Workflow-based Opportunity Assessment for Additive Manufacturing

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Abstract: Additive manufacturing (AM) offers substantial value-creation opportunities across design, digital, organisational, and strategic domains, yet industrial uptake remains uneven because firms lack structured methods to identify where in their existing workflow AM is most likely to create value. This paper proposes a workflow-based opportunity assessment method that represents the workflow as a design structure matrix, augments it with nine literature-derived opportunity factors to form a multi-domain matrix, populates the dependencies with opportunity likelihood and impact values, and applies the Change Prediction Method to compute aggregated incoming and outgoing opportunity. The method is demonstrated on a low-volume lifting tool case at a Swedish OEM. Results identify the AM design step as the dominant opportunity multiplier, design realisation as an internal hub, and qualification readiness and strategic positioning as the principal sinks of accumulated value, providing managers with a structured basis for prioritising AM interventions.

Keywords: Additive Manufacturing, Opportunity Assessment, MDM, DSM, Design Structure Matrix

1 Introduction

Additive manufacturing (AM) has evolved significantly over the last three decades, moving from a technology associated primarily with rapid prototyping to one increasingly used for tooling, spare parts, repair & remanufacturing and even in end-use production in some industrial applications (Huang et al., 2015; Thompson et al., 2016). This shift has been enabled by developments in process capability, materials, digital workflows and industrial integration (Alcácer and Cruz-Machado, 2019; Merrill, 2014; Rylands et al., 2016). Further, AM continues to be discussed as a broader enabler of new value chains through the use of distributed production and product-service innovations. The appeal of AM is strongly driven by the opportunities it offers. The literature consistently highlights advantages such as geometric freedom, part consolidation, reduced dependence on tooling, mass customisation and many other positives, which make AM a lucrative manufacturing option (Mellor et al., 2014; Tofail et al., 2018). Yet, despite these opportunities, the industrial adoption of AM remains uneven (Kulkarni et al., 2021; Martinsuo and Luomaranta, 2018). One reason is that the opportunities are often discussed in isolation with an assumption that they automatically arise directly from the technology. In practice, however, opportunities surrounding AM are highly contingent on many factors which must be put together to make the advantages realisable (Hajali et al., 2023; Isaksson et al., 2024; Mallalieu et al., 2022).

The current literature on decision support in AM broadly focuses on one of three issues: material selection (Alghamdy et al., 2019), part suitability and manufacturability (Hajali et al., 2025) or risk identification and assessment (Brahma et al., 2026). While these approaches are valuable for narrowing down manufacturing alternatives or carrying out feasibility studies, they do not sufficiently explore where in the current workflow of an organisation AM is most likely to create opportunity. To address this gap, this paper proposes a workflow-based opportunity assessment method for AM implementation. The method represents workflow elements and their dependencies in a multi-domain matrix, which are linked to AM-related opportunity factors identified from the literature. Further, the proposed method uses expert-elicited *opportunity likelihood* and *opportunity impact* values to evaluate both direct and indirect opportunity propagation through the system. Overall, the method frames AM implementation as a system-level value creation problem, which uses the workflow as its basis, rather than only a question of process choice, manufacturability, or risk mitigation.

2 Background Literature and Opportunities Identification

The following sections thematically discuss the opportunities associated with AM and its value chain. These are then synthesised into a set of *opportunity factors*, which form the conceptual basis for the workflow-based assessment method presented later in this paper.

2.1 Design and product-related opportunities

The most widely discussed opportunity provided by additive manufacturing is design freedom and flexibility. AM enables complex geometries, lightweight structures, internal channels and highly customised forms that are difficult or at times impossible to achieve with conventional manufacturing processes such as casting (Thompson et al., 2016; Wiberg et al., 2019). The value of this freedom is both geometric and functional; it allows products to be developed more directly around requirements, thereby supporting performance-driven and multifunctional design solutions (Borgue, Müller, et al., 2019; Borgue, Panarotto, et al., 2019). A related opportunity lies in product architecture design; through part consolidation and function integration, AM can reduce part count, interfaces and assembly complexity while improving features such as alignment, sealing and structural properties. AM therefore allows significant changes to how products are structured and where complexity arises in the value chain (Borgue et al., 2022; Eyers et al., 2021). These opportunities are, however, dependent on the wider workflow. Their realisation relies on how design methods, digital tools, manufacturability analysis and downstream production activities are connected (Mallalieu et al., 2022). While the design and product-related opportunity space of AM is substantial, its exploitation depends on the integration of these activities within the industrial workflow, in most cases tailored to individual organisational needs.

2.2 Process and digital workflow opportunities

A second major opportunity provided by additive manufacturing lies in its integration with the digital process chain. AM's inherent model-based nature can improve the links between design, data, production and other non-functional quality-related activities such as traceability, simulation and process planning (Belkadi et al., 2018). The value of AM therefore, extends to creating more connected and data-rich workflows across the value chain (Isaksson et al., 2024; Mallalieu et al., 2022). This creates opportunities for faster iteration, improved process visibility and stronger integration between digital and physical operations. Further, AM can shorten certain development and production times by reducing dependence on tooling and enabling direct transfer from digital models to physical artefacts (Luomaranta and Martinsuo, 2022). As digital tools such as in-situ monitoring and predictive analytics become more integrated with AM workflows, further opportunities arise through improved process quality and reduced scrap, along with more efficient qualification and control processes (Aheleroff et al., 2021; Lu and Wong, 2017). These opportunities are, however, dependent on the wider workflow of which AM is a part. The realisation of these opportunities depends on factors such as interoperability between digital tools, the continuity of data across process stages and the ability of the organisation to connect design, production and verification activities within a digital thread (Isaksson et al., 2024). The process- and digital-workflow-related opportunities provided by AM are therefore many; however, their exploitation relies on how effectively these digital and organisational factors are handled in practice.

2.3 Supply-chain and operational opportunities

A third important opportunity provided by additive manufacturing lies in its ability to improve responsiveness in the supply chain and operational flexibility. For example, AM can support on-demand production, leading to a faster response to low-volume or uncertain demand, thereby reducing reliance on physical stocks and long, often rigid logistics chains (Durach et al., 2017; Ford and Despeisse, 2016). The value of AM, therefore, extends to the possibility of reconfiguring how products, spare parts and manufacturing capacity are configured across the value chain (Ronchini et al., 2023). This creates opportunities for shorter lead times in selected use cases, improved availability of high-value or low-volume components and more agile responses to changing customer needs or to externally induced disruptions to supply chains (Ford and Despeisse, 2016). AM can also reduce certain forms of operational complexity by enabling part consolidation, lowering assembly requirements and simplifying some production and logistics flows (Borgue, Panarotto, et al., 2019; Eyers et al., 2021). These opportunities are, however, strongly dependent on the surrounding workflow and sourcing structure in which AM is implemented. The supply-chain and operational opportunity space of AM is therefore substantial, but its exploitation relies on how effectively the technology is integrated into the broader system.

2.4 Strategic and organisational opportunities

A further opportunity provided by additive manufacturing lies in its potential to support new strategic positions and new ways of organising value creation. AM can enable more differentiated offerings along with closer alignment between products and customer-specific needs and new service-oriented propositions built around customisation, rapid response, repair, or distributed fulfilment (Chaudhuri et al., 2019; Rylands et al., 2016). In this sense, the value of AM extends beyond changes in products or processes, to how firms position themselves competitively and how they participate in wider industrial ecosystems (Alcácer and Cruz-Machado, 2019; Omidvarkarjan et al., 2023). This also creates opportunities for capability development within the organisation, as AM implementation can stimulate learning in design for additive manufacturing, qualification, digital manufacturing and cross-functional coordination. As firms adopt AM, further opportunities may arise through stronger collaboration between various teams of design, production, sourcing and digital functions, as well as through the development of new roles and competencies that support more integrated innovation (Oettmeier and Hofmann, 2016; Shah and Mattiuzza, 2018). These opportunities are, however, dependent on the organisation's ability to adapt internally and to align its structures. The strategic and organisational opportunity space of AM is therefore substantial, but its exploitation depends on how effectively firms translate technological possibilities into new capabilities and new forms of competitive value creation (Klahn et al., 2020).

2.5 Sustainability-related opportunities

A final major opportunity provided by additive manufacturing lies in its potential to support more sustainable and circular forms of value creation. AM can improve material efficiency, reduce waste in selected applications, enable repair and remanufacturing and support more localised production patterns that may lower transportation burdens across the value chain (Ford and Despeisse, 2016; Graziosi et al., 2024). The value of AM is not only associated with how products are manufactured but also with how resources are used, how product lifetimes are extended and how production and logistics systems may be reorganised around more circular principles (Raabe et al., 2019). Opportunities also arise through potential design improvements through lightweighting, part consolidation and function-driven redesign, which can reduce material consumption and in some cases, improve lifecycle performance beyond the production stage itself (Borgue, Panarotto, et al., 2019). At the same time, these opportunities are highly context-dependent and cannot be assumed automatically. Their realisation depends on multiple factors such as process choice, energy mix, material sourcing, build utilisation, post-processing requirements and most importantly, the configuration of the workflow and supply chain in which AM is situated (Despeisse et al., 2024). The sustainability-related opportunity space of AM is therefore also substantive, but its exploitation depends on whether the technology is implemented in ways that improve lifecycle performance rather than simply shifting burdens from one stage of the value chain to another (Liao and Cooper, 2021).

2.6 Existing decision-support approaches and the remaining gap

A substantial part of the additive manufacturing decision-support literature has focused on helping firms choose among alternatives, most commonly through process selection, material selection, part suitability assessment, manufacturability evaluation and, in some cases, supplier or configuration choice (Altubaishe et al., 2019; De Lima et al., 2023; Moreno-Cabezali and Fernandez-Crehuet, 2020). These approaches are valuable because they support screening and selection decisions in situations where firms need to determine whether a part, process, or sourcing option is appropriate for AM (Ronchini et al., 2023). More recently, decision support has also been extended toward earlier design-phase assessment. An example is the Manufacturing Process Decision Support (MPDS) method introduced by Hajali et al. (2026), which supports designers in assessing the feasibility and suitability of AM in comparison to other manufacturing processes during the pre-conceptual design phase. This type of method is particularly valuable where the key question is both, how to design for AM, but also when AM should be selected in the first place. A different line of work has focused on the downside of AM implementation, particularly the risks associated with introducing AM into established workflows. An example is the workflow-based risk analysis method proposed by Brahma et al. (2026), in which observed or anticipated workflows are represented in multi-domain matrix form, linked to AM-related influencing factors and analysed through quantified likelihood and impact values together with propagation analysis. Further, work has also extended decision support toward supply-chain configuration, inventory strategy, simulation and optimisation of AM-enabled operational settings (De Lima et al., 2023). However, these approaches generally treat the decision problem as one of selecting or ranking alternatives, rather than understanding how value is contextualised in the workflow into which AM is introduced. As a result, they do not sufficiently address a different decision question: where, within an existing or anticipated workflow, is additive manufacturing most likely to create opportunity and how does that opportunity propagate across interacting system elements? The remaining gap, therefore, is the absence of a workflow-based method that can relate AM opportunity domains to the dependency structure of an industrial system and thereby assess how value-creation potential emerges and spreads through the workflow itself.

2.7 Synthesis of opportunity themes and derivation of opportunity factors

The literature review indicates that the opportunities associated with additive manufacturing can be synthesised into a reduced set of recurring value domains. To make these domains assessable in the proposed workflow-based method, they are consolidated into the following nine opportunity factors.

- OF1: Design realisation opportunity - The opportunity for additive manufacturing to improve the alignment between design intent, requirements, constraints, and feasible product form, while also supporting more integrated and iterative design processes.
- OF2: Product architecture and functional integration opportunity - The opportunity for additive manufacturing to enable part consolidation, function integration, and simplification or improvement of product architecture.
- OF3: Digital thread and data asset opportunity - The opportunity to create value through digital continuity, traceability, simulation, secure model flow, and the strategic use of digital design assets.
- OF4: Supply-chain and operations responsiveness opportunity - The opportunity to improve operational responsiveness through digital inventory, on-demand production, localised fulfilment, spare-parts availability, and greater supply-chain agility.
- OF5: Organisational capability development opportunity - The opportunity to build skills, expertise, and internal competence in areas such as design for additive manufacturing, qualification, process understanding, and digital manufacturing.
- OF6: Organisational adaptability opportunity - The opportunity for the organisation to adapt its roles, coordination patterns, decision structures, and innovation culture in ways that support successful AM implementation.
- OF7: Business model and strategic positioning opportunity - The opportunity for additive manufacturing to support differentiated offerings, new service models, ecosystem participation, and competitive repositioning.
- OF8: Qualification, verification, and regulatory opportunity - The opportunity to create value through improved traceability, certification readiness, verification efficiency, and the maturing standards and compliance environment surrounding additive manufacturing.

OF9: Sustainability and circularity opportunity - The opportunity for additive manufacturing to improve resource efficiency, enable repair and remanufacturing, reduce logistics burdens, and support more circular lifecycle strategies.

Together, these nine factors represent a literature-based synthesis of the principal domains in which AM implementation may create value. They form the conceptual basis for the workflow-based opportunity assessment method developed in the next section, where they are linked to workflow elements and analysed through a structured matrix-based propagation approach.

3 Method demonstration in an Industrial Case

The proposed opportunity assessment method is illustrated in Figure 2. The method begins by observing the relevant workflow (top left) and representing it as a design structure matrix (DSM), which is then expanded into a multi-domain matrix (MDM) by linking workflow elements to the identified opportunity factors. The marked dependencies are populated with opportunity likelihood and opportunity impact values, and the resulting matrices are processed using Clarkson et al. (2004)'s Change Prediction Method (CPM) to calculate direct and propagated opportunities across the system. The final output is an aggregated opportunity view in which workflow elements and opportunity factors can be interpreted in terms of incoming opportunity and outgoing opportunity. In the following subsections, each step of the method is demonstrated through an industrial case involving the introduction of additive manufacturing in the design and production of low-volume tools.

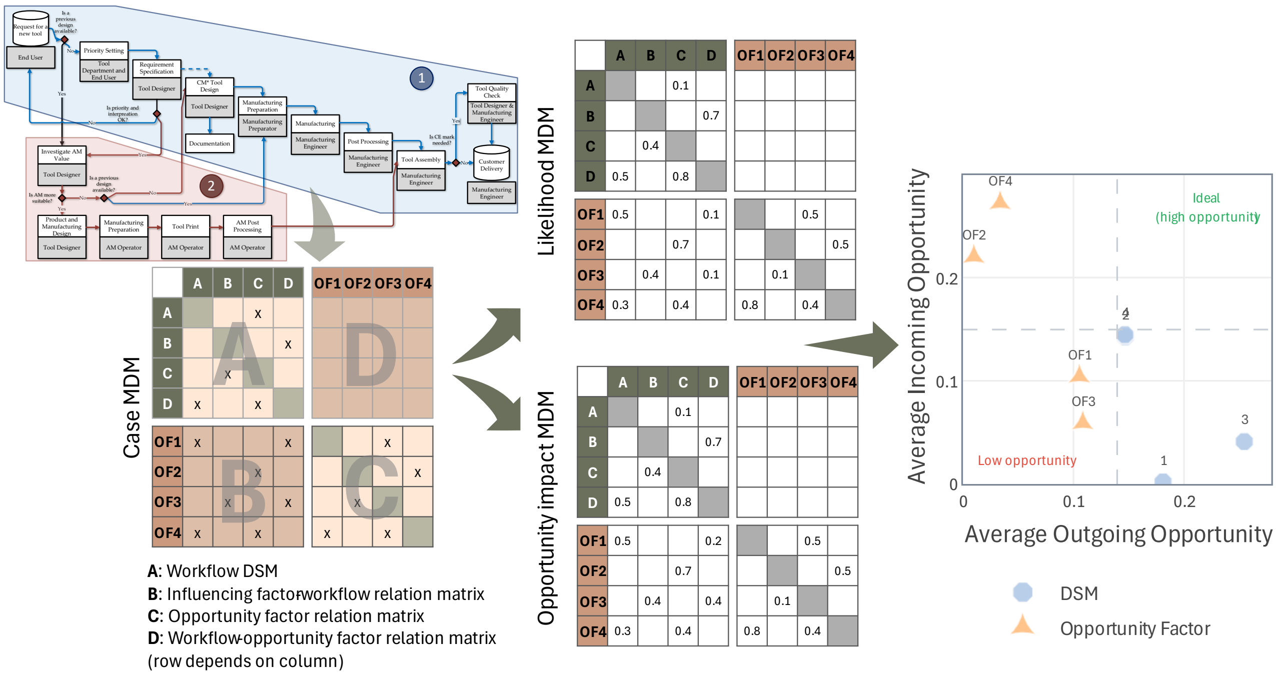

Figure 2. The proposed workflow-based opportunity assessment method.

3.1 Case context and workflow observation

The case examined in this paper concerns the introduction of additive manufacturing in the design and production of a low-volume production tool at a Swedish original equipment manufacturer (OEM), as shown in Figure 4, right. The specific tool studied is a lifting tool used in the OEM's production line. Like other tools of its kind, it is characterised by a small batch size, a short design cycle, and unique geometric requirements driven by the equipment it serves. For such tools, AM offers value: design freedom can be exercised without the cost penalty of low-volume conventional fabrication, geometric features can be tailored to specific equipment, and rapid iteration is possible without retooling.

The workflow under analysis (Figure 3) spans the steps from the initial request for a new tool to its delivery to the end-user in the production line. It is composed of three concurrent sub-chains: a conventional manufacturing (CM) chain that captures the firm's established practice; an additive manufacturing (AM) chain introduced to support the new method; and a common chain (CC) that handles assembly, certification, and delivery. The workflow elements were identified through a series of interviews and observational studies conducted at three of the OEM's plants, with input from design engineers, manufacturing engineers, spare-part manufacturers, and production personnel. The resulting twenty-one workflow elements (A–U) cover the request, prioritisation, requirement specification, design, manufacturing preparation, manufacturing, post-processing, assembly, qualification, and delivery activities across both manufacturing routes.

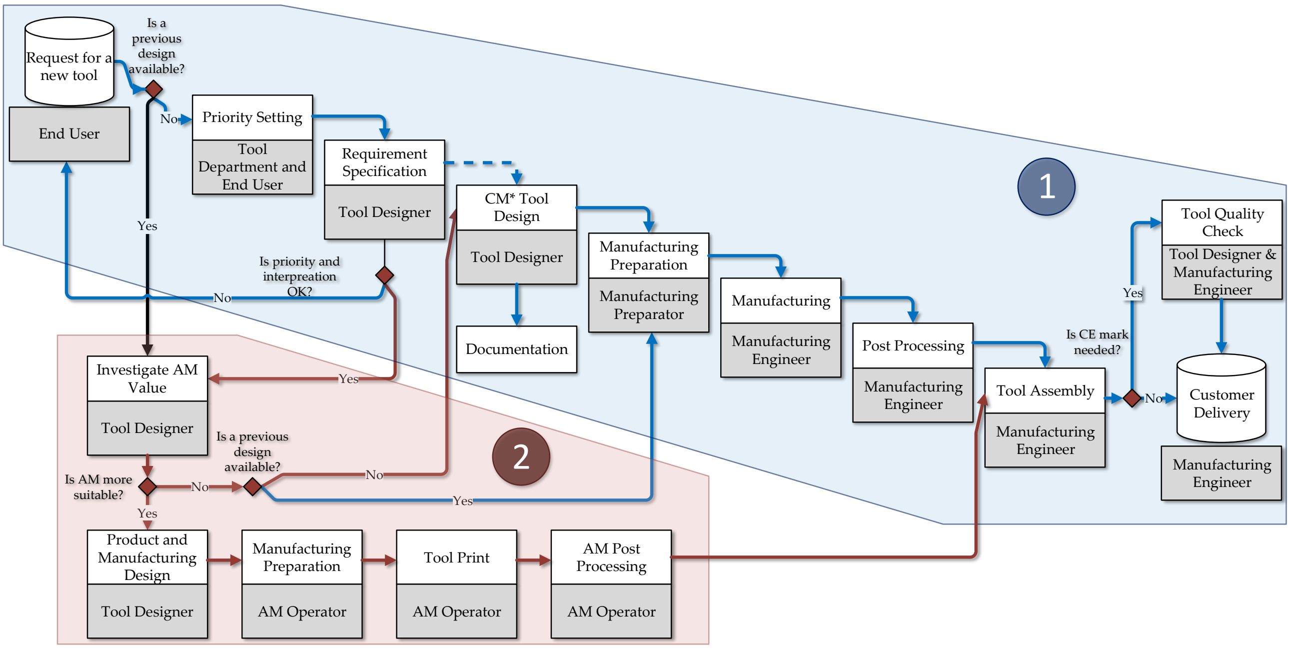

Figure 3. Observed workflow at the case OEM. Chain (1, blue) is the existing conventional manufacturing route; chain (2, red) is the additive manufacturing route introduced through the AM value-investigation and suitability decisions. Reproduced from Hajali et al., 2023, under CC BY-NC-ND 4.0.

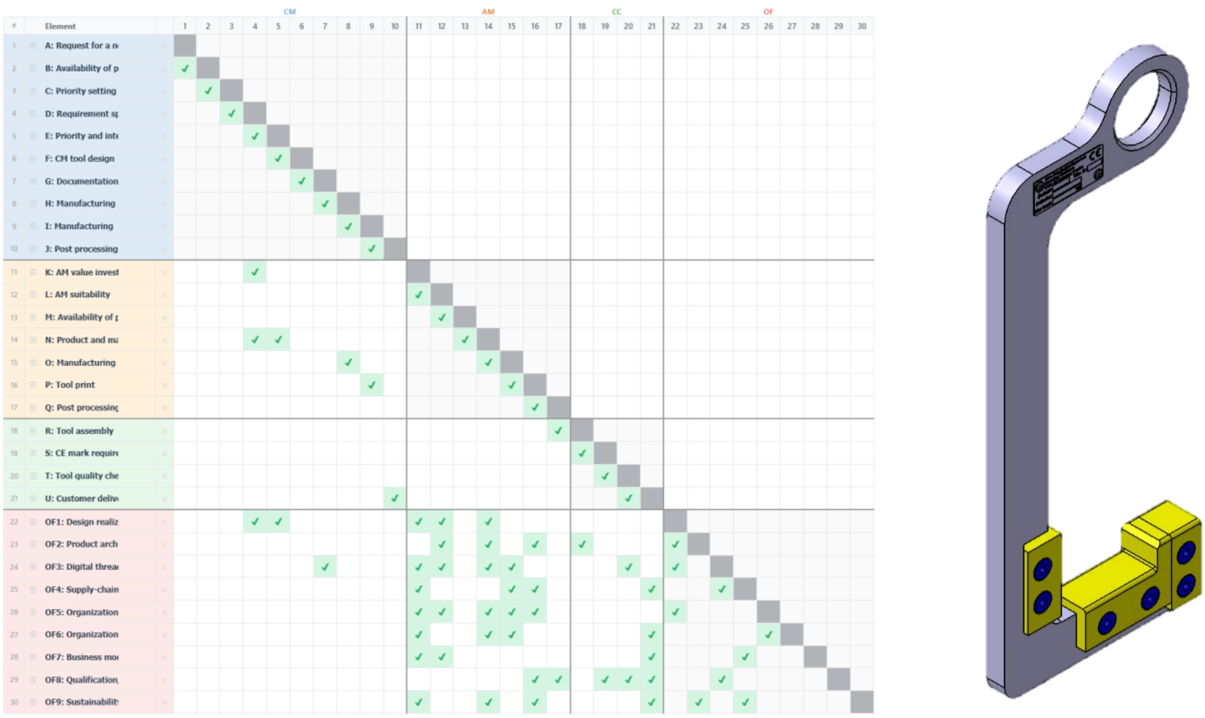

Figure 4. (Left)The MDM capturing dependencies between conventional manufacturing chain, AM chain and Opportunity Factors. (Right) CAD image of Lifting tool, which is the case examined in this paper.

3.2 DSM/MDM representation and opportunity elicitation

The observed workflow, as shown in Figure 3 is converted into an MDM (Figure 4) with two domains: the workflow domain (twenty-one elements, A–U) and the opportunity factor domain (nine elements, OF1–OF9). The MDM is composed of four sub-matrices. The convention used throughout is row depends on column. The first sub-matrix is the workflow DSM. Its dependencies were elicited through interviews and observational studies described in Section 3.1 and capture the work-and-information flow between workflow elements. The second is the workflow-to-opportunity-factor matrix, in which each opportunity factor is linked to the workflow elements that contribute to its realisation. The third is the opportunity-factor DSM, which captures cross-factor relationships for example, capability development (OF5) reinforcing qualification readiness (OF8). The fourth, capturing influence from opportunity factors back to workflow elements, is left empty in this study, consistent with the assumption that workflow elements drive value creation in the OFs rather than the reverse. This assumption can be relaxed in future applications. As the factors are drawn from overlapping themes in the literature, their scopes are not strictly independent; the aggregated opportunity values computed later are therefore interpreted as relative rankings rather than absolute measures.

Each marked dependency in the MDM is populated with two quantitative values: an opportunity likelihood and an opportunity impact. Opportunity likelihood is defined as the probability that value-creation potential at one element propagates to another, given the dependency structure of the workflow. Opportunity impact is defined as the magnitude of value created at the receiving element if such propagation is realised. Both values lie between 0 and 1. Workflow likelihoods and impacts were elicited from the same domain experts who described the workflow; opportunity factor likelihoods and impacts, both for the workflow-to-OF block and the OF-to-OF block, were elicited from researchers and practitioners with experience of AM implementation.

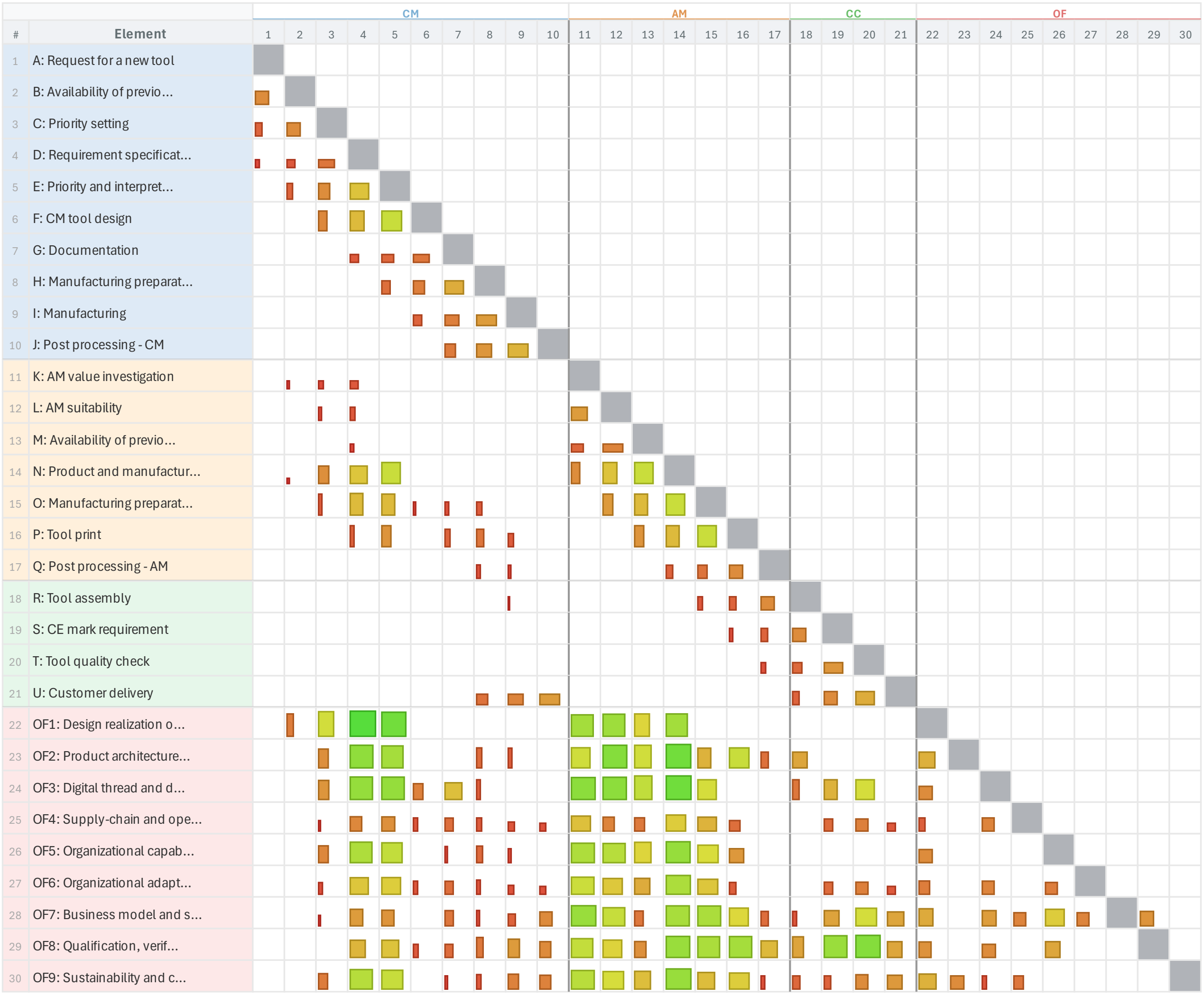

Figure 5. Combined opportunity propagation matrix for the lifting-tool case after three CPM steps. Cell height encodes combined opportunity likelihood; cell width encodes combined opportunity impact. Larger and greener cells indicate stronger combined propagation between the row and column elements. Domain blocks (CM, AM, CC, OF) are separated by gridlines.

3.3 Opportunity propagation

Once populated, the MDM is processed using the Change Prediction Method (CPM) introduced by Clarkson et al. (2004) and extended for cross-domain analysis by Hamraz et al. (2012). CPM operates in two stages. In the first stage, all propagation paths between elements are enumerated. For example, a value-creation opportunity at workflow element D may reach OF1 directly, or via the path D - E - OF1, or via D - K - L - OF1, and so on. In the second stage, the combined opportunity along each path is calculated using probabilistic operators that combine direct and indirect contributions. Following the convention adopted in the AM risk analysis literature, e.g., Brahma et al. (2026), propagation is computed for three steps; longer search depths tend toward asymptotic results without changing the relative ranking of elements. The workflow DSM is not restricted to feed-forward dependencies: planned iterations can be represented as feedback marks whose likelihood values encode the expected probability of rework. This may include the path enumeration traversing such loops up to the chosen search depth. The case workflow studied here is largely feed-forward.

The output of the CPM run is a combined opportunity matrix of the same dimensions as the input MDM. Figure 5 visualises this matrix. Within each cell, the height of the marker encodes the combined opportunity likelihood and the width encodes the combined opportunity impact, so that cells closer to a square shape and a saturated green colour represent stronger combined opportunity propagation between the row and column elements. The domain blocks (CM, AM, CC, OF) are separated by gridlines to help locate where opportunities concentrate.

Figure 6. Incoming versus outgoing opportunity for workflow elements and opportunity factors in the lifting-tool case.

A first inspection of Figure 5 shows that the dense, high-saturation region of the matrix is the workflow - OF block (rows 22–30, columns 1–21), confirming that opportunity in this case is primarily generated by workflow elements and absorbed by opportunity factors. Within that block, the AM-side workflow columns (especially N and O, columns 14 and 15) drive the strongest propagation across all OF rows, while the CM-side columns contribute mainly through upstream elements (D, E). The OF × OF sub-block (rows 22–30, columns 22–30) shows visible but modest cross-factor reinforcement, with OF1 and OF5 acting as the most active feeders. The aggregated row and column averages of this matrix are the basis for the analysis that follows in the next section.

4 Results and insights

The aggregated opportunity values for the case are summarised in Table 1 and visualised in Figure 6. The discussion that follows interprets these results, first along the opportunity factor axis and then along the workflow axis.

Three tiers of opportunity factors emerge. The first tier — qualification (OF8), strategic positioning (OF7), digital thread (OF3), and sustainability (OF9) accumulate the highest incoming opportunity. The second tier: architecture (OF2), capability (OF5), design realisation (OF1), and adaptability (OF6), sits at intermediate levels. The supply-chain factor (OF4) is the only one that sits clearly below this band. This grouping is consistent with the nature of the case: a low-volume internal tool exercises AM's design, digital, and qualification value channels strongly, but does not reconfigure the firm's supply-chain footprint in any meaningful way. The tier structure suggests a division of intervention types: the first-tier factors are where realised value should be monitored and captured, whereas the workflow multipliers identified below are where effort is most productively invested, since improvements there radiate into the accumulating factors.

Strategic and qualification opportunities accumulate primarily through propagation. OF7 (business model and strategic positioning) and OF9 (sustainability) have zero outgoing opportunity but are among the highest in incoming opportunity, indicating that they are pure sinks within the propagation structure. OF7 in particular receives most of its incoming value indirectly, through the OF5 - OF7, OF6 - OF7, and OF8 - OF7 chains, rather than directly from workflow elements. This reflects a substantive point: strategic positioning is rarely created by any single workflow activity; it accumulates from underlying capability, qualification readiness, and adaptability. The same propagation-driven character holds for OF8, where direct workflow contributions (from elements P, Q, S, T, U) are amplified through the OF3 - OF8 and OF5 - OF8 routes.

Table 4. Aggregated opportunity values for the nine opportunity factors, ranked by incoming opportunity.

Factor	Description	Incoming	Outgoing
OF8	Qualification, verification, and regulatory	0.283	0.009
OF7	Business model and strategic positioning	0.257	0.000
OF3	Digital thread and data asset	0.241	0.036
OF9	Sustainability and circularity	0.227	0.000
OF2	Product architecture and functional integration	0.213	0.008
OF5	Organisational capability development	0.174	0.033
OF1	Design realisation	0.167	0.072
OF6	Organisational adaptability	0.167	0.008
OF4	Supply-chain and operations responsiveness	0.120	0.014

Design realisation (OF1) functions as an internal hub. OF1 has the highest outgoing opportunity among the nine factors (0.072), substantially higher than any other OF, and it appears as a feeder to OF2, OF3, OF5, and OF9 in the OF-to-OF block. This position design realisation as a pivot in the opportunity network: workflow effort that strengthens OF1 propagates to architectural integration, the digital thread, capability development, and sustainability. From a managerial perspective, this implies that interventions targeted at design realisation yield disproportionate benefits across the OF set.

The supply-chain opportunity (OF4) is case-suppressed. OF4 is the lowest-ranked OF in this case (0.120 incoming). The result is consistent with the case context: a single low-volume tool produced internally for the OEM's own production line does not exercise the supply-chain reconfiguration potential of AM. The low score is therefore an indicator of the case-specific shape of the opportunity profile, not a deficiency in the method. In a different case, for example, distributed spare-parts production, OF4 would be expected to dominate. On the workflow side, four elements stand out as opportunity multipliers. Sorted by outgoing opportunity, the highest-ranked workflow elements are shown in Table 5.

These elements share a common position: they sit at upstream points in the workflow where opportunity has many downstream paths to traverse. N (AM-specific product and manufacturing design) is the strongest single multiplier and also has meaningful incoming opportunity (0.083), making it both an opportunity source and a major concentration node, the workflow element where AM value most visibly materialises. D and E are conventional-side requirements and interpretation steps that precede the AM/CM branch but still propagate strongly, because every downstream path in either branch passes through them. K and L are the AM gating decisions; their high outgoing values indicate that small uncertainties in the go/no-go assessment of AM suitability propagate into large opportunity differences downstream.

Table 5. Top-ranked workflow elements by outgoing opportunity. Outgoing opportunity is the column-average of the combined opportunity matrix and measures the extent to which an element radiates value-creation effects through the workflow.

Rank	Element	Outgoing
1	N: Product and manufacturing design – AM	0.244
2	D: Requirement specification	0.235
3	E: Priority and interpretation	0.229
4	K: AM value investigation	0.205
5	L: AM suitability	0.200

6	O: Manufacturing preparation – AM	0.158
7	M: Availability of previous design – AM	0.157

The CM chain shows weak opportunity contribution. With the exception of D, E, and H, which serve as upstream feeders to AM activities, the CM elements (F, G, I, J, B) have outgoing opportunity values below 0.07. This is not because they are unimportant to the firm, but because they do not act as significant value-creation sources for the introduction of AM specifically. The result usefully separates the question of operational importance from AM-specific opportunity contribution: a workflow element can be operationally critical while contributing little to the value created by an AM transition.

5 Conclusion

This paper proposed a workflow-based opportunity assessment method for additive manufacturing implementation and demonstrated it through an industrial case involving a lifting tool used in a production line. By combining workflow observation, DSM/MDM representation, and propagation analysis, the method makes it possible to assess not only where AM can create value, but also how the conditions for that value are recognised, preserved, and realised across dependent workflow elements. The case results show that the strongest accumulation of opportunity occurs in qualification readiness, strategic positioning, the digital thread, and sustainability, while the AM-specific design step (N) is the dominant workflow-level multiplier through which value radiates. Design realisation operates as an internal hub within the opportunity factor network, propagating effects to architectural integration, the digital thread, capability development, and sustainability. The supply-chain factor is case-suppressed, reflecting the low-volume internal-tool setting. The study has limitations: the results derive from a single case, the elicited likelihood and impact values reflect expert judgement whose influence on ranking robustness has not been examined. Future work will apply the method to cases with different opportunity profiles, examine sensitivity to elicitation uncertainty, and integrate the opportunity view with its risk-analysis counterpart. The proposed approach therefore offers a structured way to move beyond process selection and feasibility assessment toward a more systemic understanding of AM implementation as a workflow-dependent value-creation problem.

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