repository. Lower subdimension scores indicate clearer opportunities for improvement and therefore activate targeted refinement guidance.

The evaluation process follows a survey-based approach. Innovators or developers initiate the evaluation, after which coordinators collect evidence through online forms from direct users and downstream beneficiaries (when applicable), and domain-specific reviews. The resulting scores, insights, and recommendations are then compiled into a structured report. This scoring and evaluation logic is what enables the Recommendation Repository to function as an automated refinement mechanism.

By linking specific subdimension score thresholds to predefined recommendations, the repository operationalizes MDII insights and ensures that improvement actions remain consistent, evidence-based, and directly aligned with the inclusiveness constraints identified during evaluation.

The rationale behind the need for a recommendation repository

The development of the Recommendation Repository emerged directly from the practical realities of implementing the MDII across the evaluation of 8 WaPOR-based digital tools (Table 2) developed by IWMI. While these WaPOR-focused MDII pilot evaluations generate detailed empirical diagnostics, they also expose a recurring implementation gap. Evaluation outputs tend to be robust in identifying where inclusiveness is constrained, yet they do not specify which improvements are feasible within the bounded realities of development cycles, inherited system architectures, staffing capacity, and financial resources. As a result, critical inclusiveness findings risk remaining underutilized in day-to-day tool refinement processes.

Theme	Tool	Country	Tool Description
Crop Insurance	Area Yield Index Insurance (AYII)	Ethiopia	AYII is an index-insurance tool that uses high-resolution WaPOR data to estimate yields and trigger payouts, reducing the need for crop-cutting experiments and supporting quicker risk management (Tadesse et al, 2025a).
Irrigation Performance	Irrigation Management Information System of Ethiopia (IMISSET)	Ethiopia	IMISSET is an irrigation-performance tool that uses WaPOR data to analyse water use and efficiency across Ethiopia's irrigation schemes (Tadesse et al, 2025b).

Water Productivity Monitoring	Wheat Water Productivity Tool (WWPT)	Ethiopia	WWPT is a monitoring tool that uses WaPOR data to assess wheat water productivity across Ethiopia. It provides actionable insights that help extension services and farmers improve water management and crop performance (Tadesse et al, 2025c).
Irrigation Performance	Irrigation Performance Assessment and Diagnostics Tool (IPADT)	Jordan	IPAT Jordan uses WaPOR data to evaluate irrigation performance and crop water use. It supports clearer, more efficient decision-making for water management (Amdar et al, 2025).
Drought Monitoring	PakDMS	Pakistan	PakDMS is a drought-monitoring tool that uses high-resolution WaPOR and environmental data to generate dynamic drought visualizations (Cheema et al, 2025).
Irrigation Performance	Irrigation Performance Assessment Tool (IPAT)	Mozambique	IPAT applies WaPOR data to identify irrigation underperformance and provides automated indicators that guide more efficient water management (Matheswaran et al, 2025).
Irrigation Scheduling Advice	Irrigation Reference to Enhance Yield Smart Irrigation Application (IREY app)	Tunisia	IREY Tunisia applies WaPOR data to generate real-time crop water-demand alerts and support more precise irrigation decisions (Belhaj Fraj et al, 2025a)
Water Demand and Use	Water Use Tool (WUT)	Tunisia	WUT is a water-use monitoring tool that applies WaPOR data to track seasonal irrigation consumption and provide clear insights for managing scarce water resources (Belhaj Fraj et al, 2025b).

Table 2: MDII evaluated WaPOR-based tools developed at IWMI.

Comparative analysis across early MDII WaPOR evaluations revealed a set of recurring constraints, including difficulties in interpreting complex model outputs, limited contextual guidance for non-technical users, uneven documentation practices, and weak visibility of data provenance and embedded assumptions. The consistency of these patterns across tools and country contexts indicated the need for an intermediate operational layer capable of translating diagnostic evidence into prioritized and low-effort refinements that development teams could realistically implement without structural redesign.

To address this gap, the Recommendation Repository was conceived as a centralized component for systematizing the translation of evaluation outcomes into implementable guidance. This approach supports standardized, evidence-based recommendation generation while preserving contextual relevance through score-tier logic. Additionally, the repository captures how inclusiveness constraints manifest under operational conditions and translates them into refinement actions that can be implemented without fundamental architectural redesign, as seen in Figure 2. In doing so, it explicitly accounts for the temporal, technical, and financial constraints that shape most development environments.

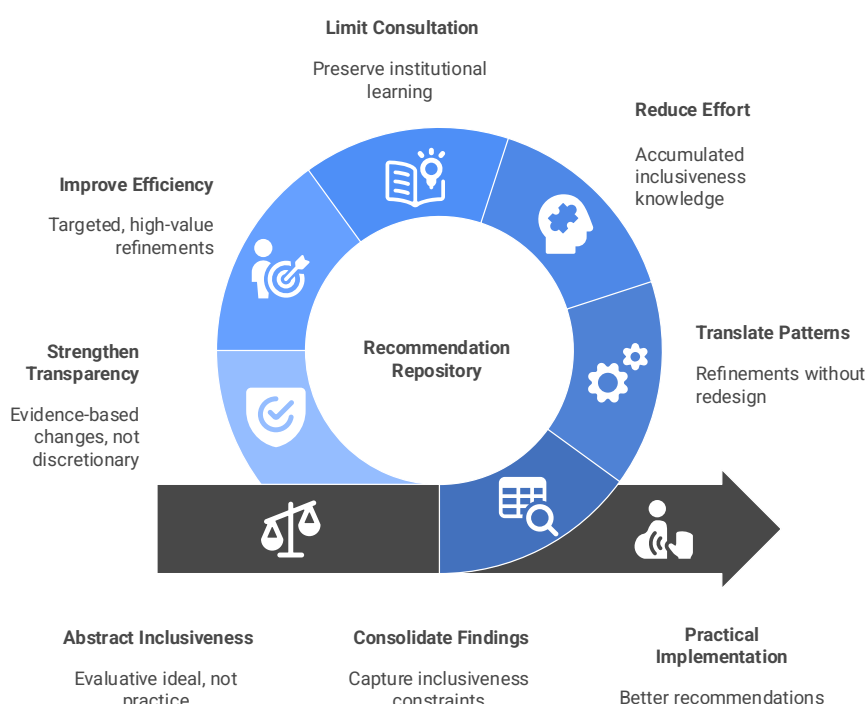


Figure 2: How the Recommendation Repository provides value to MDII. *Source:* Authors

From a governance and innovation perspective, the repository supports responsible digital innovation in three key ways. First, it reduces repetitive diagnostic effort by enabling development teams to draw on institutional knowledge rather than re-identifying the same barriers across tools and projects. Second, it limits the need for repeated consultation cycles by preserving validated recommendations in a reusable and structured form. Third, it improves the efficiency and sustainability of digital-tool investments by reducing duplication of effort and supporting targeted, high-value refinements.

The traceability embedded within the repository further strengthens transparency and accountability. Each recommendation is explicitly linked to the MDII finding, dimension, and score band from which it originates, ensuring that proposed refinements remain evidence-based rather than discretionary. Through this structure, the repository operationalizes core human-centered design principles, particularly those related to clarity, cognitive simplicity, navigability, and contextual intelligibility (Müller et al., 2024), within a systematic governance framework for tool refinement.

Design logic and operational construction

The development of the repository was guided by the following research question:

How can recommendations be centralized for scalable and consistent reporting without increasing manual workload?

To respond to this question, the repository was constructed through an applied process focused on transforming evaluative recommendations into implementable actions. Rather than treating recommendations as narrative outputs, the approach formalized recurring diagnostic insights into a structured, rule-based system capable of operating consistently across tools and reporting cycles.

Core design activities were performed during the year of 2025 and included the synthesis of recurring MDII findings across tools and country contexts, the conversion of diagnostic patterns into low-effort improvement actions, and the systematic mapping of each

recommendation to specific MDII dimensions, subdimensions, and score tiers. Feasibility was iteratively validated to ensure that proposed refinements remained technically realistic and operationally relevant. In parallel, formal score-range rules were defined to enable the automatic matching of evaluation results to the most appropriate recommendations.

From an operational perspective, the repository functions as an intermediate layer between assessment and implementation. Its current infrastructure relies on lightweight and widely available technologies, including Excel-based databases, VBA-based automation for rule execution, and Azure services for centralized storage and future online integration. This design ensures low implementation overhead, institutional portability.

Repository structure and content

The Recommendation Repository consolidates all insights generated through MDII evaluations into a single, structured reference. It links each recommendation to the specific MDII dimensions, subdimensions and decomposed indicators that triggered it. This allows developers and institutional teams to see not only what needs improvement, but why the recommendation exists and which aspect of inclusiveness it responds to. The architecture is multi-layered to enable the systematic transformation of the MDII evaluation scores into a set of prioritised, actionable recommendations. Each layer performs a distinct function, and together they ensure that the system operates consistently (see Figure 3).

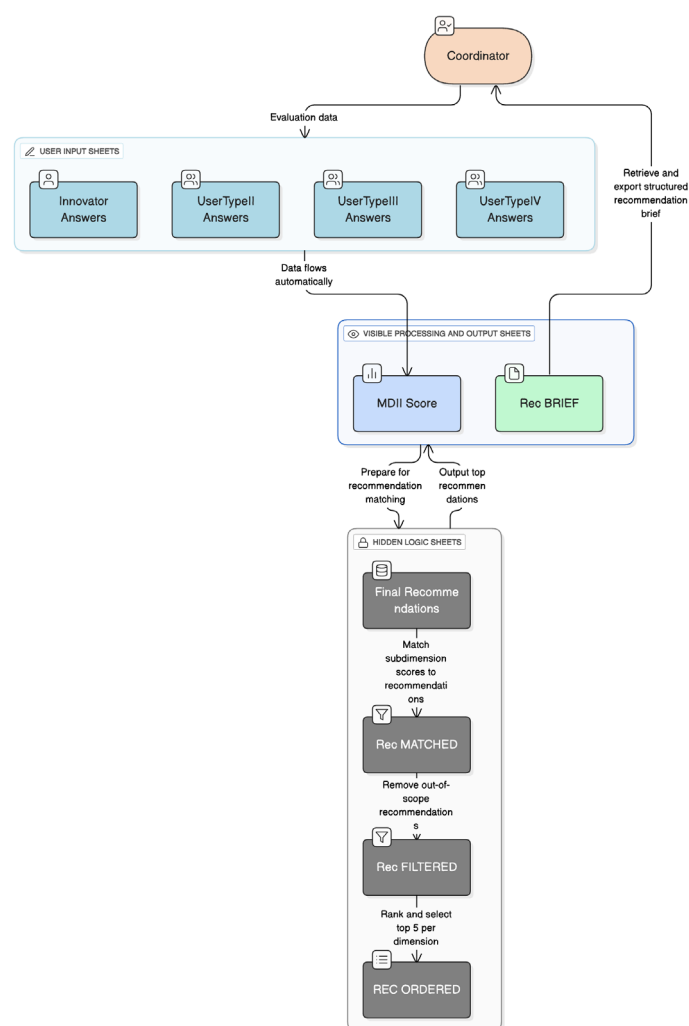


Figure 3: Recommendation Repository architecture. Source: Authors

The Recommendation Repository currently involves the following components:

1. Content Layer (Knowledge Base)

The foundation is a structured database of validated recommendations. Each recommendation is indexed by MDII dimension, subdimension, and applicable score range. This layer contains no computational logic; it serves as the authoritative source of all refinement actions that can be activated by the scoring system.

2. Mapping Layer (Score-to-Recommendation Matching)

The mapping layer links diagnostic results to the content layer. It reads subdimension-level MDII scores and compares them to the predefined score intervals attached to each recommendation. Recommendations whose score conditions are met become eligible for selection. This is the stage at which evaluative evidence is first converted into concrete, tool-specific refinement options.

3. Filtering Layer (Relevance Screening)

The filtering layer excludes recommendations that fall outside the relevant score thresholds. Only recommendations that directly correspond to the tool's performance profile remain. This prevents overgeneralization and ensures that recommendation sets are precise and grounded in the MDII scoring logic.

4. Prioritization Layer (Ranking and Selection)

Following filtering, the system ranks subdimensions from lowest to highest performance across all seven dimensions and selects a maximum of five high-priority recommendations per dimension. This produces manageable output oriented toward the most critical inclusiveness gaps, supporting iteration cycles without overwhelming development teams.

5. Automation Layer (Execution and Update Logic)

The repository's computational logic is implemented through automated Excel formulas and VBA routines. These routines execute score matching, filtering, and ordering and refresh outputs whenever new data is entered. Version control and portability are maintained through centralized storage.

6. Output Layer (User-Facing Recommendation Brief)

The final layer generates a structured recommendation brief that presents the top recommendations for each MDII dimension, making it the only component directly visible to users. It provides a synthesized, ready-to-export overview of priority actions, while all preceding layers operate invisibly in the background.

Results and findings

Analysis of the Recommendation Repository reveals a substantial body of evidence on the distribution and nature of refinement needs across the evaluated tools. As of December 2025, the repository contains 157 unique recommendation entries, which have collectively resulted in 254 recommendations delivered to innovators across the seven MDII dimensions. These values illustrate both the breadth of the curated recommendation base and the frequency with which similar inclusiveness challenges emerge across contexts.

The distribution of recommendations shows that inclusiveness constraints are not evenly spread across dimensions. Risks and Harms and Ethical and Responsible Innovation contain the highest number of activated recommendations, indicating that safeguards, transparency, and accountability remain persistent challenges in digital tool deployment. Beneficial Impact, Accessibility, and Supportive Ecosystem also display substantial refinement needs, reflecting

ongoing gaps in interpretability, documentation practices, and institutional readiness. In contrast, Usage Efficacy has the lowest number of recommendations, largely because several evaluated tools were early-stage developments in which usability pathways were not yet fully operationalized.

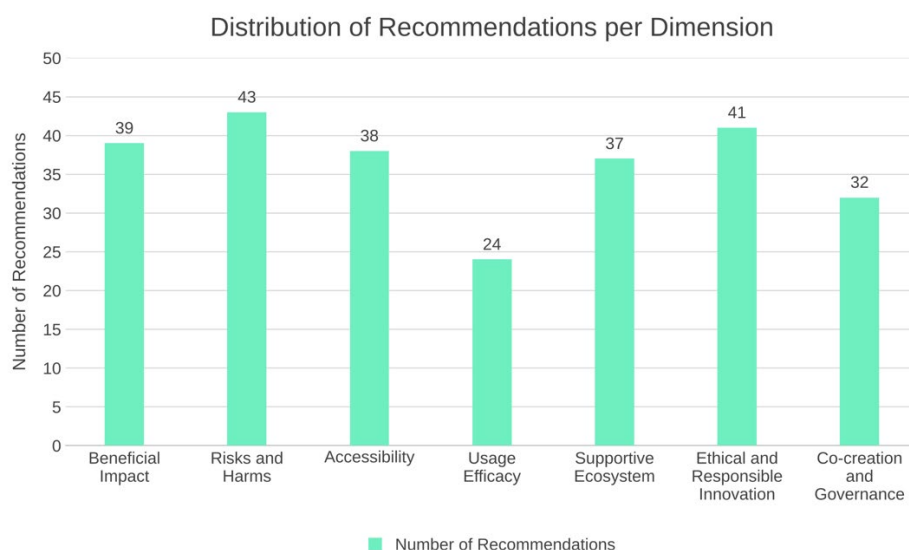


Figure 4: Distribution of recommendations per MDII dimension. *Source:* Authors

The quantitative patterns highlight that inclusiveness issues extend beyond user-interface design. Governance, ethical safeguards, and ecosystem support appear as equally significant determinants of whether tools can be used effectively and equitably across institutional and field-level contexts.

Types of recommendations

When applied across tools and country contexts, the repository consistently activates a set of recurring recommendation types. These reflect the most common inclusiveness constraints identified in the pilot evaluations and constitute the primary categories of refinement offered to development teams.

1. Interface and Usability Improvements

These recommendations address challenges related to navigating or interpreting the tool interface. They include improving clarity of labels, enhancing tooltips, simplifying dashboards, restructuring page flow, and introducing contextual guidance. Such needs were observed across tools including IPAT Jordan, AYII, WUT, and PakDMS, where users reported difficulty interpreting outputs or moving through multi-step workflows.

2. Accessibility and Connectivity Adaptations

Many users operate in low-connectivity, low-literacy, or multilingual environments. Recommendations in this category include multilingual interfaces, offline-access functionality, lightweight modes for low bandwidth, and more accessible report formats. These were particularly important for evaluations such as IMISET, AYII, and WWP.

3. Data Transparency and Interpretability Measures

To improve user trust and understanding, several tools required clearer data provenance, documentation of assumptions, explanations of model logic, and transparency around uncertainty or resolution limitations. These actions were consistently identified in evaluations of IPAT, IMISET, and PakDMS.

4. Ethical and Risk-Mitigation Safeguards

These refinements strengthen responsible and safe use of digital outputs. They include adding uncertainty warnings, clarifying appropriate use cases, strengthening privacy notices, and increasing visibility of assumptions that may influence resource-management decisions. Risk mitigation was particularly relevant in tools such as IREY, PakDMS, and IMISET.

5. Support and Capacity-Building Mechanisms

Institutions frequently requested support structures that reduce reliance on external technical teams. Recommendations include developing quick-start guides, embedded tutorials, structured FAQs, user manuals, and recorded walkthroughs. These were prominent in evaluations of WWP, AYII, and IPAT Mozambique.

6. Feedback, Documentation, and Accountability Features

Several tools would benefit from built-in mechanisms to capture user feedback, annotate outputs, track changes, or document decision steps. These features help maintain transparency and responsiveness to real-world use. They were especially visible in PakDMS, WUT, and IREY evaluations.

7. Co-creation and Governance Enhancements

Recommendations in this category strengthen collaboration with local institutions and support more transparent governance structures. Examples include formalising advisory groups, expanding integration of local knowledge, clarifying decision pathways, and showing how user feedback informs updates. These opportunities were highlighted across IMISET, WWP, and IPAT.

Table 3 summarises the main types of recommendations generated through the repository and identifies the tools in which each category was activated.

Table 3: Recommendation types given per tool. *Source:* Authors

Recommendation Type	Tools Where This Type Was Activated
Interface and Usability Improvements	IPAT Jordan, AYII, WUT, PakDMS
Accessibility and Connectivity Adaptations	IMISET, AYII, WWP
Data Transparency and Interpretability	IPAT, IMISET, PakDMS
Ethical and Risk-Mitigation Safeguards	IREY, PakDMS, IMISET
Support, Learning, and Capacity-Building	WWP, AYII, IPAT Mozambique
Feedback, Documentation, Accountability	PakDMS, WUT, IREY
Co-creation and Governance Enhancements	IMISET, WWP, IPAT Mozambique

Learnings from developing the recommendation repository

The development and application of the Recommendation Repository generated several insights regarding how inclusiveness improvements can be operationalized across digital tools. These learnings clarify the practical conditions under which recommendations are more likely to be implemented and their constraints.

Experiences with development teams showed that recommendations have greater uptake when they promote incremental refinements rather than structural redesigns and when they fall clearly within the developers' sphere of control. Although the repository links recommendations to performance tiers, teams noted continued difficulty in prioritizing actions without an assessment of the effort required for each suggestion. In practice, developers

tended to focus on a small set of high-value changes, often an informal top three, reflecting both resource limitations and the need for manageable implementation cycles.

Internal learnings highlighted the tension between context specificity and harmonization. Many inclusiveness challenges are deeply embedded in local institutional practices, cultural norms and operational workflows, which limits the applicability of highly standardized recommendations. Tools designed to address narrowly defined problems also require equally specific improvement pathways, making contextual nuance essential for relevance.

Next Steps

The recommendation repository provides a robust foundation for supporting MDII assessments in low-connectivity environments, ensuring inclusiveness not only in content but also in the delivery method. While the current structure meets the operational objectives, several enhancements could further strengthen its analytical depth, usability, and long-term integration within the MDII ecosystem.

- a) Expanding the recommendation corpus: Although the repository covers all MDII dimensions and subdimensions, some score ranges remain sparsely populated. Increasing the number and granularity of recommendations, particularly for intermediate scores, would improve the precision and contextual relevance of the outputs.
- b) Improving metadata structure: Introducing a clearer tagging or categorization system could help classify recommendations by thematic focus, implementation complexity, or required resources. This would facilitate prioritization, improve usability, and support future analytical use cases.

In summary, while the deliverable effectively translates the MDII framework into a structured and accessible resource for field teams, these improvements would enhance its applicability across diverse contexts and strengthen its long-term utility.

Conclusion

Digital tools only fulfil their purpose when they are accessible, comprehensible, and aligned with the needs of their users. The MDII provides a structured way to measure these aspects, but it is the Recommendation Repository that turns the assessment into action. It gives developers the clarity they need to improve their tools in a targeted and feasible way.

By capturing lessons across tools and countries, the repository becomes a shared resource that strengthens institutional learning. It reduces duplication of effort, increases transparency, and supports efficient use of resources. Most importantly, it ensures that developers do not face inclusiveness challenges without guidance.

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