Towards a Data Monetization Maturity Model

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Abstract. Many organizations are planning to engage in the monetization of data. However, it turns out to be a practical problem where to start and what to build on from the existing capabilities. A maturity model helps assess the maturity of the actual capabilities. At the same time the same model can be used to prescribe a desired target state. The gap between the target state and the actual status helps setting up actions to remedy the situation. This paper proposes a Data Maturity Model (DMMM), the first maturity model for data monetization. It has been scientifically developed bottom up based on literature and extensive expert knowledge and its first release is extensively documented here.

Keywords: Data Monetization, Maturity Model, Assessment Method.

1 Introduction

Data monetization describes ways of obtaining economic benefits by using data [3]. Usually, this process features the sharing of data across organizational boundaries with an underlying business model. While many activities have started to emerge on a broader scale to address this challenge [3], many organizations engage with a premature understanding of the underlying necessities to build on for sustainable data monetization. There is a growing need for tools that give orientation: how to handle the differences between monetization of data when compared to physical goods? How to find a suitable data business model? How will the company culture be affected? What are the prerequisites for technology and processes? How can I prescribe a sufficient target level and what are the steps to reach it?

This paper proposes a novel maturity model for data monetization that helps structure an organization's approach to data monetization, specifically on an early state. Such a model allows organizations to assess their status, while at the same time becoming aware of deficits to address for a more mature status. The need for action to reach a desired target state becomes transparent and facilitates setting up actions to remedy the deficit.

Maturity models in general are a proven starting point for management and leadership tasks. They are established in consulting and management practice and have been

subject to scientific research for further development. This article presents the first maturity model for data monetization.

The paper is organized as follows: the conceptual foundations for data monetization and maturity models are laid out in section 2. Our development methodology, described in section 3 contributes both to science and practice. The resulting Data Monetization Maturity Model (DMMM) in its first release is fully described in section 4. The paper closes with a discussion and an outline of the next steps in section 5.

2 Conceptual Foundations

2.1 Data Monetization

Monetization of data is of growing importance, since data is one of the most valuable resources in the world and it is a critical issue that many industries face today [5, 6].

The data monetization global market is projected to exhibit substantial growth. Based on a study by Kanhaiya et al. [7] the market is estimated to grow from $2.1 billion in 2020 to $15.5 billion in 2030. This expansion is underpinned by several driving factors as by the increasing magnitude of generated data, awareness of data monetization, emerging technology opportunities and trends [6,8].

Further driving factors are the technologies beyond these trends such as Business Intelligence and Analytics, cloud computing, blockchain, Internet of Things (IoT), social networks and post-COVID-19 pandemic business approaches and strategies [9,10].

Unlocking hidden value within an organization's data is a strategic move with immense potential. As noted by Smith et al. [11], monetizing data taps into a valuable but often underutilized asset. It can generate revenue, serving as an additional income stream for an organization, especially if the core business model has limitations or there is a need for diversification.

For organizations aspiring to craft a successful data monetization strategy, an indispensable prerequisite is a profound comprehension of their unique use case [9]. This necessitates an exhaustive examination of their value proposition, characterized by an intensive deliberation of their distinct operational context.

2.2 Maturity Models

Maturity models are a well-established management tool for executives. With their help awareness for the design of relevant areas of action can be created and a progressing development path be structured. Improvements of capabilities, processes and structures can be systematically addressed [12]. The first globally known maturity model was the Capability Maturity Model for Software Engineering, later released as CMMI [14].

Many maturity models have been developed for the digital transformation with several variants, for example the model for the evaluation of digital maturity of enterprises DT Maturity Model – DTMM [1], but also approaches with special focus, such as the one for Digital Services Capabilities of [16], the maturity model for AI initiatives [15] or maturity models for organizational ambidexterity [18, 1].

A maturity model consists of maturity *criteria* (elsewhere also called *practices*) whose degree of fulfillment is the baseline for the calculation of aggregated maturity indicators. To build a maturity model, adequate criteria must be found and formulated in a way that allows for consistent grading. For continuous maturity models the answers are self-assessments on a Likert scale, e.g. on a scale of five or seven ranging from "not at all" to "fully" applicable. Typically, the criteria are grouped to *dimensions* (also called *capability areas*) that represent a thematic cluster, such as "strategy", "culture", or "technology". Typically, a maturity model has four to nine of such dimensions [1]. Needed are also well-tuned descriptions of five to seven maturity *levels* (also called *stages*). A maturity model requires also a calibration technique that determines which capabilities should be fulfilled for the respective maturity level and a description of how the grading is calculated.

In the context of data monetization, we want to highlight two main types of maturity models: continuous ones and staged ones, e.g. [18]. In *continuous maturity models*, all criteria are assigned to all maturity levels, including different characteristics per level to outline the maturation path along all stages. The degree of fulfillment has to be calculated, for example by deriving an average value from the answers to all criteria. In *staged maturity models*, specific criteria are assigned to exactly one maturity level in a more and more challenging order. The maturity level is determined by the capability to fulfill criteria belonging to a certain level.

Maturity models can serve different purposes. In a *descriptive purpose*, the models serve the assessment of an organization's current maturity. In a *prescriptive purpose*, the models serve as guidance how to reach a desired future target maturity. In a *comparative purpose*, maturity models serve benchmarking, e.g. between two or more external organizations.

The development of maturity models can follow bottom-up or top-down characteristics [17, 18]. In *top-down approaches*, maturity levels are determined first and then the according criteria fulfillment is derived. This approach is typically derived when little is known about the constituents of maturity and little evidence is available. In *bottom-up approaches*, first the criteria are defined and then the maturity levels are assigned. This approach is typically chosen when there is evidence on what represents maturity (e.g. from literature and experience), but little is known about how to measure maturity. Once the criteria are found, they are clustered and grouped inductively to determine maturity levels.

3 Research and Development Methodologies

The comparison with scientific the state-of-the art and contribution to science is ensured by a Design Science Research approach, ensuring both scientific rigor and practical relevance [19]. The development of the maturity model follows guidelines by [4]. Both processes are intertwined, i.e. the DSR iterations and the development are synchronous in their sequence and iterations.

3.1 A Design Science Research Approach

In order to develop the maturity model in a scientifically recognized manner the team used the Design Science Research (DSR) paradigm and applied the research process presented in [19]. In DSR a maturity model is an artefact that is developed with scientific rigor to solve a practical problem. [19] structures the DSR process in three main phases: problem identification, solution design, and evaluation. The phase of problem identification has been covered already by the introductory sections of this paper: we search for a maturity model that is specifically targeting the problem of data monetization. The existing literature supports that data monetization is a practical problem, and that no maturity model exists, yet, to cover data monetization. The solution design will be covered by sections 3.2 and 3.3. and the result in section 4, which includes also the first two evaluations (one with six data monetization pilots of the DATAMITE project and one with executives of a large telecommunications company). The design process is run through in an iterative approach, so that after every evaluation, the design is adjusted.

3.2 Development Strategy

To develop the data monetization maturity model (DMMM) a core team was put together around the principal investigator. This core team consisted of members in charge of a related task of the DATAMITE project. This core team was situationally complemented by a large group of experts recruited from within and outside the DATAMITE project for design iterations.

The development strategy was defined by the principal investigator as follows. It was decided to build a continuous maturity model in a bottom-up approach. The reason was that there exists a considerable part of evidence and literature available about what criteria are needed to be considered to assess maturity, but no knowledge about suitable maturity levels. In contrast, for a staged model it would be necessary to formulate binary questions per maturity level. At the same time, available literature and experience are deemed sufficient for a bottom-up approach whereas a top-down approach would require more clarity about targeted maturity levels while neglecting the available resources of knowledge about potential criteria.

It was also decided that a seed model of the criteria catalog and the dimensions be created first from available resources and subsequent refinements be carried out through iterations. While the criteria of the seed model were to be distilled from literature, the dimension were to be derived from the St. Gallen House of Digital Business [13] because it is well published, described, and referred to in literature. **Fig. 1** exhibits the development process, which is tailored from [4].

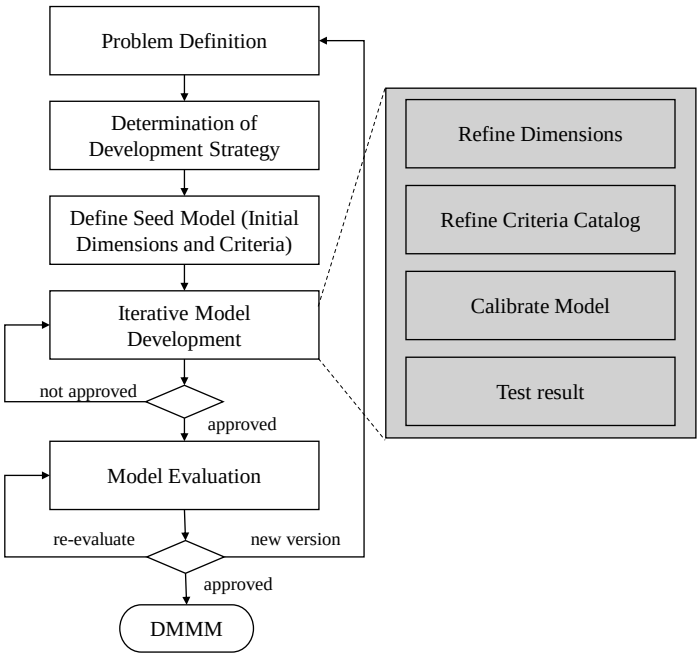

Fig. 1. Development process of the Data Monetization Maturity Model

During the iterative model development, the dimensions and criteria catalog are adjusted and calibrated according to the results from tests. The test group is gradually widened within the consortium of the DATAMITE project. The final model evaluation is to be done outside of the project members.

3.3 Creating the DMMM Seed Model

To start with, the core team has designed the first draft model based on existing related maturity models and the results of an extensive literature search. This seed model is then refined in several iteration rounds with a varying group of experts. Focus is first on the criteria catalog.

Adjustment of Related Maturity Models.

The team took two existing maturity models from the initial literature review that are close to data monetization: the Digital Transformation Maturity Model (DTMM) [1] and the maturity model on organizational ambidexterity [2]. Both models rely on the St. Gallen House of Digital Business [13] which is well documented and offers the necessary transparency for transfer to the domain of data monetization. This structure was also adopted for the DMMM. The core team went through the criteria catalogs of

these models and decided which criteria can be taken over to the DMMM without change, which criteria are eligible to be transferred with some adjustments to the domain of data monetization, and which criteria need to be left out because they are not transferrable.

Literature Search.

The resulting initial set of criteria were complemented by the results of an extensive literature search in EBSCO, Scopus, and Web of Science. The search string is depicted in **Fig. 2**.

Search String
(("Monetization" OR "Monetizing" OR "Revenue" OR "Commercialization" OR "Value Extraction")
AND
(Data OR "Big Data" OR "IoT Data" OR "Machine Learning Data" OR "Data Analytics" OR "Data Privacy" OR "Database" OR "Data Model" OR "Digital Product" OR "Data Sharing")
AND
("Maturity model" OR "Framework" OR "Assessment model" OR "Progression Stages")
AND
("Strategy" OR "Enterprise Capabilities" OR "Company Strategies" OR "Business Strategies" OR "Organizational Strategies" OR "Business Tactics" OR "Business Competencies"))

Fig. 2. Search string for the literature search

This search yielded 1583 articles. Applying further filtering for eligibility based on title and further meta information, the core team reduced the number in several steps to 326 relevant papers of which the abstracts were thoroughly analyzed. This resulted in further filtering with the result of 21 matching full papers to be thoroughly reviewed for criteria to be taken over.

Sounding by Core Team.

The core team went through the results and matched the criteria candidates with their own experience, reformulating some criteria, merging closely related criteria, sorting out semantic double listings, erased candidates deemed not eligible or useful. As the result of these steps a list of 86 criteria was released as an initial seed for further iterations with further experts in concerted workshops. The criteria were also structured into clusters according to the St. Gallen House of Digital business, selecting *Customer Experience*, *Strategy*, *Culture & Expertise*, *Process Digitalization*, *IT*, *Organization*, and *Product Innovation* as relevant. *Transformation Management* and *Collaboration* were omitted because the focus of data monetization is less on operative management and collaboration to be included under processes. Generally, it was agreed that only the data relevant aspects of the remaining structure must be taken into account and thus a renaming of the dimensions be considered.

3.4 Design Iterations

To develop the full version of the model, we have carried out two workshops with experts from within the DATAMITE project workforce.

The first workshop was among members of the business, legal, and ethics work packages with 25 participants and carried out online. The participants were given access to the seed criteria catalog and were given the following questions to reflect about: Does an individual criterion make sense? Does the formulation need to be adjusted? Is there a repetition, can two criteria be merged? What new criteria should be added? Is the clustering sound? During the workshop the discussion was moderated by the core team and the catalog updated.

After the first workshop, the core team consolidated the feedback into a new catalog with 99 criteria.

The second workshop took place in breakout sessions of a DATAMITE plenary workshop with over 50 participants from 25 organizations, with a subset of volunteers being actively engaged in the refinement of the model. The experts were now also from technical and legal backgrounds but were not briefed beforehand about the actual catalog. Thus, the discussion yielded 56 new criteria, many of them out-of-the-box, i.e. with an aspect not covered by the existing catalog. Some of them very relevant, some out of scope for data monetization.

After the two workshops the core team consolidated the new long list of 155, focusing on elimination of redundancies and also out-of-scope criteria that emerged in the plenary workshop. At the same time very relevant in-scope criteria could be taken over into the new list. This resulted in a stable, well-checked list of 48 criteria as the first stable version. At the same time the structuring through dimensions was reviewed and expressions adjusted according to the necessary monetization context, e.g. *Customer Experience* into *Customer* focusing more on customer needs, *Strategy* into *Data Strategy*, focusing on the data aspects exclusively, *Process Digitalization* into *Processes* targeting the whole process design for data monetization, *Product Innovation* into *Data Products, Culture & Expertise* into *Culture & Skills* with skills giving a focus on HR.

3.5 Test with DATAMITE pilot activities

As a next step we evaluated the model with representatives of two energy distribution network operators (DNO), two high performance computing centers (HPC), one incumbent telecommunications network operator, and a provider of services for smart cities.

The evaluation was made in one-hour interview sessions each, where the above-mentioned preliminary criteria catalog of 48 criteria was gone through one by one with the principal investigator conducting the interviews, giving explanations to facilitate the answering process. The interviewees were members of the DATAMITE project and specialists from innovation, data engineering, and technology departments. They were asked to imagine integrating data monetization into their home organizations. The answers were to be given on a Likert scale of 5 where 1 means “does not apply at all” and 5 means “fully applies”. It was requested to give the answers without too much pondering and only semantic questions were answered during the process, as well as hints

about the calibration. For example, it was given that per dimension a level of 3.5 was the threshold to start engaging in data monetization meaningfully without fixing other readiness conditions first.

Table 1 depicts the results where the individual score of the seven dimensions was determined as the arithmetic average of the answers within each dimension. The overall score itself is the arithmetic average of the score of the seven dimensions, i.e. all dimensions are equally weighted.

Table 1. Results for the first design evaluation

ID	*Overall*	Culture& Skills	Customer	Data (Business) Product	Data Strategy	IT	Org	Processes
Pilot A	*3.33*	3.62	3.00	2.83	3.25	4.40	3.00	3.22
Pilot B	*2.88*	3.25	3.25	1.50	2.50	4.20	3.38	2.11
Pilot C	*2.47*	2.62	2.25	1.83	2.50	3.40	2.00	2.67
Pilot D	*3.33*	3.46	3.75	2.00	3.00	4.40	3.25	3.44
Pilot E	*3.74*	3.69	3.75	3.83	3.50	4.80	3.13	3.44
Pilot F	*3.00*	3.31	3.00	2.00	2.75	4.20	2.63	3.11

All interviewees were asked at the end of their session if they considered the results as giving a realistic picture of the maturity of their organization and if they would suggest further questions. The qualitative answers were convincingly positive about the accuracy of the overall picture and the completeness of the catalog. However, need for calibration of the answers for comparison became evident.

In order to receive feedback for improvements of the model from these tests, we made plausibility checks together with the interviewees. For simplicity we want to highlight two of them in more detail. In **Table 1**, Pilots C and D represent Distribution Network Operators from the energy sector of two different European countries. Their business is comparable to each other; however, the overall maturity differs considerably, between 2.47 and 3.33 which is roughly equivalent to one entire maturity level (e.g. rounding results to one integer value). However, both respondents confirmed in a more detailed analysis that the results are sound, confirming that one Pilot D is organizationally more mature for data monetization than Pilot C.

The second examples concern Pilots E and F which are connected with both High Performance Computing (HPC) centers. HPC centers usually represent non-commercial undertakings in supercomputing with a strong dedication to providing services for the common (academic) good. As a matter of fact, they typically are very advanced in technical capabilities and also of the user groups they are serving, however rather as technical products and not as commercial products with business plans and competitive pricing. While Pilot E is a quasi-monopolist in a country and there is reason to confirm the high grading in most dimensions, there is obviously a semantic gap in the

interpretation of the dimension *Data Product* with scores of 2.00 vs. 3.83. In the concept of data mesh there exists the expression of a data product as a bundle of technical features for data sharing with users (customers), there is typically no monetizable product understanding involved [20, 21]. However, within the context of data monetization and the origins of the St. Gallen House of Digital Business, there is a clear commercial context attached to it. This led to semantically different co-notations. As feedback, the label for this dimension was changed to *Data Business Product* which augments the technical understanding of a data product by commercial product features. As a result, new criteria were introduced (e.g. DBP.3, DBP.4, DBP.5, DBP.6, DBP.10, identifiers correspond to the criteria catalog in **Table 2**) and some existing formulations adjusted.

Furthermore, during all tests the feedback arose to introduce criteria from legal and regulatory affairs, given the high importance of European directives such as GDPR, Data Act, Data Governance Act, AI Act, etc. as potential obstacles if not addressed properly with rulebooks (P.12) and conscious reporting (P.9).

Along with further adjustments from the tests (reformulations, merger of criteria, new criteria), this led to the release of the criteria list with 61 entries exhibited in **Table 2**.

4 The Data Monetization Maturity Model (DMMM), Release 1

4.1 The Dimensions

As explained in section 3, the dimensions have been derived from the St. Gallen House of Digital Business, we can refer to [13] for a detailed description of the originating dimensions. At the same time, we have tailored them in the direction of data monetization as described in section 3.3, leaving out some irrelevant dimensions and focusing on the remaining ones.

Culture & Skills describes the organizational culture towards data sharing and data monetization, as well as the mindedness towards data from an HR perspective.

Customer addresses the completeness of the view of the actual customer, i.e. the data consumer, of offered data products. Also, the integration of the customer in feedback loops for detailed insights are mirrored in this dimension.

Data Business Product reflects the degree of packaging a data service into an easy understandable and highly usable product. The first step is to realize this product technically, as reflected for example in the data product understanding of a Data Mesh. However, here we extend the analogy to physical products to a business plan of billable data products, thus data business products.

Data Strategy denotes the focus of a business strategy to the relevant aspects of data.

Information Technology (IT) describes the technical capabilities to deliver data business products, including IT agility.

Organization addresses the organizational readiness for new topics such as data monetization as well as the organizational agility that is required. This dimension also includes the topics of key performance indicators (KPIs) and data governance.

Processes describes the readiness of business (support) processes. Also, legal and regulatory aspects are included in this dimension.

The criteria catalog is clustered according to the dimensions. The seven dimensions can be also exhibited as the axes in a spider chart as exhibited in **Fig. 3**. The score per dimension is calculated from the average of the answers on the Likert scale per criterion belonging to this dimension. A spider chart is a good way to intuitively picture the gap between an as-assessment and the to-be target. Actions to bridge this gap can be derived by analyzing the contributing criteria per dimension and the remediation per criterion. A portfolio of actions to increase organizational maturity to reach the target state can be derived easily from this gap analysis based on the DMMM.

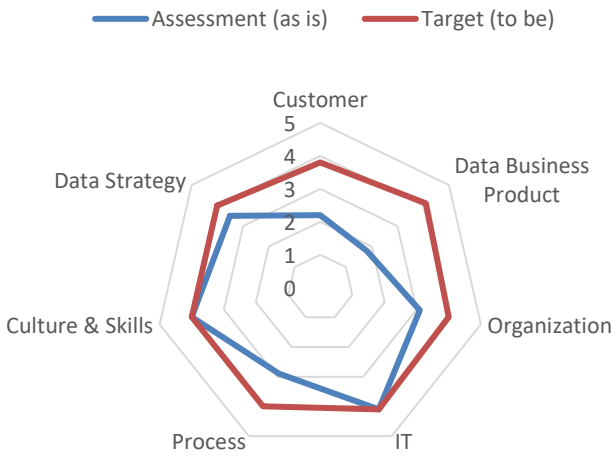

Fig. 3. Schematic example of an assessment depicted in a spider diagram with the seven dimensions and a target of 4.0 across all dimensions.

The DMMM assumes that all dimensions have an equal influence on the organizational maturity, even if the dimensions do not contribute with the same numbers of criteria in the catalog.

4.2 The Criteria Catalog

The criteria resulting from the development process described in the previous sections are aggregated in **Table 2**.

Table 2. The DMMM Criteria Catalog, Release 1

Identifier	Criterion
	Dimension Culture & Skills
CS.1	Staff feel empowered to experiment with data monetization beyond the formal definition of their role; Positive experiences/outcomes of data monetization experimentation are shared across the organization to create a positive feedback loop that stresses the importance of data monetization.
CS.2	Our organizational culture prioritizes data quality and management, recognizing their strategic importance for successful monetization.
CS.3	As a company, we value data as a primary product, focusing on creating value for customers and innovating beyond physical products.
CS.4	Our company culture is proactively geared towards recognizing and capitalizing on data monetization opportunities (e.g. through innovation and learning).
CS.5	Our employees are highly skilled or will be trained in topics like data management and analysis, data products, aligning with best practices for successful data monetization. Roles like Data Product Manager are being operationalized.
CS.6	Organizational agility: Our organization effectively adapts its operational structures and processes to support dynamic data monetization strategies.
CS.7	Building data monetization expertise is a central component of our employee development plan, our employees understand our own data monetization products and utilize them; data monetization expertise is an important recruiting criterion.
CS.8	"Anomalies" of data value when compared to material goods are understood by key people.
CS.9	Our data monetization products are constantly improved by learning from known errors.
CS.10	Our organization allows for (controlled) explorative experiments, including pivoting, that provide insight.
CS.11	Role descriptions (HR) for data monetization exist and are documented
CS.12	We use our IT-expertise in the area of data analytics and engineering to design new data monetization products and business models
CS.13	IT-Competence around Data Analytics, Data Engineering, and Artificial Intelligence is available in-house.
	A partner network is established to provide AI, Data Analytics, and Data Engineering if internal resources are insufficient.
	Dimension Customer
C.1	Data monetization -opportunities for the future are continuously observed and identified, incl. systematic monitoring of market.
C.2	Our data value network collaboration is centered on leveraging data for monetization, with a clear focus on customer benefits.
C.3	We derive insights from customer and interaction data that influence our marketing and communication activities.
C.4	We include customers actively when developing data monetization products

	Dimension Data Business Product
DBP.1	We have set up data products to fuel data sharing with external partners or customers.
DBP.2	We have business case(s) for data products ready.
DBP.3	We have clarified and quantified the advantages of data sharing within our organization.
DBP.4	The success of data sharing has been demonstrated within our organization.
DBP.5	Data valuation / pricing models have been developed / archetypes are known (cost based, flat rate, demand based, etc.).
DBP.6	We have set up concrete business models for data products.
DBP.7	Pricing, Rating & Billing of Data Products is a regular activity for our organization.
DBP.8	Sales Channels (such as a data e-shop) are identified and introduced.
DBP.9	New data monetization ideas were executed in the past.
DBP.10	Our Competition observes us as a driver in data monetization innovation.
	Dimension Data Strategy
DS.1	Resources to define and monitor data monetization strategy are available. The data monetization strategy is periodically reviewed.
DS.2	Data monetization plays a central role in our data strategy.
DS.3	Data monetization follows a strategic plan in our organization.
DS.4	Our integrated systems ensure data is secure and of high quality, making it a reliable asset for monetization.
DS.5	Our company has successfully integrated a clear data strategy that aligns with our overarching corporate goals and is effectively communicated and implemented across all business units.
DS.6	Data monetization strategies have been developed / strategic archetypes are known.
DS.7	Our monetization and pricing strategies are built on the value delivered to customers, not necessarily tied to physical products.
DS.8	Our strategy and vision are committed to developing and offering comprehensive data-driven solutions.
DS.9	We have developed a comprehensive roadmap and project portfolio dedicated to data monetization.
	Dimension Information Technology (IT)
IT.1	In order to assess limitations (e.g. what data are missing) data information structures and data architecture are periodically reviewed.
IT.2	Our data-related infrastructure is scalable and integrates seamlessly with various platforms, supporting real-time data streaming and interoperability.
IT.3	Our data infrastructure is agile: we are able to adjust our data monetization offers on short notice if the business requires it.
IT.4	Our IT is able to deliver all of the relevant technologies necessary for data monetization.

IT.5	Data protection and IT security solutions are always up-to-data.
	Dimension Organization
O.1	We have formed a dedicated unit to drive these initiatives.
O.2	Our organization is agile in developing and implementing innovative data-driven business models that capitalize on new market opportunities.
O.3	Data monetization projects are planned and executed across departments (and silos).
O.4	A data governance that defines rights and responsibilities of data producers, Data Consumers, and Data Intermediaries (Data Platforms) has been developed.
O.5	KPIs and metrics for data monetization have been introduced and are monitored.
O.6	The goals of data monetization are defined in a measurable way and are monitored (e.g. KPIs with balanced score card).
O.7	Our data value monitoring is sophisticated, feeding into the organization's strategic decisions and contributing to the optimization of our data exploitation processes across the value chain.
O.8	We engage with external experts to develop additional knowledge.
	Dimension Processes
P.1	KPIs and metrics for internal processes have been introduced and are monitored.
P.2	Our processes leverage data-driven insights for optimization, enhancing our capabilities to offer digital services.
P.3	We engage in horizontal integration with our data networks to expand our data monetization capabilities.
P.4	Data analytics drive our decision-making processes, directly contributing to our data monetization efforts.
P.5	Our value chain is fully digitized, enabling end-to-end data monetization from product inception to after-sales services.
P.6	Enterprise-wide continuous process improvement based on data monetization is defined; All decisions require data-monetization-driven evidence to be supported at all levels of the organization.
P.7	Our data is continually checked for monetization opportunities.
P.8	We have installed quality metrics for our data channels/pipelines.
P.9	We have understood and are fully aware of the requirements of regulation (GDPR, AI Act, Data Governance Act, Data Act).
P.10	We have put measures into place to fulfill regulatory requirements for data sharing. There are no concerns about unintentionally violating regulation.
P.11	We have put measures into place to keep trade secrets.
P.12	We inform proactively how data are used (business, ethics, legal, tech, security), rulebook.

4.3 The Maturity Levels and their Calibration

The calibration of data maturity levels requires a holistic approach that integrates not only data monetization but also organizational strategies, a well-structured data governance and compliance with numerous regulatory authorities, especially within the boundaries of the European Union. The calibration of the maturity models should ensure seamless propagation while mitigating risks. Different sectors are facing different risks, either related to personal data privacy regulations and restrictions, or on business sensitivity data. The larger the organization, the more complex its environment becomes, increasing the need for precise calibration. Scalable and secure data infrastructures that facilitate ethical monetization approaches force organizations to adopt towards minimizing potential exposure to risks.

Moreover, calibration should also be applied, due to criticality on fostering data-driven decision making, especially, since a well-established data culture should be supported and trained by the organization's management. Multi-tier access controls, anonymization mechanisms, and compliance-driven data policies are also important on managing data sensitivity, while performance tracking requires continuous auditing, AI-driven analytics, and a dynamic data governance plan that will ensure adaptability in monetization strategies.

The cross-functional collaboration among various departments within an organization is crucial. Different departments and their experts have different understandings in various data-related concepts. IT, legal, compliance, or business units should be aligned and have a common understanding on aligning monetization efforts with organizational business objectives while maintaining ethical, legal, or any system integrity. Toward this goal, data sharing Proof-of-Concept (PoC) projects could possibly allow organizations to experiment with monetization strategies on a small scale, to establish and evaluate and approach / process before any full-scale implementation.

Table 3 exhibits the five levels of the DMMM together with the description of each level, reflecting the result of the calibration. It should be noted that theoretically a successful and profitable data monetization could be executed even on maturity level 1, but then it is rather an activity of singularity, often linked to the engagement of one motivated and knowledgeable person. But for the organization itself is not structurally repeatable (e.g. if this person leaves). On the other hand, an organization could reach as high as maturity level 4 while having all organizational prerequisites in place, but for some reasons without not yet reaching the market. Maturity level 5 builds on learnings and optimizations from existing data business products on the market for further improvements.

Table 3. The levels of the data monetization maturity model

Maturity Level	Description
1 - Ad-hoc	The organizational culture does not encourage data sharing and monetization and there is no assessment of necessary skill profiles. The organization has no systematic picture of their consumers of data sharing / data products. The organization might or might not have technical data products in place, but with no commercial

	aspects. A data strategy might or might not be in place but not targeting monetization. There is no IT architecture addressing data sharing or monetization. The organizational chart does not reflect synergies and necessary agility for data sharing or monetization. The support processes do not enable delivery of data products, not to speak of billing of data business products.
2 - Reactive	The organizational culture addresses data sharing and data monetization only situationally in response to market development. The organization has some understanding of their data customers, but no systematic view. The company has a regular approach to technical data products, but no commercial product thinking in relation to data sharing. There is a generic data strategy around, possibly touching topics like data quality and storage, but not cross-organizational data sharing and commercialization. The IT is well able to address data engineering and data analytics, but not cross-organizational data sharing. The organization has introduced some agility features and cross-sectoral synergies as well as KPIs. The core support processes are managed well, leaving little room for exploration in the direction of data monetization.
3 - Defined	The organizational culture and HR positioning target data engineering, data analytics, and data sharing, but typically not explicitly data monetization. Customer insights are systematically assessed, including data usage. Technical data products and cross-organizational data sharing are mastered, but data business products might have been tried as pilots but have not yet been systematically placed to the market. A full data strategy has been developed that includes cross-organizational data sharing and mentions data monetization. Data engineering for data sharing and relevant processes are already systematically in place, typically with technical data products. However, no regular activity to realize monetization with data yet implemented with rating and billing of data business products not yet realized. The organization is agile and has a data governance in place. The processes are fully controlled and regulatory aspects of data consciously addressed, but not under the aspect of monetization.
4 – Controlled	The organizational culture and HR positioning have fully embraced data monetization (not just data engineering and cross-organizational data sharing). Customer insights for data business products is a regular activity. Launch of data business products is a regular activity and highly automized. Data monetization takes in integral part in the organizational data strategy. The IT is highly agile both in developing innovative data business products and in supporting them in the backend. The organization is agile with an adequate data governance in place. The support processes are mostly automized and

	state-of-the-art for data business products while all regulatory aspects are effectively addressed. The organization is experienced and safe to engage in data monetization.
5 - Optimized	The organizational culture is routinely improving by learnings from explorative experiments in data monetization to sustain thought leadership. Top new products are developed with the participation of lead customers, new data business products emerge from superior customer insights. The data strategy is focused on data monetization. The IT is highly agile and allows for a maximum degree of automation for new product development and business support. The organization is centered around data business products and data governance. Data-driven decision-making is maximally automated and is being continuously improved.

Important for the application of the calibration is the fact that the DMMM is a continuous model. This means that if a question does not fully apply then the answer is not digital (fulfill vs. not fulfilled), but a reduced score that comes closest to the descriptions of **Table 3**. An example is criterion CS.4 from **Table 2** "Our company culture is proactively geared towards recognizing and capitalizing on data monetization opportunities (e.g. through innovation and learning).". An organization that does not engage in capitalizing data monetization word by word, but for example in cross-organizational data sharing could achieve also a score of 4 or 3 on the Likert scale. It is only for staged maturity models that binary answers must be applied.

An evaluation interview series with managers from an incumbent telecommunications company, that were not personally involved in the DATAMITE project led to comparable results, confirming the calibration as approvable, applying the above rule. Consequently, the DMMM was released in the first version.

5 Discussion and Next Steps

This paper introduced the DMMM Data Monetization Maturity Model to support organizations in their monetization process, particularly in the early stages, to evaluate their status and identify areas for improvement. By structuring their data monetization approach, the model is emphasizing transparency, making necessary actions clear. The proposed DMMM enables organizations to proceed toward a more mature and effective monetization strategy.

The DMMM serves well for both descriptive and prescriptive purposes. It has already shown high value at making the status transparent and catalyzing the subsequent communication. At this development stage, comparative purpose is recommended to be relative, not absolute. This means that the overall score should be used only for comparison with other organization relatively to each other, not as an absolute "verdict" for benchmarking. Once a bigger empirical basis of assessments exists, further

calibration can be done, so that comparison can become possible based on absolute overall values.

Typically, a maturity model like the DMMM should be applied with several interview partners from one organization. Ideally, it would offer a 360-degree view of the organization stemming from interviews on employee and expert level, to mid-management to senior executives.

As a plan for future work, the focus will be on incorporating quantitative assessment methods and addressing sector-specific challenges. As data continues to be an asset for organizations, structured maturity models like the one proposed can navigate organizations in optimizing their monetization strategies and achieving sustainable data-drive value creation.

On the research side, it is planned to document the development of the DMMM in design strategies according to [22]. Also, the process of the assessment should be formalized in a comprehensive method artefact according to [23].

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