

Transforming Healthcare using Data Mesh

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Abstract: In the healthcare industry, various sources for data include hospital records, medical records of patients, results of medical examinations, and devices that are a part of internet of things. Biomedical research also generates a significant portion of big data relevant to public healthcare. To provide relevant solutions for improving public health, healthcare providers are required to be fully equipped with appropriate infrastructure to systematically generate and analyse data. An efficient management, analysis, and interpretation of data can change the game by opening new avenues for modern healthcare. Data modernization has become an urgent competitive necessity for businesses to stay ahead of the curve-anticipate market changes earlier, understand customer needs more closely, and take and implement winning decisions faster than the competition. Data mesh is the new data platform or paradigm for Data modernization that is based on four principles-1. Domain ownership 2. Data as product 3. Self-server data platform 4. Federated computational governance. In this paper, The data mesh concept solves the challenges of centralisation and brings the agility and faster time to market by democratising the data management at the business domains level. In this paper, we will explore how healthcare domain can adopt data mesh architecture paradigm to democratize data management and accelerate healthcare solutions.

Keywords: Data Mesh, Healthcare, Domain, Product, Governance

1. Introduction

As data sources are continuously evolving and complexity growing in healthcare industry it needs to be tackled with a new approach which is primarily driven by people who owns a domain and productize it using robust architecture. We will discuss the same in subsequent sections

2. How to Implement Data mesh in healthcare

a) Data Mesh adoption Roadmap

The architecture of data mesh is not just a technical architecture but is also an organizational structure, there are several points and steps that organisations need to consider

when they will start adopting Data Mesh and establishing its pillars. It begins on the organisational and leadership level, with the requirement of having a domain-driven development and establishing a bounded context in which the organisation will know what teams will work together, what is the good constellation of teams or what constitutes the domain. Afterwards, the organisation should ensure that the teams are empowered and feel accountable and ownership of the solutions. Also, organisations need to treat data as an essential part of what they do and be aware that there is a difference between building a feature and building a data product. The process continues with putting these abstractions and automation in place, and governance, standards and regulations play an important role.

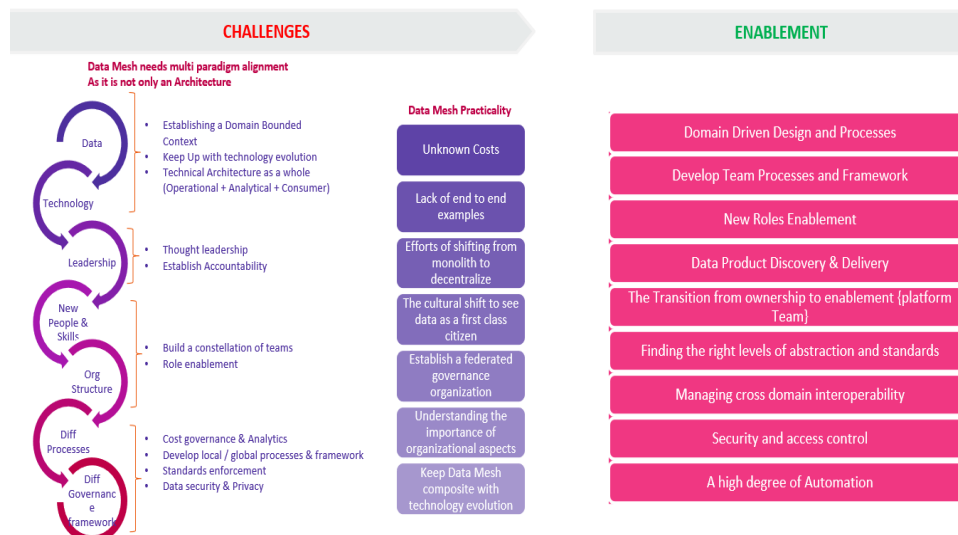


Figure 1: Data Mesh-Operational Challenges & Enablement

Healthcare organization understand the data, technology and people challenges hence this needs to be deliberated through a design thinking session and a view need to be drawn

regarding the tasks / activities needs to be done against timeline for Data Mesh adoption. A Reference is provided below that can be customized for their use-

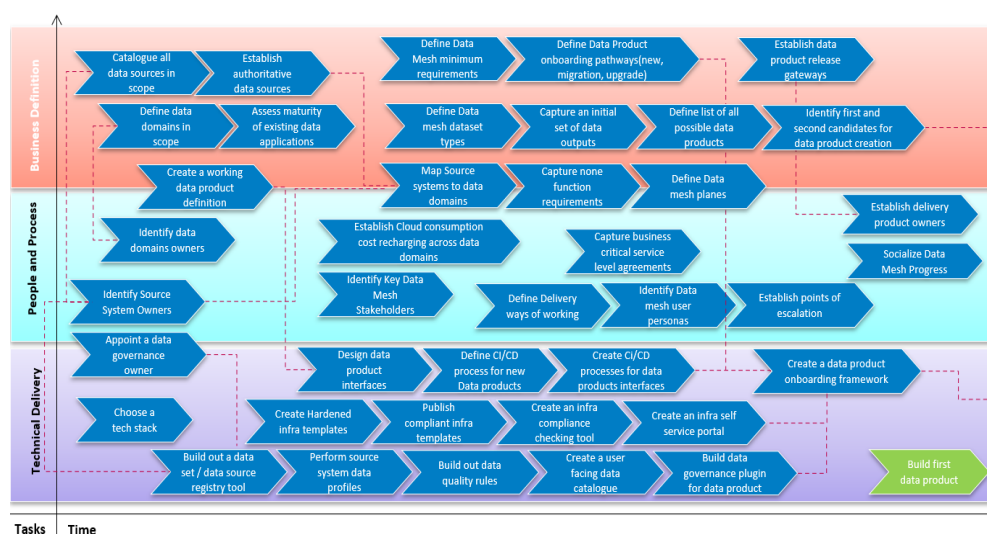


Figure 2: Data Mesh-Reference Roadmap

Data mesh roadmap spans in three dimensions 1. Business Definitions 2. People and Process 3. Technical Delivery. At a broad level 3 key activities are required to be performed to adopt data mesh architecture and culture in healthcare organization-

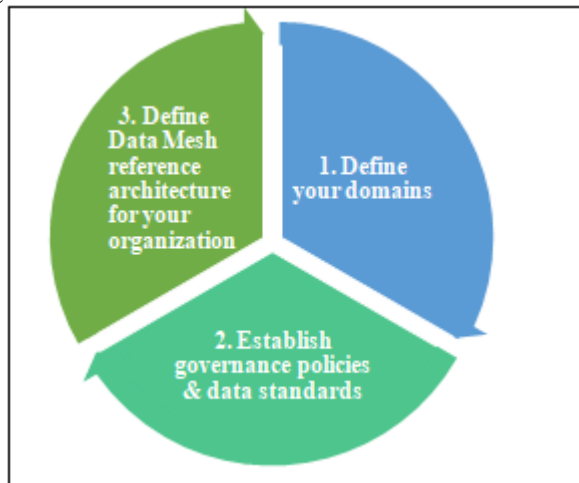


Figure 3: Data Mesh-Key focus area

1) Define your Domains

Determine the different functional teams of your healthcare organization and decide what are the data sets required by them for decision making for e. g., there could be payor, provider, labs may be your different teams or at a fine-grained level let's say If you are provider then there could be different teams under that. Identification of reasonable number of bounded context (data domains) is another important step that one should do. A design thinking workshop can be arranged to identify the granularity and reasonability for data domain. Decentralized ownership and architecture. Unlike the centralization in the data lake, we define domains and the perimeter they cover and then work on top of these domains to define products and ownerships.

Following image provide a view on how domain level decomposition can be done, and responsibilities / ownership can be assigned at enterprise level.

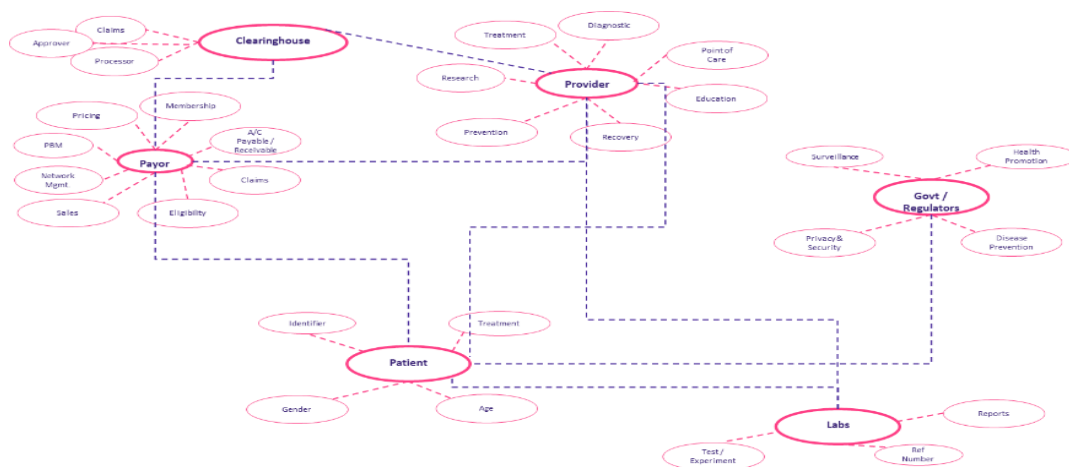


Figure 4: Healthcare domain modelling-different domains (a sample)

Once data domains are decomposed and assigned to a set of domain SME they can treat it as product which later can be offered through marketplace. Productization of data may demand specialized tools, AI/ML processes, automated and

manual governance processes to make data more valuable to customer. Hence following two dimensions becomes important-

a) Data Product

Data product: tables, databases, data warehouses, data pipeline, data governance, AI/ML algorithms applied to data can be defined as a data product based on the needs of the business, strongly emphasizing the concept of reusability. Data products can be of different types: raw data, derived data, algorithms, decision support (like dashboards), and automated decision-making.

b) Data Product Owner

Person or team who knows the product inside-out and is responsible for also adding new features and satisfying requests from other data product owners or business needs

2) Establish governance policies and data standards

As with the first principle, data ownership by domain, federated governance is largely an organizational concern.

The objective is to ensure that independent and autonomous teams, which own all of the data products within the mesh, can actually work together. You want to make sure that the various constituents of the mesh actually "mesh," so that you can generate real network effects and create value.

Predominantly, this has to do with creating global standards and applying those across the full mesh. So although you started with decentralization in the first and second principles, you now want to strike the right balance between decentralization and centralization in order to tie everything together. This isn't easy, and in practice, the execution will likely differ from organization to organization. A strong data governance practice is required to achieve this.

Following figure explains different tenets of governance-

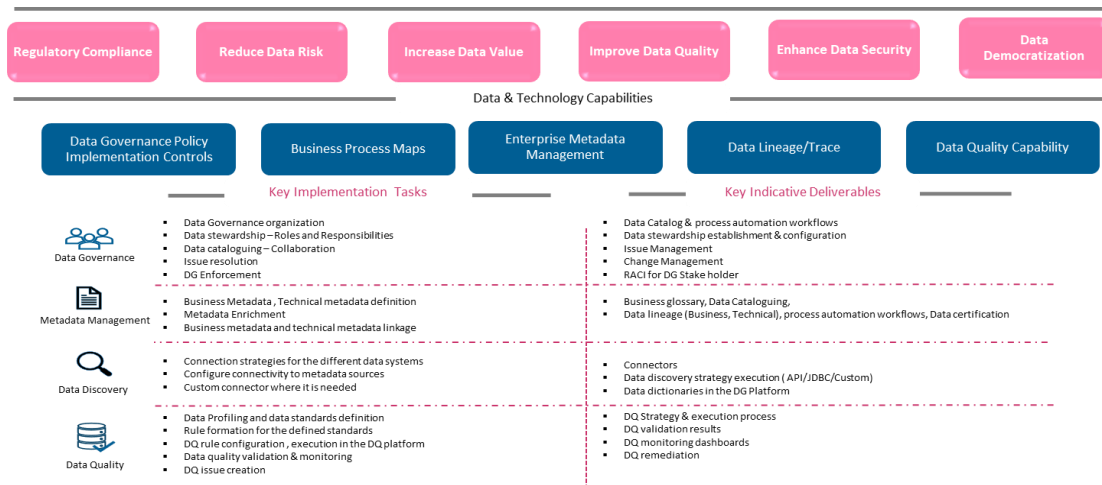


Figure 5: Data Mesh-Governance Approach (balance between centralization and decentralization)

Data governance control should be backed by a robust strategy-



Figure 6: Data Mesh-Governance Strategy (balance between centralization and decentralization)

3) Define Data mesh reference architecture for your organization

Final step is to define the reference architecture of data mesh along with capabilities that your organization is seeking in near-term, mid-term and long-term. A sample architecture is given as reference.

Data Landing zone would be an area where data would land in as-as form but there would be data analytics and CICD

tools to process the raw data, improve its quality, curated for upstream layers consumption.

Data management, tagging, Data quality, access control would be applied to this data and API would be provided for easy consumption. Every domain can own their data and offer it through marketplace.

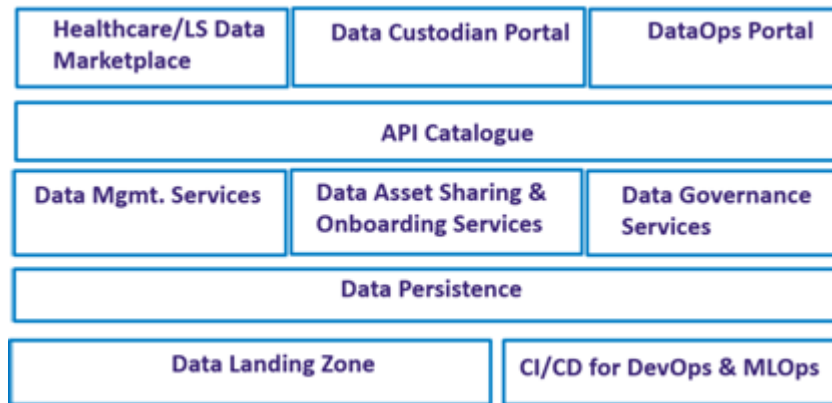


Figure 7: Data Mesh Reference Architecture

3. Conclusion & Summary

Data platform options have evolved from data warehouse, data lake to data mesh. This is new architectural paradigm which not only considers technology but also focuses on people ownership. People close to data knows the challenges and solution around owning and offering the data to other domains. Distributed responsibilities with robust centralized governance help data to become more valuable to businesses. Data Mesh allows healthcare organizations to create a connected data ecosystem by linking patient data across EHR with other mission-critical healthcare systems. With this connected ecosystem hospitals, health systems, and other care facilities can better support value-based care initiatives and effectively track and report outcomes. Further, Data Mesh Provides greater data accessibility, agility, and scalability that speeds time to market for healthcare solutions whether it's digital health applications, IoT-enabled medication adherence devices, real-time analytics platforms that support clinical decision-making, and other data-driven healthcare management tools. Data mesh provides a foundation to enable secure data sharing between providers, payers, and other authorized parties and enables clinicians to better support a range of healthcare activities, including telemedicine, precision medicine, and data-driven early interventions that improve population health management, as well as facilitate better patient care coordination across the healthcare continuum.

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Author Profile



Rajeev Jha, Solution Architect (Life Sciences and Healthcare Domain Strategic Capability Group of TCS), is an accomplished professional delivering over 22 years' architectural and functional career success in driving Futuristic IT Ecosystems, IT Solution Delivery, Innovation, Business Process Reengineering/Benchmarking using Digital Technologies. He has a strong expertise in Modern data platform and supported integration technologies with a good knowledge of Microservices, Big Data, Business Process Management.