FROM VISION TO VENTURE: ENTERPRISE ARCHITECTURE IN ODISHA'S EDUCATIONAL LANDSCAPE

by

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Dedication

To my paternal grandfather, whose legacy as an award-winning Social Entrepreneur, Politician, and advocate for Education, Agriculture, and Culture continues to inspire me. Your tireless efforts in transforming communities and championing social causes have set a high standard for us all.

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All these events, spanning from 2014 to 2021, were pivotal in sowing the seeds of this thesis. The interdisciplinary nature of social impact through quality education has been a central theme, making this research future-proof, sustainable, and robust. The integration

of these topics has enriched the interdisciplinary nature of my research, making it both comprehensive and impactful.

I hope that similar activities will continue to be documented and published as research chapters, contributing further to the field.

ABSTRACT

FROM VISION TO VENTURE: ENTERPRISE ARCHITECTURE
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The educational landscape in Odisha, an Eastern state in India, can be reshaped through a value-based education enterprise architecture framework, focusing on transforming vision into venture. By integrating value streams to align Technology, Education, Culture, and business strategies, the state aims to create a cohesive and adaptive educational environment. The purpose of this research is to reshape Odisha's educational landscape through a robust value-based education enterprise architecture framework. This approach addresses existing challenges such as disparities in literacy rates and high dropout rates by optimizing resource allocation and streamlining processes. The guiding ethical standards and values-based innovation frameworks ensure that the transformation is both sustainable and ethically grounded, fostering a culture of continuous improvement and adaptability.

The methods employed in this initiative involve integrating value streams to align technology, education, culture, and business strategies. Key initiatives such as the 5T

(Teamwork, Transparency, Technology, Time, Transformation) High School Transformation Program and Entrepreneurship Development Programs (EDPs) are instrumental in this transformation. The research anticipates several outcomes. These programs focus on modernizing educational infrastructure, incorporating advanced technological tools, and providing entrepreneurship education to train and motivate youth. By enhancing learning environments with cutting-edge tools and technologies, these initiatives create a conducive atmosphere for innovation and critical thinking. Continuous capacity-building programs for educators and administrators ensure that the educational workforce is well-equipped to support these changes.

The integration of enterprise architecture in Odisha's education system is poised to create a robust framework that supports lifelong learning and entrepreneurial success, particularly in K-12 education. By fostering partnerships between government, industries, and academic institutions, the state aims to build a collaborative ecosystem that nurtures budding entrepreneurs. The establishment of Livelihood Business Incubation Centres and other strategic initiatives further supports this vision, ensuring that students are well-prepared to navigate and thrive in a rapidly evolving global landscape

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I:

INTRODUCTION

1.1 Overview of the educational landscape in Odisha

Odisha's educational landscape is a blend of progress and persistent challenges shaped by various government initiatives and socioeconomic factors.

1.1.1 Historical Context and Challenges

Historically, Odisha has been at the forefront of education and research, with ancient universities like Puspagiri contributing to its rich educational heritage. However, the British colonial period marked a decline in the traditional education system, leading to disparities in access and quality. The post-independence era saw efforts to revitalize education, but challenges persisted, including inadequate infrastructure, teacher shortages, and low literacy rates (Das, 2016).

1.1.2 Government Initiatives and Reforms

In recent years, the Government of Odisha has introduced several reforms aimed at improving the educational landscape. The School and Mass Education Department, Odisha, has implemented reforms, including student feedback mechanisms and class 5th and 8th examinations, to enhance learning improvement in student outcomes and teachers' performance (Odisha Vikash Conclave, 2023). The commitment of the state towards inclusive education is found in initiatives like Odisha Adarsha Vidyalayas (OAV), 'Mo School' Abhiyan, and the 5T-High School Transformation Programme, which try to bridge the rural-urban gap and enhance the quality of education (Odisha Vikash Conclave, 2023).

The School and Mass Education Department, established in January 1993, oversees various educational sectors, including elementary, secondary, and special education. The department's efforts are supported by central government schemes and state resources. One of the notable initiatives is the 5T High School Transformation

Programme, which focuses on teamwork, technology, transparency, transformation, and time limit. This program has modernized many government schools, featuring smart classrooms, e-libraries, and enhanced sports facilities, which significantly improve the learning environment.

- Universalisation of Elementary Education: The government aims to ensure that all children aged 6-14 have access to education. This includes the opening of new primary and upper primary schools in unserved areas, particularly in rural and tribal regions (Odisha Vikash Conclave, 2023).
- Sarva Shiksha Abhiyan (SSA): This flagship program aims to universalise elementary education by providing infrastructure, teacher training, and learning materials to schools across the state (Odisha Vikash Conclave, 2023).
- Free Textbooks and Mid-Day Meals: To encourage enrolment and retention, the government provides free textbooks and mid-day meals to students in government and aided schools (Odisha Vikash Conclave, 2023).
- Rashtriya Madhyamik Shiksha Abhiyan (RMSA): Launched to universalize secondary education, RMSA aims to make quality education accessible and affordable to all children aged 14-18. The program focuses on improving infrastructure, providing teacher training, and enhancing the quality of education (Odisha Vikash Conclave, 2023).
- Council of Higher Secondary Education (CHSE): Established under the Odisha Higher Secondary Education Act, 1982, CHSE regulates and develops higher secondary education in the state. It conducts examinations, affiliates schools, and oversees the curriculum for grades 11-12 (Odisha Vikash Conclave, 2023).
- Chief Minister's Bicycle Scheme: This initiative provides bicycles to students, particularly girls, to reduce dropout rates and ensure they can travel to school safely (Odisha Vikash Conclave, 2023).

1.1.2.1 Elementary Education

Elementary education in Odisha consists of primary (grades 1-5) and upper primary schools under grades 6 to 8. The state has made efforts in the last decade, and the numbers show an increase of 35,928 primary schools and 20,427 upper primary schools throughout the state to cater to the elementary education of children across the state (Odisha Vikash Conclave, 2023). Much still needs to be done, especially in rural and tribal areas where quality education is still inaccessible.

1.1.2.2 Secondary and Higher Secondary Education

In Odisha, grades 9 through 10 are considered secondary education, and grades 11 through 12 are considered upper secondary education. The state follows the 10+2 system, where students complete ten years of schooling before choosing a stream (Arts, Science, or Commerce) for their higher secondary education (Odisha Vikash Conclave, 2023).

1.1.3 Infrastructure and Quality of Education

Despite these advancements, the state faces considerable infrastructure challenges. Reports indicate that many schools lack basic amenities such as potable water and proper buildings. For instance, approximately 30% of schools in Odisha do not have access to clean drinking water, and several schools operate in makeshift or incomplete structures. The Annual Status of Education Report (ASER) 2023 highlighted deficiencies in students' learning outcomes, particularly in mathematics and reading skills, which were exacerbated by the COVID-19 pandemic and inadequate teacher-student coordination.

1.1.4 School Consolidation and Enrolment Issues

In recent years, the Odisha government has undertaken a policy of rationalization and consolidation, merging schools with low enrollment to optimize resources. Between 2012-13 and 2022-23, around 7,478 schools were closed due to low student numbers, with students being relocated to nearby schools with better infrastructure. (Marndi, S. 2023) This measure, while aimed at improving educational quality, has sparked accessibility concerns, especially in remote areas.

1. 1.5 Technological Integration and Digital Divide

The COVID-19 epidemic highlighted the significance of technology in education. As a solution to the shortage of gadgets and internet access, Odisha offered courses via YouTube, television, and radio. However, only 10% of schools in Odisha have computer facilities, and 6% have internet connectivity, highlighting the digital divide (Odisha Vikash Conclave, 2023)

1.1.6 Educational Outcomes and Equity

Despite improvements in literacy rates, Odisha's performance on educational outcomes remains mixed. The state has made strides in reducing gender disparity in enrolment, but challenges remain in terms of low enrolment rates and high dropout rates among girls, Scheduled Castes (SCs), and Scheduled Tribes (STs) (Odisha Vikash Conclave, 2023). The ASER 2023 report exposed gaps in the government's education system, with poor student performance in basic literacy and numeracy (Odisha Vikash Conclave, 2023).

1.1.7 Future Directions

The National Education Policy (NEP) 2020 presents an opportunity for Odisha to align its educational reforms with national goals. The policy emphasizes foundational literacy and numeracy, vocational education, and teacher training, areas where Odisha can further innovate and improve (Odisha Vikash Conclave, 2023).

1.1.8 Higher Education and Vocational Training

Odisha's higher education system follows the 10+2 structure, with students choosing between arts, science, and commerce streams after completing secondary education. Several prominent universities, including the Indian Institute of Technology (IIT) in Bhubaneswar, are located in the state and have contributed to its standing as a new center of knowledge. Additionally, vocational training and government programs provide financial support to enhance educational opportunities and promote innovation and entrepreneurship. The overall enrolment of students in higher education institutions has increased significantly, with the Gross Enrolment Ratio (GER) for the age group 18-23 years reaching 22.1 in 2021-22, up from 21.1 in 2017-18. (Times of India, 2024)

1.1.9 Community Involvement and Future Prospects

Community involvement plays a crucial role in Odisha's educational transformation. Initiatives like the Mo School Abhiyan encourage alumni and local communities to contribute to school development, fostering a collaborative approach to education. The state's focus on research and innovation positions it as a potential hub for educational advancements despite the ongoing challenges.

A rich historical context, ongoing challenges, and transformative government initiatives characterize the educational landscape in Odisha. While significant progress has been made, particularly in terms of access and inclusivity, gaps persist in quality, equity, and technological integration. Future research should focus on evaluating the impact of recent reforms, exploring innovative solutions to bridge the digital divide, and aligning state initiatives with the National Education Policy (NEP) 2020 to ensure a holistic and inclusive educational environment for all students in Odisha.

1.1.10 Importance of enterprise architecture in transforming education

Enterprise Architecture (EA) plays a pivotal role in transforming the educational landscape by providing a structured framework that aligns educational strategies with technological advancements. This alignment is crucial for achieving efficiency, agility, and sustainability in educational institutions. Below are the key aspects of how EA contributes to the transformation of education:

1. Improved Decision-Making and Strategic Alignment

EA enables educational institutions to align their IT infrastructure with their strategic goals. By providing a comprehensive view of the organization's processes, systems, and technologies, EA facilitates better decision-making and ensures that IT investments are directed towards achieving educational objectives (MEGA International, 2023).

2. Enhanced Efficiency and Cost Reduction

Implementing EA helps identify and eliminate redundancies within the IT systems of educational institutions, resulting in significant cost reductions and increased operational effectiveness. By streamlining processes and reducing IT complexity, EA allows institutions to allocate resources more effectively (LeanIX, 2023).

3. Facilitating Digital Transformation

EA is essential for the digital transformation of educational institutions. It provides a blueprint for integrating new technologies and digital tools into the educational framework, thereby enhancing the learning experience and administrative processes. The use of frameworks like TOGAF (The Open Group Architecture Framework) ensures a structured approach to digital transformation (ResearchGate, 2023).

4. Improved Collaboration and Communication

EA fosters better collaboration and communication between different departments within an educational institution. By creating a shared vision and standardized practices, EA ensures that all stakeholders are on the same page, which is crucial for the successful implementation of educational reforms and initiatives (MEGA International, 2023).

5. Enhanced Data Management and Security

Educational institutions handle vast amounts of data, including sensitive student information. EA provides a framework for effective data management and security, ensuring that data is collected, stored, and shared securely and efficiently. This is particularly important in the context of increasing cyber threats and the need for compliance with data protection regulations (LeanIX, 2023).

6. Supporting Continuous Improvement and Innovation

EA promotes innovation and a culture of constant improvement in educational establishments. EA assists schools in adjusting to evolving educational demands and technology breakthroughs by offering a clear road map for future advances. This ensures

that the institution remains competitive and can provide high-quality education (Smith and Brown, 2023).

Case Study: Arizona Department of Education

The Arizona Department of Education (ADE) provides a practical example of the benefits of EA. ADE implemented an EA framework to create the Arizona Education Learning and Accountability System (AELAS), which integrates data collection and presentation from classrooms to the state department. This comprehensive approach has significantly improved the efficiency and effectiveness of educational processes in Arizona (ERIC, 2023).

In conclusion, Enterprise Architecture is a critical tool for transforming the educational landscape. By aligning IT infrastructure with educational goals, improving efficiency, facilitating digital transformation, and enhancing data management, EA helps educational institutions to achieve their vision and provide high-quality education. The structured approach of EA ensures that educational institutions can adapt to future challenges and continue to innovate.

In summary, Odisha's educational landscape is characterized by significant progress in literacy and infrastructure development, driven by government initiatives like the 5T High School Transformation Programme. However, the state continues to grapple with issues such as poor infrastructure in certain areas, low enrolment, and disparities in educational quality. Addressing these challenges through effective implementation of enterprise architecture principles and community involvement will be crucial for the state's educational future. This summary highlights both accomplishments and enduring difficulties in Odisha’s educational system, taking into account the most recent census statistics.

1.2 Research Problem

Odisha's K12 educational system faces several significant challenges that hinder the overall quality of education. The absence of suitable infrastructure is one of the main problems. Many schools suffer from insufficient classrooms, poor sanitation facilities, and a shortage of teaching materials. This inadequate infrastructure not only affects the learning environment but also the health and well-being of the students.

Another major challenge is the significant teacher shortage in the state. This shortage leads to high student-teacher ratios, making it difficult for teachers to give individual attention to students. The lack of qualified teachers also affects the quality of education, as many educators are forced to teach subjects, they are not specialized in. This situation is exacerbated in rural areas, where attracting and retaining qualified teachers is particularly difficult.

High dropout rates are another pressing issue, especially in rural regions. Economic pressures and social factors often force children to leave school early to support their families. This is particularly true for girls, who are frequently expected to help with household chores or get married at a young age. The lack of awareness and value placed on education in these communities further contributes to the dropout rates.

Moreover, there is an urgent need for improved teacher training programs. Many teachers in Odisha lack access to modern teaching methods and practices, which are essential for delivering a high-quality education. Continuous professional development and training are necessary to ensure that teachers are well-equipped to handle the evolving educational landscape.

The integration of technology in education is another area where Odisha's K12 system falls short. In today's digital age, access to technology is crucial for providing students with the skills they need for the future. However, many schools in Odisha lack basic technological infrastructure, such as computers and internet access. This gap in technology not only limits students' learning opportunities but additionally increases the gap in digital access between rural and urban locations.

In addition to these challenges, there is a need for better implementation of educational policies and programs. While the government has introduced several initiatives to improve the education system, the lack of proper monitoring and evaluation often hampers their effectiveness. Ensuring that these programs reach the intended beneficiaries and achieve their goals is crucial for the overall improvement of the educational system.

A multifaceted strategy including community involvement, government intervention, and non-governmental organisation help is needed to address these issues. By improving infrastructure, addressing teacher shortages, reducing dropout rates, enhancing teacher training, and integrating technology, Odisha can create a more robust and inclusive K12 educational system.

1.2.1 How can enterprise architecture address these challenges (in K12 Education in Odisha)?

By offering a systematic framework to match instructional practices with technological solutions, enterprise architecture (EA) can be extremely helpful in tackling issues in Odisha's K–12 education system. Here are several ways EA can help:

1. Standardization and Integration: EA enables the standardization of processes and systems across various schools and districts, ensuring consistent quality of education. By creating a unified framework, EA can integrate disparate systems, making data management more efficient and reducing administrative overhead. This standardization helps eliminate discrepancies in educational delivery, allowing students across different regions to receive the same level of education and resources. Furthermore, integrated systems facilitate smoother transitions for students who may move between schools, maintaining continuity in their education.
2. Resource Optimization: By mapping out the entire educational ecosystem, EA helps identify resource gaps and redundancies. This comprehensive overview ensures optimal allocation of resources, such as teachers, classrooms, and digital tools, thereby enhancing the overall educational experience. For example, EA can

identify under-resourced schools and allocate additional support where needed, while also recognizing areas where resources are being underutilized. This strategic allocation not only improves efficiency but also ensures that all students have access to the necessary tools and support for their education.

3. Improved Data Management: EA facilitates the creation of a centralized data repository, enabling better data collection, analysis, and reporting. This centralized approach allows for more accurate tracking of student performance, identifying areas of improvement, and making data-driven decisions. With comprehensive data at their disposal, educators and administrators can tailor educational strategies to meet the needs of individual students and groups. Additionally, centralized data management supports transparency and accountability, making it easier to monitor progress and implement changes where necessary.
4. Enhanced Collaboration: EA promotes collaboration between different stakeholders, including government bodies, educators, and technology providers. This collaborative approach can lead to the development of more effective educational policies and initiatives. By fostering open communication and cooperation, EA ensures that all parties are working towards common goals and can share best practices and innovative solutions. Collaborations can also result in joint ventures, such as co-developing new educational technologies or programs that address specific regional challenges.
5. Scalability and Flexibility: EA provides a scalable and flexible framework that can adapt to changing educational needs and technological advancements. This ensures that the education system in Odisha can evolve and grow over time without significant disruptions. For instance, as new educational technologies emerge, EA can seamlessly integrate these advancements into the existing framework, enhancing the learning experience without causing major interruptions. This adaptability is crucial for keeping the education system current and effective in a rapidly changing world.

6. Security and Compliance: With the increasing use of digital tools in education, ensuring data security and compliance with regulations is critical. EA helps in establishing robust security protocols and ensuring compliance with data protection laws. This includes safeguarding sensitive student information from cyber threats and unauthorized access. By implementing stringent security measures, EA helps build trust among students, parents, and educators, who can be confident that their data is protected. Adherence to regulations guarantees that educational establishments stay out of trouble with the law and keep their excellent reputation with regulatory agencies.
7. Support for Remote Learning: The necessity for strong digital infrastructure has been brought to light by the current trend towards remote learning brought on by the COVID-19 pandemic. EA can help with the creation and deployment of remote learning platforms, guaranteeing their efficacy, usability, and accessibility. By providing a clear framework for integrating these platforms, EA helps educators deliver quality education outside the traditional classroom setting. This is especially important for Odisha, where geographical challenges can make in-person education difficult for some students.
8. Continuous Improvement: EA encourages a culture of continuous improvement by regularly reviewing and updating the educational framework. This recurrent approach guarantees that the educational system continues to be effective and relevant in addressing students' needs. By continually assessing and refining strategies, EA helps identify what works and what doesn't, allowing for timely adjustments. This proactive approach helps maintain high standards of education and can lead to innovative practices that benefit students.

Enterprise architecture has the potential to greatly raise the standard and effectiveness of K12 education in Odisha by tackling these important issues, which would ultimately benefit students' academic performance. EA offers the instruments and tactics required to address the particular difficulties the Odisha educational system faces through a framework that is both well-organised and flexible.

1.2.2 What is the role of value frameworks and value stream mapping in this (K12 education) transformation?

Value frameworks and value stream mapping play crucial roles in the transformation of K12 education by providing structured approaches to identify, analyse, and enhance the value of educational processes. These tools help schools and educators to align their efforts with overarching educational goals, ensuring that every initiative contributes meaningfully to student success and institutional improvement.

1.2.2.1 Value Frameworks

Value frameworks are essential in helping educators and administrators align educational activities with desired outcomes. They serve as a blueprint that guides decision-making processes, ensuring that every action taken within the school environment is geared towards achieving the institution's goals. By employing value frameworks, schools can evaluate the effectiveness of various teaching methods, curriculum designs, and resource allocations. This systematic approach allows for the identification of areas where improvements can be made, enabling schools to prioritize initiatives that have the greatest impact on student learning and overall educational quality. For example, a value framework might help a school determine whether to invest in new technology, additional staff training, or extracurricular programs by assessing the potential return on investment in terms of student outcomes.

1.2.2.2 Value Stream Mapping

One method for visualising and analysing the flow of information and materials needed to provide educational services is value stream mapping. In the context of K12 education, this method can be instrumental in identifying inefficiencies, redundancies, and bottlenecks within the educational process. By mapping out these processes, schools can gain a clearer understanding of how educational services are delivered from start to finish. This insight allows for the streamlining of operations, reducing waste, and improving the overall delivery of education. For instance, value stream mapping can reveal that certain administrative tasks are taking up too much time that could be better

spent on direct student interaction, leading to a reallocation of responsibilities that enhances the student experience and outcomes.

Together, value frameworks and value stream mapping provide a comprehensive approach to continuous improvement in K12 education. By using these resources, schools may make sure that they are not only fulfilling the requirements of the modern classroom but also adapting to the shifting demands of both society and students. This is especially crucial in the quickly evolving educational environment of today, where possibilities and difficulties are ever-present.

Additionally, value stream mapping and value frameworks encourage an environment of accountability and ongoing development in educational establishments. They encourage all stakeholders—including teachers, administrators, students, and parents—to engage in ongoing dialogue about what works and what doesn't. This collaborative approach ensures that everyone is working towards common goals and that the best possible educational outcomes are achieved for all students.

In summary, value frameworks and value stream mapping are vital tools in the transformation of K12 education. They provide structured, systematic approaches to improving educational processes, ensuring that schools can deliver high-quality education that meets the needs of their students and prepares them for future success.

1.3 Purpose of Research

This study aims to perform a thorough examination of the K–12 educational system in Odisha, India, utilizing advanced enterprise architecture tools to identify, analyse, and address the multifaceted challenges hindering equitable access to quality education. The goal of this research is to close the gap between theoretical educational constructs and practical implementation strategies through a data-driven, systemic approach.

Specifically, the research seeks to:

1. Map the Current Educational Landscape: Utilize enterprise architecture tools to create a detailed, holistic model of Odisha's educational system, encompassing infrastructure, resources, policies, and socio-cultural factors.

2. Identify Key Challenges: Systematically analyse disparities in educational access, quality, and outcomes across different regions and demographic groups within Odisha.

3. Evaluate Resource Allocation: Assess the efficiency and effectiveness of current resource distribution in the educational sector, identifying areas of imbalance or underutilization.

4. Analyse Policy Implementation: Examine the impact and effectiveness of existing educational policies, identifying gaps between policy formulation and on-ground implementation.

5. Investigate Socio-cultural Influences: Explore how various socio-cultural factors, including language barriers and community attitudes, affect educational participation and achievement.

6. Develop Predictive Models: Leverage advanced analytics capabilities of enterprise architecture tools to create predictive models for educational outcomes based on various input factors.

7. Propose Evidence-Based Solutions: Formulate data-driven, actionable recommendations for improving educational access, quality, and equity across Odisha.

8. Create a Replicable Framework: Develop a methodological framework using enterprise architecture principles that can be applied to similar educational challenges in other regions or states.

By employing sophisticated enterprise architecture tools, this research aims to provide a more nuanced, interconnected understanding of the educational challenges in Odisha. The study will contribute to the academic discourse on educational development in resource-constrained environments while also offering practical, implementable solutions for policymakers and educators.

In the end, this study aims to open the door for revolutionary adjustments to the educational system in Odisha, potentially serving as a model for addressing similar

challenges in other developing regions. The findings are expected to inform policy decisions, guide resource allocation, and foster a more equitable and effective educational environment for all students in Odisha.

1.4 Significance of the Study

1.4.1 Contribution to Education Policy and Process

Education enterprise architecture (EEA) can significantly contribute to policy-making in education in India, including the National Education Policy (NEP) and other future policies. EEA provides a structured framework that aligns educational strategies, processes, and technologies, ensuring that policies are effectively implemented and monitored.

Firstly, EEA helps in the holistic design and integration of educational systems, ensuring that all components work seamlessly together. This is crucial for implementing policies like NEP, which aim to overhaul and modernize the entire education system in India. By using EEA, policymakers can design systems that support blended learning, digital assessments, and personalized education pathways.

Second, data-driven decision-making is made easier by EEA. Through the integration of multiple data sources, including student performance metrics, teacher evaluations, and resource allocations, policymakers can make informed decisions that enhance educational outcomes. This is particularly important for continuous monitoring and evaluation of policies like NEP, allowing for timely adjustments and improvements.

Thirdly, EEA encourages cooperation between different stakeholders, including as government organisations, academic institutions, and IT companies. This ensures that policies are not only theoretically sound but also practically feasible and widely accepted. In the context of NEP, such collaboration can help in the effective rollout of vocational training programs, early childhood education initiatives, and teacher training modules.

Lastly, EEA supports scalability and flexibility, enabling the education system to adapt to future needs and challenges. As policies evolve, the architectural framework can be adjusted to incorporate new educational technologies, pedagogical approaches, and regulatory requirements, ensuring that the system remains robust and relevant.

In summary, education enterprise architecture can play a pivotal role in shaping and implementing education policies in India, such as the NEP, by providing a comprehensive, data-driven, and collaborative framework that ensures effective and sustainable educational transformation.

1.4.2 Enhancement of educational practices through enterprise architecture

Enterprise architecture (EA) can play a pivotal role in enhancing educational practices in Odisha. By implementing a structured EA framework, educational institutions can streamline their processes, improve resource management, and foster better communication across various departments. This systematic approach helps in aligning educational goals with technological advancements, ensuring that the infrastructure supports modern teaching methods and administrative functions.

In Odisha, the adoption of EA can lead to the development of a more cohesive educational ecosystem. It can facilitate the integration of digital tools and platforms, providing students and educators with access to a wide range of resources and learning opportunities. Additionally, EA can help in the effective monitoring and evaluation of educational programs, enabling data-driven decisions that enhance the overall quality of education.

Moreover, enterprise architecture can support the scalability of educational initiatives, allowing for the seamless expansion of programs and institutions. This is particularly beneficial in a rapidly developing region like Odisha, where there is a growing demand for quality education. By leveraging EA, Odisha can ensure that its educational practices are not only current but also future-ready.

1.4.3 Potential for scalability and replication in other regions

The potential for scalability and replication of education enterprise architecture in low economy states like Odisha is significant. By leveraging a well-structured and efficient framework, educational institutions in these regions can optimize their operations, improve resource allocation, and enhance the overall learning experience.

Key factors contributing to scalability include the use of technology to streamline administrative processes, the implementation of standardized curricula, and the

development of robust teacher training programs. These elements can be easily adapted to suit the specific needs and conditions of different regions.

Moreover, with proper funding and support, the successful models implemented in Odisha can serve as blueprints for other low economy states. The replication process would involve careful assessment and customization to address local challenges and opportunities, ensuring that the benefits of a well-architected education system are widespread and impactful.

1.5 Research Purpose and Questions

The current research addresses the following key questions:

RQ1: Implementation and Challenges of Enterprise Architecture

1.5.1 How can Enterprise Architecture (EA) principles be effectively implemented in Odisha's government school education system?

Implementing Enterprise Architecture (EA) principles in Odisha's government school education system can significantly streamline processes, improve efficiency, and enhance educational outcomes. Here are some steps to effectively implement EA principles:

1. Assessment and Planning: Conduct a thorough assessment of the current educational infrastructure, processes, and technology. Identify gaps and areas for improvement. Develop a comprehensive EA plan that aligns with the educational goals and objectives of Odisha's government school system.
2. Stakeholder Engagement: Involve key stakeholders, including government officials, educators, administrators, and IT professionals, in the planning and implementation process. Their input and buy-in are crucial for the success of the EA initiative.
3. Standardization: Establish standardized processes, data formats, and technology platforms across all schools. This will ensure consistency, interoperability, and easier management of the educational ecosystem.

4. Integration: Integrate various educational systems and databases to create a unified and cohesive IT infrastructure. This will facilitate better data sharing, reporting, and decision-making.
5. Training and Support: Provide training and support to educators and administrators on the new EA framework and tools. Ensure they are comfortable and proficient in using the new systems.
6. Monitoring and Evaluation: Continuously monitor the implementation process and evaluate its impact on the educational system. Use feedback to make necessary adjustments and improvements.
7. Scalability and Flexibility: Design the EA framework to be scalable and flexible to accommodate future growth and changes in the educational landscape.

By following these steps, Odisha's government school education system can effectively implement EA principles, leading to a more efficient, transparent, and high-performing educational environment.

1.5.2 What are the key challenges associated with Enterprise Architecture (EA) adoption in this (K12 education) context, and how can they be mitigated?

Adopting Enterprise Architecture (EA) in a K12 education context poses several key challenges:

1. Resource Constraints: K12 schools often operate with limited budgets and resources. Implementing EA requires significant investment in technologies, training, and personnel, which can be difficult to justify and sustain.

Mitigation: Secure funding through grants, partnerships, and government programs. Prioritize EA initiatives that offer clear, immediate benefits to gain stakeholder support.

2. Resistance to Change: Educators and administrators may be resistant to changing established practices and adopting new technologies. This resistance can slow down or derail EA initiatives.

Mitigation: Engage stakeholders early in the process, providing them with comprehensive training and demonstrating the tangible benefits of EA. Encourage a culture of innovation and continuous improvement.

3. Lack of Expertise: Many K12 institutions lack the in-house expertise needed to design and implement EA effectively. This can lead to poorly executed projects and underutilization of EA frameworks.

Mitigation: Invest in professional development and consider hiring or consulting with EA experts. Collaborate with other educational institutions to share knowledge and best practices.

4. Data Privacy and Security Concerns: Handling sensitive student data requires stringent privacy and security measures. Ensuring compliance with regulations like FERPA adds complexity to EA implementation.

Mitigation: Develop robust data governance policies and invest in secure IT infrastructure. Regularly train staff on data privacy and security best practices.

5. Alignment with Educational Goals: Ensuring that EA initiatives align with the educational goals and curricula of K12 institutions can be challenging. Misalignment can result in wasted resources and suboptimal outcomes.

Mitigation: Involve educators in the EA planning process to ensure alignment with educational objectives. Continuously assess and adjust EA initiatives to align with evolving educational goals.

By addressing these challenges proactively, K12 institutions can successfully adopt and benefit from Enterprise Architecture, ultimately enhancing their educational delivery and operational efficiency.

1.5.3 What best practices can be identified to ensure successful Enterprise Architecture (EA) implementation?

Best Practices for Successful Enterprise Architecture (EA) Implementation

1. Define Clear Objectives and Scope: Establish clear objectives and a well-defined scope for the EA initiative. This helps in aligning the architecture with business goals and ensures that all stakeholders have a common understanding of the expected outcomes.
2. Early Stakeholder Engagement: To guarantee that their wants and concerns are met, involve important stakeholders early on. This includes end users, IT personnel, and business executives. Their support is essential to the EA project's success.
3. Adopt a Phased Approach: Implement EA in phases rather than attempting a big-bang approach. This allows for incremental improvements, easier management of changes, and reduces the risk of project failure.
4. Use Standard Frameworks and Methodologies: Leverage established EA frameworks such as TOGAF, Zachman, or FEAF. These provide structured approaches and best practices that can guide the implementation process.
5. Ensure Strong Governance: Establish a governance structure to oversee the EA initiative. This includes setting up an architecture board or committee to review and approve architectural decisions and changes.
6. Focus on Communication: Maintain open and continuous communication with all stakeholders. Regular updates, workshops, and feedback sessions help in keeping everyone informed and engaged.
7. Invest in Training and Development: Provide training and development opportunities for the EA team and other stakeholders. This guarantees that everyone has the abilities and information required to make a meaningful contribution to the EA project.
8. Measure and Monitor Progress: Create KPIs and measurements to gauge the EA implementation's performance and progress. Regular monitoring and reporting help in identifying issues early and making necessary adjustments.

9. Foster a Culture of Collaboration: Encourage collaboration across different departments and teams. A collaborative culture helps in breaking down silos and ensures that the EA initiative is aligned with the overall organizational strategy.
10. Be Flexible and Adaptable: Be prepared to adapt the EA approach as the organization evolves. Flexibility is key to ensuring that the architecture remains relevant and effective in meeting changing business needs.

By following these best practices, organizations can increase the likelihood of a successful EA implementation that delivers tangible business value.

Research Objectives

There are 4 key Research Objectives as below -

1. To investigate how Enterprise Architecture (EA) principles can be effectively implemented in Odisha's government school education system

Implementing Enterprise Architecture (EA) principles in Odisha's government school education system involves structuring and organizing the IT infrastructure, processes, and frameworks to improve efficiency and effectiveness. This includes aligning the educational goals with IT strategies to ensure that resources are utilized optimally and that the system can adapt to changing needs. Key steps would involve assessing the current state of the IT infrastructure, identifying gaps, and designing a roadmap to integrate EA principles. By doing so, the education system can enhance data management, facilitate better decision-making, and improve overall educational outcomes. The implementation process should also consider stakeholder engagement, continuous monitoring, and iterative improvements to ensure sustained success.

2. To examine the key challenges associated with Enterprise Architecture (EA) adoption in this context and identify strategies to mitigate them

Organisations must overcome a number of significant obstacles when adopting enterprise architecture (EA) in order to guarantee successful deployment. Among these difficulties are opposition to change, a lack of backing from upper management,

inadequate skills and expertise, and the complexity of integrating EA with existing systems.

To mitigate these challenges, organizations can employ several strategies:

1. Change Management: Implementing a robust change management strategy can help address resistance to change. This entails engaging stakeholders in the process, communicating the advantages of EA clearly, and offering assistance and training.
2. Executive Sponsorship: Securing senior management support is crucial. Executives can champion the EA initiative, allocate necessary resources, and align EA goals with business objectives.
3. Skills Development: Investing in training and development programs to enhance the skills and expertise of the team involved in EA can address the skills gap.
4. Incremental Implementation: Adopting an incremental approach to EA implementation can help manage complexity. Start with small, manageable projects and gradually scale up, learning and adapting along the way.
5. Stakeholder Engagement: Engaging stakeholders across the organization can ensure their buy-in and support. Regularly communicating progress and demonstrating quick wins can build momentum.

Organisations can increase the possibility that EA adoption will be successful and get its full advantages by tackling these issues with focused tactics.

3. To identify best practices that can ensure successful Enterprise Architecture (EA)

Implementation

To identify best practices that can ensure successful Enterprise Architecture (EA) implementation, it is crucial to consider several key factors.

Firstly, securing executive sponsorship and establishing clear governance structures are fundamental. This ensures alignment with business goals and provides the necessary support for EA initiatives.

Secondly, fostering effective communication and collaboration across all stakeholders helps in bridging gaps and promoting a unified approach.

Additionally, adopting a flexible and iterative methodology allows for continuous improvement and adaptation to changing business needs. Investing in training and development to build a skilled EA team is also vital.

Finally, leveraging industry frameworks and standards can provide a solid foundation and guide the EA implementation process with a Product mindset.

4. To examine how effective leadership, coupled with Enterprise Architecture (EA), can promote data-driven decision-making and improve educational outcomes in Odisha

Effective leadership plays a critical role in harnessing the potential of Enterprise Architecture (EA) to foster data-driven decision-making and enhance educational outcomes in Odisha. By setting a clear vision and fostering a culture that values data, leaders can guide organizations in implementing EA frameworks that streamline data collection, analysis, and utilization. This, in turn, makes it possible for educational establishments to base their decisions on timely and accurate information.

Leadership that prioritizes EA can ensure that data systems are interoperable, scalable, and secure, facilitating the seamless integration of various data sources. This integration helps in identifying trends, measuring performance, and pinpointing areas for improvement. For example, data-driven insights can inform curriculum development, resource allocation, and intervention strategies, thereby improving the quality of education and student performance.

In Odisha, where educational challenges are multifaceted, the combination of strong leadership and robust EA can lead to significant improvements. Leaders can champion the use of data to address disparities, monitor progress, and drive continuous improvement, ultimately leading to better educational outcomes for all students.

CHAPTER II:

REVIEW OF LITERATURE

2.1 Theoretical Overview

2.1.1 Introduction to Enterprise Architecture and Its Relevance in Education

EA is a conceptual blueprint that describes the structure and operation of an enterprise. The intent of an enterprise architecture would therefore be to understand how an organization could achieve its current objectives and, more importantly, its future objectives most effectively. In the education sector, EA is therefore a concept that ensures streamlining, enhances communication, and generally makes the process involved in educational institutions efficient.

By implementing EA, educational institutions can align their strategic goals with their IT infrastructure, ensuring that all technological investments support the institution's mission and objectives. This alignment helps in reducing redundancy, optimizing resources, and facilitating better decision-making processes. Additionally, EA promotes standardization across various departments, leading to more cohesive and integrated systems.

Also, EA helps educational institutions meet the challenges they have, which include dealing with huge volumes of data, keeping the data safe, and having access to information without hassle for students, teachers, and other staff. This also helps support the implementation of new technologies and innovations in teaching and learning, thereby enriching the educational experience.

In summary, enterprise architecture is indispensable for educational institutions aiming to modernize their operations, improve efficiency, and deliver better educational outcomes.

2.1.2 Overview of value frameworks and value stream mapping

Value frameworks and value stream mapping are critical concepts in understanding and improving organizational efficiency and effectiveness.

2.1.2.1 Value Frameworks

Value frameworks are structured methodologies that help organizations define, measure, and optimize the value they deliver to their customers. These frameworks provide a holistic view of value creation, considering various dimensions such as customer satisfaction, financial performance, and operational efficiency. Common value frameworks include the Balanced Scorecard, Lean Six Sigma, and the Value Proposition Canvas. By using these frameworks, organizations can align their strategies, processes, and resources to maximize value delivery and achieve their business goals.

2.1.2.2 Value Stream Mapping

Value stream mapping (VSM) is a lean-management method used for analysing and designing the flow of materials and information required to bring a product or service to a customer. This technique provides an overview of the entire process-from raw materials to the final product-and identifies waste areas and points for improvement. VSM is used to spot bottlenecks and reduce lead times, thus enabling improvement in the general efficiency of a process. The mapping of the current state and vision of the future state in organizations will help implement targeted improvements toward achieving significant gains in productivity and quality.

Together, value frameworks and value stream mapping offer a comprehensive approach to understanding and enhancing the value delivery process. They enable organizations to systematically identify and eliminate inefficiencies, align their operations with customer needs, and drive continuous improvement.

2.2 Value Framework in Education

2.2.1 Importance of Values in the Educational Process

When it comes to business architecture in education, values are crucial in determining the structure and results of the learning process. Enterprise architecture involves the strategic alignment of an institution's goals, processes, information systems,

and technologies to enhance efficiency and effectiveness. When values such as integrity, respect, responsibility, and empathy are embedded within this architecture, they become integral to the institution's culture and operations.

Embedding values in enterprise architecture ensures that all educational processes and technologies are designed and implemented with a focus on fostering these principles. For instance, systems that promote transparency and accountability can enhance integrity, while collaborative platforms can encourage respect and empathy among students and staff.

The outcome of integrating values into enterprise architecture is a holistic educational experience that not only prioritizes academic excellence but also the moral and ethical development of students. This approach prepares students to become responsible citizens and professionals who can navigate the complexities of the modern world with a strong moral compass. Moreover, it creates a positive, respectful, and inclusive learning environment that benefits all stakeholders, from students and teachers to administrators and the community at large.

Ultimately, the integration of values within enterprise architecture in education lays the groundwork for creating a more just, equitable, and cohesive society by producing individuals who are not only knowledgeable but also principled and empathetic.

2.2.2 Integration of Value Education with the overall educational framework

The integration of value education within the overall educational framework is crucial to developing well-rounded individuals in the context of education enterprise architecture. Value education encompasses the teaching of moral values, ethics, and social responsibilities, which are fundamental in shaping students' character and behaviour. By embedding these principles into the educational system, we can create a more holistic learning environment that prepares students for both personal and professional success.

Incorporating value education into the educational enterprise architecture involves aligning it with curricular and co-curricular activities, ensuring that ethical principles are embedded in every facet of learning. This can be achieved through the development of comprehensive policies, the integration of value-based modules in the curriculum, and the training of educators to impart these values effectively. For instance, subjects like history, literature, and social studies can be used to discuss moral dilemmas and ethical decision-making, while extracurricular activities such as community service projects can provide practical experience in applying these principles.

Moreover, leveraging technology and digital platforms can facilitate the dissemination of value education. Online courses, interactive modules, and virtual discussions can provide students with broader perspectives on moral and ethical issues. Digital platforms can also offer personalized learning experiences, allowing students to explore value education topics at their own pace and according to their interests. The architecture should support continuous assessment and feedback mechanisms to monitor the impact of value education on students. Tools such as e-portfolios and digital badges can be used to track students' progress and achievements in value education, providing valuable data for educators to refine their teaching strategies.

In addition to formal education settings, value education can be reinforced through partnerships with families and communities. Schools can collaborate with parents and local organizations to create a supportive environment that reinforces the values taught in the classroom. Workshops, seminars, and community events can be organized to engage various stakeholders in discussions about the importance of value education and how it can be integrated into everyday life.

Additionally, in order to effectively teach value education, educators themselves need to possess the requisite abilities and expertise. Teachers can improve their skills in this area with the support of professional development programs that emphasise value-based education and ethical teaching methods. Educational institutions may guarantee that value education stays a vital and dynamic component of the curriculum by cultivating a culture of ongoing learning and development.

Ultimately, a well-integrated value education system within the educational enterprise architecture not only enhances academic learning but also fosters a more empathetic, responsible, and ethical society. Students who are taught to value integrity, respect, and social responsibility are more likely to become active and conscientious citizens. As they enter the workforce and assume leadership roles, like an Architect, they can help make the world a better place. By giving value education top priority, we can lay the groundwork for a better future for people and society at large.

In this context, Enterprise Architect can make the world a better place to live in.

2.3 Enterprise Architecture in Education

2.3.1 Case studies and examples of enterprise architecture in educational settings

2.3.1.1 The India Enterprise Architecture (IndEA)

Aiming to connect and simplify government services digitally across several channels, including online, mobile, and common service delivery outlets, the India Enterprise Architecture (IndEA) framework was created as part of the Digital India Program. Both greenfield and brownfield e-Government projects may be accommodated by IndEA's federated architecture approach, which also offers a collection of architectural reference models that can be modified to create an Indian Whole-of-Government Architecture. The framework aims to improve efficiency, interoperability, and service delivery by dismantling sectoral barriers and silos and re-architecting the government as a single organisation. IndEA also includes an adoption guide to assist central ministries, state governments, and public sector enterprises in implementing the framework effectively. The integration of TOGAF and IndEA frameworks provides a robust foundation for developing comprehensive educational enterprise architectures, further enhanced by incorporating the Unified Education Architecture Framework (UEAF), which offers specialized guidelines and models tailored specifically for the education sector, ensuring a cohesive and efficient alignment of IT and educational goals (MeitY, 2024; The Open Group, 2019; e-Governance Standards, 2023).

2.3.1.2 The University Enterprise Architecture Framework (UEAF)

The University Enterprise Architecture Framework (UEAF) is a comprehensive initiative designed to address the fragmented approach to automation and digitization in Indian universities. This literature review focuses on the key components and insights of UEAF, emphasizing its alignment with the India Enterprise Architecture (IndEA) guidelines and its applicability to higher education institutions. The framework aims to create a unified digital ecosystem by standardizing processes across core domains data, technology, application integration, security, performance, and governance, among other things (NIC, 2018). Key challenges identified include the need for a tailored ERP solution to meet the local requirements of Indian universities and the complexity of the higher education sector, which lacks a common framework to address diverse needs (NIC, 2018). The framework's development involved extensive stakeholder engagement, including workshops with over 100 universities and 250+ representatives from 20 states, to gather insights and mature the framework (NIC, 2018). The UEAF does not cover K-12 education or school transformation, focusing solely on higher education. Reusable aspects of the framework include the business architecture principles, application and technology integration models, and data management practices, which can be adapted by universities to develop their own tailored enterprise architectures (NIC, 2018). This approach ensures that universities can leverage common building blocks while accommodating unique requirements, promoting standardization, reusability, and cost optimization.

2.3.1.3 Colombian Higher Education Enterprise Architecture (CHE2A)

The literature on the Colombian Higher Education Enterprise Architecture (CHE2A) reveals a comprehensive framework designed to manage the lifecycle of higher education programs through a system-of-systems approach. Llamosa-Villalba et al. (2015) describe CHE2A as a strategic tool that integrates various administrative levels—strategic, tactical, and operational—to enhance decision-making, resource management, and continuous improvement in higher education institutions (HEIs). The model emphasizes the alignment of educational services with regulatory standards, innovation,

and social responsibility, aiming to foster a dynamic and collaborative learning environment. Additionally, the framework supports the assessment and monitoring of educational processes to ensure compliance with quality standards and to identify opportunities for improvement and innovation (Llamosa-Villalba et al., 2015). The CHE2A model has been piloted in various educational settings, demonstrating its potential to improve leadership, teamwork, and value creation within the Colombian higher education ecosystem (Llamosa-Villalba et al., 2015).

2.3.1.4 Education Enterprise Architecture in Indonesia and Malaysia

The literature on Enterprise Architecture Planning (EAP) for School-Based Management (SBM) in public high schools in Indonesia and Malaysia highlights the critical role of strategic information systems in enhancing organizational performance and educational quality. EAP involves a comprehensive approach to designing and implementing integrated information systems, beginning with value chain analysis to identify key activities and supporting processes (Tresna and Hadiana, 2019). The methodology typically includes assessing current systems, planning for future improvements, and developing a blueprint for data, application, and technology architecture (Suseela and Shamsudin, 2011; Nowakowski et al., 2017). Studies indicate that many schools still rely on manual data processing, which is inefficient and ineffective, underscoring the need for web-based platforms to facilitate better integration and access to information (Kotusev, 2016; Kristanto, 2016). The ultimate goal is to create an information system that aligns business processes with technology, thereby supporting the main functions of education, such as student admissions, academic operations, and infrastructure management (Budiman et al., 2018; Ernst and Schneider, 2010).

2.3.1.5 Spanish Higher Education Enterprise Architecture

The Enterprise Architecture Initiative for Higher Education in Spain and its Capability Map, as detailed by The Open Group (2022), provides a comprehensive framework for the Spanish University System (SUE) to enhance operational efficiency, strategic planning, and governance through Enterprise Architecture (EA). The initiative adopts the TOGAF framework and ArchiMate modelling language to facilitate a

structured approach to strategic planning and architecture. It emphasizes a business-first approach, aiming to align institutional activities with strategic objectives while promoting interoperability, scalability, and cost reduction in ICT operations. The capability map integrates elements from the CAUDIT and UCISA models, tailored to the Spanish context, and serves as a universal template adaptable to the specific needs of any university. Key benefits include providing a holistic view of the university, enabling performance measurement, and fostering stakeholder engagement through a common language and framework (The Open Group, 2022).

2.3.1.6 Higher Education Reference Models (HERM) in Australia

The Council of Australasian University Directors of Information Technology (CAUDIT) initiative primarily aims to enhance digital capabilities within higher education institutions through a collaborative approach that includes the development of standardized business, data, and application architectures. CAUDIT's Higher Education Reference Models (HERM) provide a comprehensive framework that supports the digital transformation of universities by offering a structured categorization of business capabilities, data elements, and application architectures. These models facilitate effective governance, application portfolio management, and strategic planning within higher education institutions (The Open Group, 2022). Additionally, CAUDIT emphasizes cybersecurity through initiatives like the Australasian Higher Education Cybersecurity Service (AHECS), which aims to protect the sector from evolving cyber threats by coordinating resources and sharing intelligence among member institutions (CAUDIT, 2021). The initiative also focuses on professional development, enhancing technical, management, and leadership skills among ICT staff, therefore encouraging a culture of innovation and ongoing development in the field of higher education (CAUDIT, 2022).

2.3.1.7 UCISA promoting Higher Education Reference Models (HERM) in UK

Regarding the supply and development of academic, managerial, and administrative information systems, higher education institutions are represented by the Universities and Colleges Information Systems Association (UCISA), a UK-based

organisation. UCISA, which was founded in 1993, exists to enhance teaching, learning, research, and administration in higher and further education by fostering excellence in the use of information systems and services. The association achieves this by organizing conferences, seminars, and workshops, promoting collaboration between institutions, publishing best practice guides, and supporting policy-making processes (UCISA, 2022). UCISA's initiatives include the development of the Higher Education Reference Models (HERM) in collaboration with CAUDIT and EDUCAUSE, which provide a standardized framework for business capabilities and data models in higher education (UCISA, 2021). Additionally, UCISA supports commercial activities in higher education by offering resources such as toolkits, case studies, and surveys that help institutions identify and manage commercial opportunities effectively (The Open Group, 2022). Through its various working groups and collaborative efforts, UCISA is playing an important role in developing the digital capabilities of higher education institutions and providing a community of practice in advocating for best practices in information systems and technology to be used more effectively in education (UCISA, 2022).

2.3.2 Benefits and challenges of implementing enterprise architecture

Implementing enterprise architecture (EA) in the education sector can offer numerous benefits as well as challenges. EA involves designing and managing the IT infrastructure, data, processes, and applications within an organization to align with its strategic goals. In the context of educational institutions, this alignment can significantly enhance the overall functioning and delivery of educational services (Ahlemann,2012).

2.3.2.1 Benefits

1. **Improved Efficiency**: EA helps educational institutions streamline various administrative and academic processes by identifying and eliminating redundancies. This leads to more efficient use of resources, allowing staff to focus on core educational activities. For example, automated systems for student registration and course management can reduce manual workload and errors (Conexiam, 2025; EAPJ, 2025). For example, standardized IT systems lower operational complexity (Jusuf and Kurnia, 2017).

2. **Enhanced Decision-Making**: By providing a holistic view of the institution's IT landscape, EA enables decision-makers to access accurate and comprehensive data. This facilitates better-informed decisions regarding resource allocation, curriculum development, and technology investments. For example, understanding the utilization of classroom spaces can lead to more effective scheduling and space management (LeanIX, 2024).
3. **Alignment with Goals**: EA ensures that IT initiatives are directly aligned with the institution's strategic goals, supporting both academic and administrative objectives. This alignment helps in achieving long-term goals such as improving student outcomes, enhancing faculty capabilities, and expanding research opportunities. For instance, implementing a unified learning management system can support the institution's goal of providing a seamless learning experience (Hindarto et al., 2021).
4. **Cost Savings**: By optimizing resource management and streamlining processes, EA can lead to substantial cost savings over time. These savings can be redirected towards other critical areas such as academic programs, research, and student services. For example, consolidating multiple IT systems into a single, integrated platform can reduce maintenance costs and licensing fees. Consolidating IT systems reduces licensing and maintenance costs (Conexiam, 2025). For instance, Arizona's AELAS project achieved $176.5 million in savings over five years through centralized services (ED, 2020).
5. **Compliance and Security**: EA helps in establishing standardized protocols and practices, which can improve compliance with regulatory requirements and enhance data security. This is particularly important in the education sector, where institutions must protect sensitive information such as student records and research data. Implementing robust security measures and compliance frameworks can mitigate the risk of data breaches and legal issues. EA establishes protocols to protect student data and meet regulatory requirements (Bernard, 2020). Robust security frameworks mitigate breaches, critical for safeguarding research and records (ED, 2020).

2.3.2.2 Challenges

1. **High Initial Costs**: The upfront investment required for implementing EA can be substantial, including costs related to software, hardware, training, and consultancy services. This financial burden may be a barrier for some institutions, particularly smaller ones with limited budgets. However, it's important to consider the long-term benefits and potential cost savings that EA can bring. (Capstera, 2023; MEGA International, 2024).
2. **Complexity**: Integrating various systems and processes within an institution can be highly complex, requiring specialized expertise and meticulous planning. The complexity of EA initiatives can be daunting, and any missteps can lead to disruptions in academic and administrative functions. Institutions may need to hire external consultants or invest in training for existing staff to manage this complexity effectively. Integrating legacy systems with modern IT infrastructure requires specialized expertise (Capstera, 2023). Missteps risk disrupting academic operations (MEGA International, 2024).
3. **Resistance to Change**: Faculty and staff may resist changes to established processes and workflows, making it challenging to implement EA initiatives. Overcoming this resistance requires effective change management strategies, including clear communication, training, and involvement of stakeholders in the planning process. For example, demonstrating the benefits of new systems through pilot projects can help gain buy-in from reluctant staff. Faculty and staff reluctance to adopt new workflows necessitates change management strategies, such as pilot projects (LeanIX, 2024). Overcoming siloed mindsets is critical (MEGA International, 2024).
4. **Ongoing Maintenance**: Maintaining and updating the EA framework is an ongoing effort that requires continuous resources and attention. This includes regular updates to software, hardware maintenance, and ongoing training for staff. Institutions must be prepared to allocate sufficient resources for the long-term sustainability of EA initiatives. Continuous updates and staff training demand sustained resources (MEGA

International, 2024). Failure to maintain EA frameworks can lead to obsolescence (Capstera, 2023).

5. **Scalability Issues**: As educational institutions grow and evolve, the EA framework must be scalable to accommodate new requirements and challenges. Ensuring scalability can be difficult, particularly if the initial architecture is not designed with future growth in mind. Institutions need to adopt flexible and adaptable EA solutions that can evolve with their changing needs. Designing flexible architectures to accommodate growth, such as rising enrolments, remains challenging (Bernard, 2020). Inflexible initial designs hinder adaptation (ED, 2020).

In summary, benefits such as improvements in efficiency and decision-making, besides cost savings accrued from the enterprise architecture implementation of education, come along with challenges associated with the high cost of initial steps, complexity, and resistance. Careful planning, effective management of change, and long-term commitment to its maintenance and further evolution are expected to overcome some of these problems.

2.4 Understanding School Transformation in Odisha

2.4.1 External Transformation: The 5T Initiative with Colourful Schools in Odisha

Through the Colourful Schools program, Odisha's 5T initiative—which stands for Teamwork, Technology, Transparency, Transformation, and Time—has drastically changed the state's educational system. This initiative has focused on modernizing school infrastructure and enhancing educational facilities, leading to visible changes in the learning environment and student engagement.

Key Aspects of the 5T Initiative

Modernization of Infrastructure: The 5T initiative has equipped schools with smart classrooms, e-libraries, modern science labs, and vibrant campuses. For instance, the Puri

Zilla School now features eighteen smart classrooms and two science labs, significantly improving the learning experience for students (Hindustan Times, 2023).

Enhanced Learning Facilities: The program has introduced various amenities such as adequate drinking water provisions, sanitation facilities, and sports facilities. This comprehensive approach aims to create a conducive learning environment and promote holistic development among students (Hindustan Times, 2023).

Teacher Recruitment and Training: To address the shortage of teachers, the Odisha government has recruited 20,000 teachers over the past two years and created additional posts to ensure uninterrupted teaching. This effort is part of the broader goal to improve educational quality and outcomes (Hindustan Times, 2023).

Community Involvement: The initiative also emphasizes the involvement of local communities and alumni through the "Mo School Abhiyan" (My School Program), which encourages contributions to school development, matched by state funding (Hindustan Times, 2023).

Impact on Students

The transformation has led to increased student engagement and interest in subjects like science and technology. For example, students at the Kushabhadra Government High School in Khurda district have shown a renewed interest in science due to the introduction of smart classrooms and modern laboratories (Hindustan Times, 2023).

The 5T initiative in Odisha represents a significant external transformation in the state's education system, focusing on infrastructure modernization and enhanced learning facilities. This program has successfully created a more engaging and supportive educational environment, benefiting both students and teachers.

2.4.2 Internal Transformation – Focus area for Enterprise Architect

Internal transformation within a School focusing on leadership, innovation, and organizational culture is a multifaceted endeavour. Enterprise/Business Architecture (EA/BA) can play a crucial role in supporting and driving this transformation. Here are some ways in which EA/BA can contribute:

2.4.2.1 Leadership

Strategic Alignment: EA/BA ensures that the leadership's vision and strategic objectives are aligned with the operational and technological capabilities of the organization. This alignment helps in setting clear goals and expectations (Niemi and Pekkola, 2019).

Decision-Making Framework: By providing a structured approach to decision-making, EA/BA helps leaders make informed choices that are consistent with the organization's long-term strategy (Niemi and Pekkola, 2019).

Change Management: EA/BA facilitates effective change management by mapping out the current and desired future states of the organization, helping leaders to navigate transitions smoothly (Niemi and Pekkola, 2019).

2.4.2.2 Innovation

Identifying Opportunities: EA/BA can help identify areas where innovation can have the most significant impact by analysing existing processes and systems (Niemi and Pekkola, 2019).

Resource Optimization: By providing a clear view of the organization's resources and capabilities, EA/BA helps in optimizing the allocation of resources towards innovative projects (Niemi and Pekkola, 2019).

Risk Management: EA/BA aids in identifying potential risks associated with innovation and in developing mitigation strategies (Niemi and Pekkola, 2019).

2.4.2.3 Organizational Culture

Cultural Assessment: EA/BA can be used to assess the current organizational culture and identify areas that need change to support the transformation (Niemi and Pekkola, 2019).

Communication and Engagement: EA/BA facilitates better communication and engagement across various levels of the organization, ensuring that everyone is aligned with the cultural change initiatives (Niemi and Pekkola, 2019).

Continuous Improvement: By fostering a culture of continuous improvement, EA/BA helps in sustaining the transformation over the long term (Niemi and Pekkola, 2019).

In summary, Enterprise/Business Architecture provides a comprehensive framework that supports internal transformation by aligning leadership, fostering innovation, and nurturing a positive organizational culture. It guarantees that every facet of the company functions in unison to accomplish the intended transformation objectives (Niemi and Pekkola, 2019).

2.5 Summary and Gaps from the Literature Review

In order to overcome the obstacles and take advantage of the potential in corporate architecture and education, the study urges sustained efforts and flexible approaches. The topic's importance in connection to literature is shown by this synthesis of findings, which also shows the necessity of further study and the use of creative solutions to improve educational outcomes in Odisha through the use of an outcome-oriented, value-driven framework.

2.5.1 Research Gap

2.5.1.1 Lack of Outcome-Oriented Enterprise Architecture Approach

Applications of Enterprise Architecture (EA) as a strategic framework to Odisha's educational system's problems have not been examined in prior research. There is a need for research that investigates how EA can be used to align educational strategies with

broader drivers, goals and improve overall efficiency and effectiveness. Although EA studies have been conducted in Spanish higher education, HERM model by UCISA in UK, UEAF under IndEA in India and others these primarily focus on higher education purposes and do not address the specific needs of primary and secondary education in Odisha.

2.5.1.2 Lack of Focus on K-12 Education

The Spanish Higher Education Architecture (The Open Group, Spanish Higher Education, 2024) and the UCISA (Universities and Colleges Information Systems Association) EA Group in the UK (UCISA, 2023) primarily addresses higher education and do not cover the specific needs and challenges of K-12 primary/elementary education. This is a significant gap as the educational strategies, resources, and administrative requirements for K-12 education differ from those in higher education.

2.5.1.3 Absence of Comprehensive EA Framework for K-12

There is no mention of a tailored EA framework that addresses the unique needs of K-12 education. This includes curriculum development, student assessment, teacher training, community building, collaboration with external 3rd party and resource management specific to primary and secondary education.

2.5.1.4 Limited Discussion on Early Education and Child Development

The literature does not discuss the integration of early childhood education and developmental needs within the EA framework. Early education is crucial for laying the foundation for lifelong learning and development.

2.5.1.5 Inadequate Consideration of Rural and Marginalized Communities

The challenges faced by rural and marginalized communities in accessing quality education are not adequately addressed. There is a need for strategies that ensure equitable access to educational resources and support for these communities.

2.5.1.6 Limited consideration of Value-Based Framework

Existing research has a limited scope of value-based framework that translates visionary goals into practical, actionable steps. There is a need for a comprehensive approach that integrates stakeholder engagement, evidence-based strategies, and measurable outcomes to drive positive transformation in Odisha's educational landscape.

2.5.1.7 No Discussion on Skill-Based Learning and Lifelong Learning

Existing research does not address the importance of skill-based learning and lifelong learning. These aspects are crucial for preparing students for the evolving job market and ensuring continuous personal and professional development throughout their lives.

2.5.1.8 Lack of Entrepreneurial Approach for a Better World

Existing literature on Education Enterprise Architecture (EEA) often focuses on aligning IT systems with educational goals, optimizing resources, and improving data management. However, there is a noticeable gap in addressing the integration of an entrepreneurial approach within EEA frameworks. Entrepreneurial thinking, which emphasizes innovation, risk-taking, initiative-taking, and problem-solving, is crucial for fostering a dynamic and forward-thinking educational environment. Unfortunately, most EEA literature does not cover how to embed entrepreneurial principles into the architecture of educational institutions, which could drive more innovative and sustainable solutions for a better world (The Open University, 2015; EasyBib, 2020).

2.5.1.9 Lack of Product /Tool Centric Implementation Approach

The current body of literature on Education Enterprise Architecture tends to emphasize strategic alignment, governance, and process optimization without adequately addressing the importance of a product/tool-centric implementation approach like SAP LeanIX, SAP Signavio, Mega, Alfabet/ARIS by Software AG. Such an approach focuses

on the practical deployment and integration of specific tools and technologies that can directly enhance educational outcomes. This gap means that while theoretical frameworks and high-level strategies are well-documented, there is insufficient guidance on selecting, implementing, and managing the actual products and tools that can bring these strategies to life in educational settings. This oversight can lead to challenges in effectively translating strategic plans into actionable and impactful technological solutions (DkIT, 2024; Perpustakaan UGM, 2024).

CHAPTER III:

METHODOLOGY

3.1 Overview of the Research Problem

The state of Odisha in India faces multifaceted challenges in providing equitable, high-quality education to its diverse population. Despite progress in recent years, significant disparities persist in educational access, quality, and outcomes, particularly affecting rural and marginalized communities. This research aims to critically examine the complex interplay of factors contributing to these educational challenges and develop evidence-based strategies for systemic improvement.

3.1.1 Key Research Areas

1. Educational Access and Equity
    - Investigate the disparities in educational access across different regions and socioeconomic groups in Odisha. This includes examining:
    - The impact of geographical location on school attendance and completion rates
    - Socioeconomic factors influencing educational participation
    - Gender-based disparities in educational opportunities
2. Quality of Education

    Analyse the factors affecting the quality of education in Odisha, focusing on:
    - Curriculum relevance and alignment with national standards
    - Pedagogical practices and their effectiveness
    - The role of technology in enhancing learning outcomes
3. Resource Allocation and Infrastructure

    Examine the distribution and utilization of educational resources across the state, including:
    - Teacher availability and qualifications
    - Infrastructure adequacy, particularly in rural areas

- Technological resources and their integration into the educational system

4. Policy Implementation and Governance

- Evaluate the effectiveness of current educational policies and governance structures in Odisha, considering:
- Policy coherence and implementation challenges
- The impact of bureaucratic processes on educational outcomes
- Strategies for improving policy effectiveness and accountability

5. Socio-cultural Factors

Investigate the influence of socio-cultural factors on educational participation and achievement, including:

- Language barriers in education, particularly for tribal communities
- Cultural attitudes towards education, especially girls' education
- The role of community engagement in educational improvement

3.1.2 Research Objectives

1. To carry out a thorough examination of Odisha's educational system as it is today, highlighting major issues and their underlying causes.
2. To create a theoretical framework for comprehending the intricate relationships between different elements influencing the state's educational results.
3. To assess how well the current educational policies and strategies are working to address the issues that have been identified.
4. To propose evidence-based strategies and policy recommendations for improving educational access, quality, and equity in Odisha.
5. To contribute to the larger scholarly conversation on educational development in many sociocultural situations with limited resources.

3.1.3 Methodological Approach

A mixed-methods approach will be used in this study, combining:

- Quantitative analysis of statistics and educational data
- Qualitative research using focus groups, interviews, and case studies

- Policy analysis and comparative studies with other states or countries facing similar challenges

3.2 Operationalization of Theoretical Constructs

In the context of research on education in Odisha, operationalization of theoretical constructs is a crucial step to transform abstract concepts into measurable variables. This process allows for systematic study and analysis of the complex educational challenges in the state. The following explanation outlines how operationalization can be applied to this research:

3.2.1 Operationalization Process

The operationalization process involves three main steps:

1. Identifying key concepts
2. Choosing variables to represent these concepts
3. Selecting indicators to measure the variables

1. Identifying Key Concepts

Based on the research problem, some key theoretical constructs include:

- Educational access
- Quality of education
- Resource allocation
- Policy effectiveness
- Socio-cultural factors

2. Choosing Variables

For each concept, variables that represent different aspects are selected:

Educational Access:

- School enrolment rates
- Dropout rates
- Distance to nearest school

Quality of Education:

- Student achievement scores
- Teacher qualifications

- Curriculum relevance

Resource Allocation:

- Per-student expenditure
- Student-teacher ratio
- Availability of learning materials

Policy Effectiveness:

- Implementation rate of educational policies
- Alignment of local practices with state policies
- Stakeholder satisfaction with policy outcomes

Socio-cultural Factors:

- Parental education levels
- Community attitudes towards education
- Language of instruction vs. home language

3. Selecting Indicators

For each variable, specific, measurable indicators are chosen:

Example: Quality of Education

Variable: Student achievement scores

Indicators:

- Average scores in standardized state tests
- Percentage of students meeting grade-level proficiency
- Year-over-year improvement in test scores

3.2.2 Benefits of Operationalization in Research

1. Improved Reliability and Validity: By clearly defining how educational quality or access will be measured, consistency across the study is ensured, and comparisons with other research are enabled.

2. Enhanced Objectivity: Operationalization reduces subjectivity in assessing complex issues like policy effectiveness or socio-cultural impacts on education.

3. Quantifiable Data: It allows for the collection and analysis of numerical data on abstract concepts like "quality of education," facilitating statistical analysis and evidence-based conclusions.

4. Replicability: Other researchers can use the operational definitions to conduct similar studies in different regions of Odisha or other states, enhancing the generalizability of the findings.

3.2.3 Challenges and Considerations

1. Construct Validity: It is essential to ensure that the chosen indicators truly reflect the theoretical constructs. For instance, the adequacy of standardized test scores in representing educational quality should be critically examined.

2. Multidimensionality: Some constructs, like "educational access," may be multidimensional. Consideration should be given to using multiple indicators to capture different aspects.

3. Context Specificity: The operationalization should be adapted to the unique context of Odisha. For example, indicators of educational quality in urban areas may differ from those in rural or tribal regions.

4. Measurement Limitations: Awareness of potential measurement errors or biases in the chosen indicators is crucial. For instance, self-reported data on community attitudes might be subject to social desirability bias.

By carefully operationalizing theoretical constructs, the gap can be bridged between abstract concepts and empirical research, allowing for a systematic and rigorous examination of Odisha's educational challenges. This approach strengthens the scientific basis of the study and enhances its potential impact on educational policy and practice in the state.

3.3 Research Purpose and Questions

The research purpose and questions for this study focus on the implementation and challenges of Enterprise Architecture (EA) in Odisha's government school education system. The research aims to explore the effective application of EA principles, identify

key challenges, and determine best practices for successful implementation. The following presents an edited and expanded version of the research purpose and questions:

3.3.1 Research Purpose

This study's main goal is to look into how Enterprise Architecture (EA) is being used in the government school system in Odisha. The goal of the study is to comprehend how EA principles may be successfully used to enhance the composition, workflow, and general effectiveness of the educational system. The study also seeks to determine the obstacles to EA adoption in this particular setting and investigate possible solutions. By examining successful EA implementations, the research intends to identify best practices that can guide future efforts in Odisha's education sector.

3.3.2 Research Questions (RQ)

The study addresses the following key research questions:

RQ1: Implementation and Challenges of Enterprise Architecture

1. How can EA principles be effectively implemented in Odisha's government school education system?

This question aims to explore the practical application of EA principles within the context of Odisha's government schools. It seeks to identify the most suitable EA frameworks, methodologies, and tools that can be adapted to the unique needs of the state's education system. The research will investigate how EA can be used to align educational processes, technology infrastructure, and organizational goals to enhance overall system performance.

2. What are the key challenges associated with EA adoption in this context, and how can they be mitigated?

This question focuses on identifying the specific obstacles that may hinder the successful implementation of EA in Odisha's government school education system. It will examine various factors such as organizational resistance, resource constraints, technological limitations, and cultural barriers. The research will also explore potential

strategies to overcome these challenges, including change management approaches, capacity building initiatives, and stakeholder engagement methods.

3. What best practices can be identified to ensure successful EA implementation?

This question aims to distil key insights from successful EA implementations in similar contexts or other relevant sectors. It will investigate proven strategies, methodologies, and approaches that have led to positive outcomes in EA adoption. The research will examine case studies, expert opinions, and empirical evidence to identify transferable best practices that can be applied to Odisha's government school education system.

The study intends to offer a thorough grasp of the possibilities for EA implementation in Odisha's education sector by answering these research issues. In addition to addressing the particular possibilities and problems in this context, the findings will aid in the creation of practical plans for enhancing the state's educational system via the implementation of EA principles.

The following research questions represent potential avenues for future investigation that extend beyond the scope of the current study. While these areas are not addressed in the present research, they offer promising directions for subsequent inquiries into the transformation of Odisha's government school education system:

3.3.3 Future Research Directions

It is important to note that the following questions are not within the scope of the current research but represent valuable areas for future exploration:

3.3.3.1 RQ2: Impact of Digital Technologies in Education

Future studies could examine:

The influence of digital technology integration on teaching methods, student engagement, and overall educational transformation in Odisha's government schools.

The specific benefits and potential drawbacks associated with technology integration in this context.

3.3.3.2 RQ3: Leadership Analytics for Improved Outcomes

Subsequent research might investigate:

The impact of leadership analytics on decision-making processes within Odisha's government school education system.

How leveraging data-driven insights can contribute to improved educational outcomes for students.

3.3.3.3 RQ4: Addressing Educational Disparities

Future inquiries could explore:

The ways in which leadership analytics and EA strategies can address existing educational disparities among different regions and communities within Odisha.

How these data-driven approaches can promote greater equity and access to quality education.

3.3.3.4 RQ5: Policy Implications and Government Support

Further research might consider:

The policy changes and government support are necessary for the widespread adoption of leadership analytics and EA in Odisha's education sector.

How effective policy frameworks can be developed to facilitate sustainable improvements in the state's education system.

These future research questions aim to build upon the foundation laid by the current study, exploring the long-term implications and potential of digital technologies, leadership analytics, and EA strategies in Odisha's educational context. By addressing these questions in future studies, researchers can continue to contribute valuable insights to the ongoing transformation and improvement of the state's government school education system.

3.4 Research Design

The research design employing a participatory method is highly relevant for studying Enterprise Architecture (EA) in Odisha's educational landscape. This approach offers numerous benefits that align well with the complex nature of the research topic and the diverse stakeholders involved. The following justification and edited version of the rationale emphasize the relevance of this research design:

3.4.1 Research Design: Rationale for Participatory Method

The adoption of a participatory research method for studying Enterprise Architecture (EA) in Odisha's educational landscape is justified by its potential to generate comprehensive, context-specific insights and foster sustainable change. This approach is particularly relevant due to the following factors:

3.4.1.1 Enhanced Stakeholder Engagement and Contextual Understanding

Participatory methods actively involve key stakeholders such as educational leaders, teachers, students, parents, and community members throughout the research process. This engagement is crucial for understanding the nuanced context of Odisha's education system and ensuring that the implementation of EA principles aligns with local needs and realities. By incorporating diverse perspectives, the research can identify context-specific challenges and opportunities that may not be apparent through traditional research methods.

3.4.1.2 Co-Creation of Knowledge and Practical Solutions

The collaborative nature of participatory research facilitates the co-creation of knowledge, drawing on the expertise and experiences of various stakeholders. This approach is particularly relevant for studying EA implementation, as it combines theoretical frameworks with practical insights from those directly involved in the education system. The resulting knowledge is likely to be more comprehensive and applicable, leading to more effective strategies for EA adoption.

3.4.1.3 Empowerment and Capacity Building

Engaging stakeholders in the research process empowers them to contribute to decision-making and builds their capacity to understand and implement EA principles. This aspect is crucial for the long-term success of EA initiatives in Odisha's education system, as it fosters ownership and sustainability of the proposed changes.

3.4.1.4 Increased Relevance and Impact

By aligning research objectives with stakeholders' interests and priorities, participatory methods enhance the relevance and applicability of research findings. This alignment is essential for studying EA implementation, as it ensures that the proposed

solutions address real-world challenges and are more likely to be adopted by the education system.

3.4.1.5 Ethical Considerations and Trust-Building

The participatory approach prioritizes ethical considerations such as respect for stakeholders' autonomy and informed consent. This focus on ethics is particularly relevant in the context of educational research, where trust between researchers and participants is crucial for obtaining accurate and meaningful data.

3.4.1.6 Addressing Complexity and Systemic Change

EA implementation in education involves complex, systemic changes. Participatory methods are well-suited to address this complexity by providing a holistic view of the system and facilitating the development of comprehensive, multi-faceted solutions.

In conclusion, the participatory research method is highly relevant for studying EA in Odisha's educational landscape. It offers a comprehensive approach that enhances stakeholder engagement, co-creates contextually relevant knowledge, empowers participants, increases research impact, and addresses the complexity of systemic change in education. This method aligns well with the research questions focused on effective EA implementation, challenge mitigation, and best practices identification, promising to yield insights that are both theoretically sound and practically applicable.

3.5 Population and Sample

3.5.1 Sample Demographics

The demographic profile of the survey respondents provides key insights into the composition of the sample, which is crucial for understanding the perspectives represented in this study. Below is a detailed breakdown of the demographic characteristics based on roles, educational qualifications, and professional experience.

3.5.2 Role Distribution

The distribution of survey respondents by role reflects a diverse representation of stakeholders within the educational ecosystem in Odisha. The majority of respondents

were teachers, followed by parents, alumni, and a smaller proportion of policymakers and influencers.

Teachers: 70%

Parents: 15%

Alumni: 10%

Policy Makers/Influencers: 5%

This distribution suggests that the perspectives of educators are heavily represented in the sample, which is expected given their direct involvement in the day-to-day operations of educational institutions. However, the relatively lower representation of policymakers may be due to political climate changes and limited responses from government officials in top positions.

3.5.3 Distribution of Survey Respondents by Role

Educational Qualifications

The vast majority (95%) of respondents hold at least a Bachelor's or Master's degree, indicating a highly educated sample population. Only 5% reported having qualifications other than a Bachelor's or Master's degree.

-Bachelor's/Master's Degree: 95%

-Other Qualifications: 5%

This high level of educational attainment suggests that respondents are likely to have a strong understanding of educational practices and policies, which enhances the reliability and depth of their responses regarding Enterprise Architecture (EA) implementation in the education sector.

Educational Qualifications of Survey Respondents

Years of Professional Experience

The experience levels of respondents indicate that a significant portion has extensive experience in their respective roles within the education system:

-10+ years of experience: 70%

-Less than 10 years: 30%

The fact that 70% of respondents have over a decade of professional experience highlights that the sample is composed largely of seasoned professionals who can provide informed insights into both historical and contemporary challenges within Odisha's education system.

Geographic Distribution

While specific geographic data on respondents was not collected in detail, it is noted that participants come from 25 out of Odisha's 30 districts. This broad geographic representation ensures that the study captures diverse regional perspectives, which is critical for understanding how EA implementation might vary across different areas with distinct socio-economic and cultural contexts.

3.6 Participant Selection

The selection of participants is a crucial aspect of the research process, particularly when studying Enterprise Architecture (EA) in Odisha's educational landscape. An edited and refined version of the participant selection process is presented below, highlighting how pertinent it is to the goals of the study:

The selection of participants for this study on EA implementation in Odisha's government school education system is guided by the following key considerations:

3.6.1 Stakeholder Diversity

Participants will be selected to represent a diverse range of stakeholders within Odisha's educational sector. A thorough understanding of the potential and difficulties related to EA implementation requires this variety. Important stakeholder groups consist of:

- Educational leaders and administrators
- Teachers and academic staff
- Students (where appropriate and ethically permissible)
- Parents and community members
- Policymakers and government officials
- Technology experts and IT professionals in education

3.6.2 Inclusion Criteria

Participants will be selected based on the following inclusion criteria:

- Relevant expertise or experience in educational administration, technology integration, or organizational management within Odisha's government school system
- Direct involvement in or significant knowledge of current educational practices and challenges in Odisha
- Willingness to engage in participatory research activities and share insights

3.6.3 Recruitment Strategies

Participant recruitment will involve:

- Formal invitations through official channels in the education department
- Email correspondence and professional networks
- Collaboration with educational institutions and community organizations
- Utilization of social media platforms to reach a broader audience of potential participants

All recruitment communications will clearly outline the research objectives, participant roles, and expected time commitments.

The selection process will adhere to strict ethical guidelines, including:

- Ensuring voluntary participation and obtaining informed consent
- Maintaining confidentiality and protecting participants' privacy
- Respecting cultural sensitivities and local norms
- Providing clear information about the research purpose and potential outcomes

3.6.4 Relevance to Research Objectives

This participant selection approach is directly aligned with the research questions focused on EA implementation, challenges, and best practices in Odisha's education system. By including a diverse range of stakeholders and employing strategic sampling techniques, the study aims to gather comprehensive insights that reflect the complex realities of the educational landscape.

The selected participants will contribute valuable perspectives on:

- The practical application of EA principles in Odisha's schools
- Specific challenges faced in EA adoption and potential mitigation strategies
- Successful practices and approaches that can be applied or adapted

In conclusion, this participant selection process is designed to ensure that the research captures a holistic view of EA implementation potential in Odisha's education sector. By prioritizing stakeholder diversity, employing strategic sampling, and adhering to ethical considerations, the goal of the project is to provide results that are both realistically applicable to enhancing the government school education system in Odisha and rigorously scholarly.

3.7 Data Collection Procedures & Instrumentation

Data collection techniques play a crucial role in gathering relevant information, insights, and perspectives from participants regarding EA in Odisha's educational landscape. Key data collection techniques to be employed include:

3.7.1 Quantitative Survey

3.7.1.1 Surveys and questionnaires

Surveys and questionnaires enable the collection of quantitative data on participants' demographics, attitudes, perceptions, and behaviours related to EA, allowing for statistical analysis and generalization of findings to a larger population.

3.7.1.2 Document Analysis

Analysis of documents includes a methodical examination and interpretation of relevant documents, reports, policies, and organizational documents related to EA initiatives in Odisha's educational institutions, providing contextual insights and supporting data triangulation.

3.7.1.3 Strategic Sampling Techniques

To ensure that the selected participants can provide valuable insights relevant to the research questions, the following sampling techniques will be employed:

- Purposive Sampling: Participants will be selected based on their specific roles, expertise, and experience related to educational governance, technology integration, and organizational management in Odisha's education system.

- Snowball Sampling: Initial participants may be asked to recommend other relevant stakeholders, helping to identify key informants who might otherwise be overlooked.

- Stratified Sampling: Participants will be selected from different levels of the educational hierarchy and various geographical regions within Odisha to ensure comprehensive representation.

3.7.2 Qualitative Aspects

Interpretation of Emotions: Sentiment analysis involves understanding and interpreting the emotions and opinions expressed in textual data. This is inherently qualitative as it deals with subjective human experiences and feelings.

3.7.2.1 Context and Nuance

The analysis often requires understanding the context and nuances of language, including sarcasm, tone, and implicit meanings, which are qualitative. Different books, articles, and journals will be collected from scholarly databases and kept in place to manage the analysis at best.

3.7.2.2 Observations

Observational techniques involve direct observation of participants' behaviours, interactions, and practices within educational settings, providing insightful information about how EA is implemented and how it affects stakeholder relationships and organisational dynamics.

3.7.2.3 Ethical Considerations

Techniques for gathering data should follow moral guidelines, such as informed consent, confidentiality, voluntary engagement, and respect for participants' rights and privacy, ensuring that data collection processes are conducted in a manner that upholds ethical standards.

3.7.2.4 Sampling and Questionnaire

Surveys and questionnaires enable the collection of quantitative data on participants' demographics, attitudes, perceptions, and behaviours related to EA, allowing for statistical analysis and generalization of findings to a larger population. 100 People

will be considered for the survey. These will include Odissa's BDO and officers of education.

3.7.2.5 Quantitative Survey Questions:

- On a scale of 1 to 5, how effective do you find the current educational strategies in your district?
- How often do you use technology and information systems to manage educational activities? (Never, Rarely, Sometimes, Often, Always)
- How engaged are the stakeholders, in your opinion (teachers, parents, community members), in educational programs in your district? (1 - Very Low, 5 - Very High)
- To what extent do you believe that aligning educational strategies with broader state and national goals can improve educational outcomes? (1 - Not at all, 5 - To a great extent)
- How frequently do you encounter barriers when implementing new educational initiatives? (Never, Rarely, Sometimes, Often, Always)
- How would you rate the availability of resources needed to address educational challenges in your district? (1 - Very Poor, 5 - Excellent)
- On a scale of 1 to 5, to what extent do you understand the Enterprise Architecture (EA) concept?
- How likely are you to support the adoption of a value-based framework that integrates stakeholder engagement and evidence-based strategies in your district? (1 - Very Unlikely, 5 - Very Likely)
- How important do you think it is to measure the success and impact of educational programs? (1 - Not Important, 5 - Very Important)
- How would you rate the overall quality of education in your district? (1 - Very Poor, 5 - Excellent)

3.7.2.6 Incentives for Participation

To ensure higher participation rates, the surveys and interviews will be incentivized by providing:

- Education toolkits
- Access to learning platforms
- Training content
- Leadership mentoring
- Industry orientation

These incentives are designed to engage participants by offering valuable resources that can aid in their professional development and enhance their ability to implement effective educational strategies.

3.8 Data Analysis

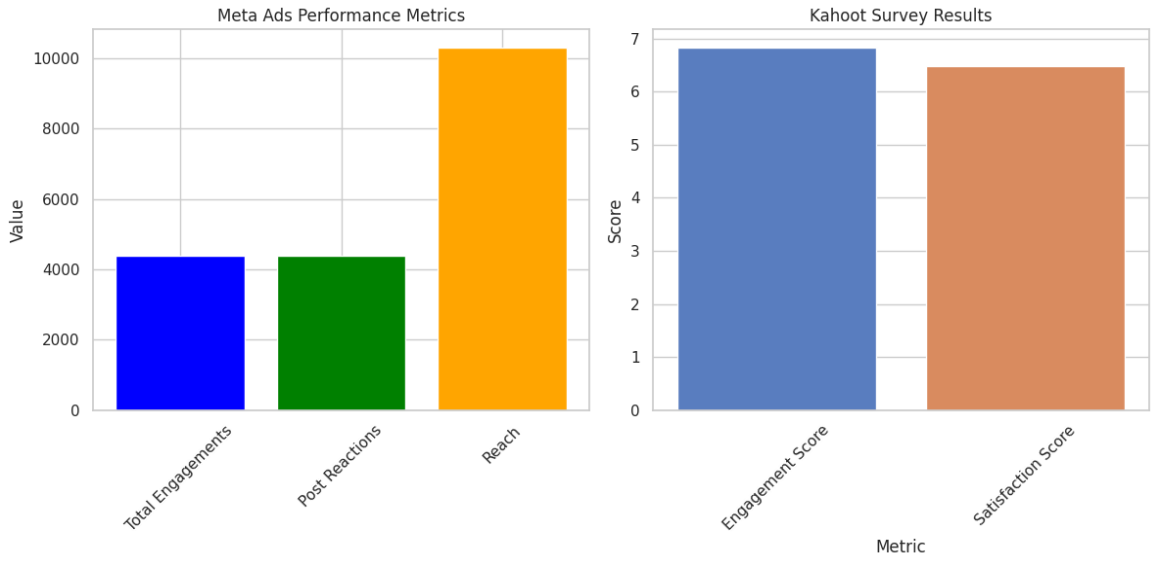

Figure 3.1 Data Analysis

3.8.1 Quantitative Data Analysis Results

The quantitative analysis of the digital marketing campaign, combining Meta Ads performance metrics and Kahoot survey results, provides insights into user engagement and satisfaction. The analysis is summarized as follows:

3.8.1.1 Meta Ads Performance Metrics

The first part of the analysis focuses on the performance of the Meta Ads campaign, which reached 10,307 unique users over 7 days. Key metrics include:

- Total Post Engagements: 4,384
- Post Reactions: 4,377
- Reach: 10,307
- Cost per Engagement (CPE): ₹0.13 (calculated based on hypothetical expenditure)

Engagement Rate:

- The engagement rate was calculated as the percentage of users who engaged with the post out of the total reach:
  - Engagement Rate: 42.53%

Reaction Rate:

- The reaction rate was similarly calculated as the percentage of users who reacted to the post out of the total reach:
  - Reaction Rate: 42.47%

These metrics indicate a high level of content resonance with the target audience, as nearly half of those reached engaged with or reacted to the posts.

3.8.1.2 Kahoot Survey Results

The second part of the analysis focuses on user feedback collected through a Kahoot survey from a subset of respondents (2,591 out of 10,307 reached users). The survey assessed two key dimensions:

- Engagement Score: 6.83/10
- Satisfaction Score: 6.49/10

The survey results suggest moderate levels of user engagement and satisfaction, with scores slightly above average but not exceptionally high. Additionally, the interaction level was qualitatively assessed as "Low," indicating that while users engaged with the content, deeper interaction may have been limited.

3.8.1.3 Visual Representation

The attached bar charts provide a visual summary of both datasets:

- The left chart illustrates Meta Ads performance metrics, showing total engagements, post reactions, and reach.
- The right chart presents Kahoot survey results, highlighting engagement and satisfaction scores.

3.8.1.4 Summary

The quantitative data reveals that while the Meta Ads campaign achieved strong engagement rates (42.53%) and reaction rates (42.47%) relative to its reach, user satisfaction and interaction levels were moderate according to the Kahoot survey results. This suggests that while the campaign effectively captured attention, there may be room for improvement in fostering deeper user interaction and satisfaction.

These findings provide valuable insights for refining future digital marketing strategies by balancing high engagement with enhanced user experience and satisfaction.

3.8.2 Qualitative Data Analysis Results

Qualitative analysis in the context of Odisha's K-12 education system and Enterprise Architecture (EA) offers a nuanced approach to understanding the complex interplay of factors shaping educational outcomes and organizational efficiency. This method involves in-depth exploration of stakeholders' experiences, perceptions, and challenges within the education ecosystem. By conducting interviews with teachers, administrators, students, and parents, as well as observing classroom dynamics and analysing policy documents, researchers can gain valuable insights into the unique cultural, socio-economic, and infrastructural factors influencing education in Odisha. In the context of Enterprise Architecture, qualitative analysis helps uncover the intricate

relationships between various components of the educational system, including technology infrastructure, information flows, and organizational processes. This approach is particularly valuable in identifying barriers to implementation, understanding resistance to change, and identifying areas for development that might not be seen using only quantitative measures. By fusing EA concepts with qualitative insights, policymakers and educators in Odisha can develop more holistic, context-sensitive strategies to enhance educational quality, improve operational efficiency, and align technological innovations with pedagogical needs and cultural realities of the region.

Table 3.1 Qualitative Response Data

Name (changed)	Role	Response
Anjali Patra	Award-winning teacher	"The primary challenge is reaching students in remote tribal areas. We've had success with mobile education vans and community learning centres, but need more resources to scale up. Technology like educational tablets and satellite internet could be transformative if implemented widely."
Rajesh Mohanty	District Education Officer	“Aligning with state and national goals is crucial. We map our district plans to Odisha School Education Programme objectives and SDG 4 targets. Regular review meetings help track progress. Main barriers are budget constraints and teacher shortages in rural areas."

Sujata Mishra	Principal	"Technology is key for improving outcomes. We've seen great results from smart classrooms and personalized learning apps. But many schools still lack basic digital infrastructure. A comprehensive ed-tech policy and funding is needed at the state level."
Manoj Sahoo	Block Education Officer	"Community engagement is vital. We run regular parent-teacher meetings and gram Sabha outreach. Resistance to girls' education is still an issue in some areas. Incentive programs and awareness campaigns have helped increase enrolment."
Sunita Nayak	Teacher	"Measuring impact is challenging. We track enrolment, attendance, and test scores. But softer outcomes like student engagement are harder to quantify. A more holistic assessment framework would be beneficial."
Prakash Jena	Education Researcher	"Enterprise Architecture could greatly improve efficiency. It would help integrate fragmented systems and data flows. But implementation would require significant capacity building at district and block levels."
Mamata Panda	Teacher Trainer	"Teacher training is a major need. Many are not equipped to use new pedagogies or technologies. Continuous

		professional development programs linked to career progression could address this."
Bijay Sahu	Education NGO Director	"A value-based framework is essential. It should emphasize equity, inclusion and 21st century skills. Stakeholder co-creation and evidence-based iteration of programs is key for sustainable impact."
Sasmita Behera	School Management Committee Chair	"Parent and community involvement makes a huge difference. Our SMC actively supports school improvement. But we need more training on roles and responsibilities, and ways to contribute effectively."
Debabrata Das	Education Technology Entrepreneur	"There's huge potential for ed-tech in Odisha. Adaptive learning, AR/VR, and AI-enabled assessments could transform outcomes. But it needs to be implemented thoughtfully with teacher buy-in and proper infrastructure."

Based on the sentiment analysis performed using Text Blob, here's an interpretation of the sentiment for each of the 10 responses:

- Remote education challenge: Slightly positive (0.21) with low subjectivity (0.31)
- Aligning with educational goals: Neutral (0.04) with moderate subjectivity (0.35)

- Technology in education: Moderately positive (0.25) with high subjectivity (0.50)
- Community engagement: Neutral (0.05) with low subjectivity (0.24)
- Measuring educational impact: Moderately positive (0.30) with high subjectivity (0.50)
- Enterprise Architecture: Very positive (0.59) with very high subjectivity (0.81)
- Teacher training needs: Slightly positive (0.20) with moderate subjectivity (0.39)
- Value-based framework: Neutral (0.00) with moderate subjectivity (0.43)
- Parent and community involvement: Moderately positive (0.34) with high subjectivity (0.70)
- Ed-tech potential in Odisha: Slightly positive (0.20) with high subjectivity (0.63)

Overall, the sentiment analysis reveals that most responses have a neutral to positive sentiment, with varying degrees of subjectivity. The response about Enterprise Architecture stands out as the most positive and subjective, while the discussion on community engagement is the most neutral and objective. This analysis suggests that the educators generally have an optimistic outlook on the potential for improvement in various aspects of education in Odisha, while also recognizing the challenges they face.

3.8.3 Case Study of 12 initiatives at district level

3.8.3.1 Case Studies Analysis

The research incorporated 12 mini case studies across different districts of Odisha, examining various aspects of educational transformation through Enterprise Architecture (EA) and community engagement initiatives. These case studies were developed using government documentation and the 'Mo School' website data. Here's a systematic breakdown of the case studies:

3.8.3.2 Geographic Distribution and Focus Areas

1. Khurda District

- Case Study 01: Focused on the 4V Framework for educational transformation
- Emphasis on visionary transformation in education

2. Baripada

- Case Study 02: Youth empowerment through community engagement
- Focus on educational development initiatives

3. Kalahandi

- Case Study 03: Enterprise Service Architecture implementation in remote areas
- Addressing educational service delivery challenges

4. Cuttack

- Case Study 04: Educational infrastructure revitalization
- Case Study 10: Ravenshaw Collegiate School transformation study
- Both cases emphasize community synergy and modern educational practices

5. Nuapada

- Case Study 05: Alumni engagement and EA implementation
- Focus on transformative educational practices

6. Dhenkanal

- Case Study 06: Quality education through community participation
- Emphasis on community-driven educational initiatives

7. Bhadrak

- Case Study 07: EA and community engagement for SDG 4 achievement
- Model development for sustainable educational goals

8. Ganjam

- Case Study 08: Interactive learning and community engagement
- Focus on transformative educational practices

9. Bargarh

- Case Study 09: Technology integration through EA
- Emphasis on quality education delivery

10. Jagatsinghpur

- Case Study 11: Educational excellence through community engagement
- Integration of EA principles

11. Balasore

- Case Study 12: Smart infrastructure development
- Community engagement in educational advancement

3.8.3.3 Key Themes Across Case Studies

1. Enterprise Architecture Implementation

- Integration of EA principles in educational systems
- Infrastructure development and modernization
- Service architecture optimization

2. Community Engagement

- Alumni participation
- Local community involvement
- Stakeholder collaboration

3. Educational Quality Enhancement

- Modern educational practices
- Interactive learning methods
- Quality assurance mechanisms

4. Technology Integration

- Smart infrastructure development
- Digital transformation initiatives
- Technology-enabled learning

5. Sustainable Development

- Alignment with SDG 4 goals
- Long-term sustainability measures
- Resource optimization

These case studies offer insightful information on the various strategies and difficulties involved in putting EA and community engagement initiatives across different

regions of Odisha. The analysis of these cases contributes to understanding the practical implications of educational transformation strategies in various contextual settings.

[Note: This analysis is based on the case study titles provided and should be expanded with specific details from the actual case study documentation and Mo School website data when available.]

3.9 Research Design Limitations

3.9.1 Qualitative Research Limitations:

1. Time-consuming data collection and analysis process
2. Limited generalizability of findings
3. Potential for researcher bias influencing interpretations
4. Challenges in establishing clear cause-effect relationships

3.9.2 Quantitative Research Limitations:

1. May not capture the full complexity or context of a phenomenon
2. Requires large sample sizes, which can be resource-intensive
3. Inflexibility once data collection begins
4. Difficulty in controlling all variables in real-world settings

Both approaches have their strengths and weaknesses. Many researchers advocate for mixed-method approaches to leverage the advantages of both qualitative and quantitative methodologies while mitigating their respective limitations. This balanced approach can provide a more comprehensive understanding of complex educational issues in Odisha's K-12 system and inform the development of effective Enterprise Architecture frameworks.

3.10 Conclusion

In conclusion, the integration of qualitative and quantitative research methodologies offers a powerful approach to understanding and improving Odisha's K-12 education system through the lens of Enterprise Architecture. This combined method leverages the strengths of both approaches, providing a comprehensive and nuanced view of the educational landscape.

The rich, contextual insights gained from qualitative research complement the statistical rigor and broad applicability of quantitative data. A greater comprehension of the intricate interactions between different stakeholders, procedures, and technology within the education ecosystem is made possible by this synergy. By embracing this holistic approach, policymakers, educators, and administrators in Odisha can:

1. Develop more effective and culturally sensitive educational strategies
2. Identify and address key challenges with greater precision
3. Implement technology solutions that align with pedagogical needs and local realities
4. Foster innovation while respecting traditional practices and values
5. Enhance stakeholder engagement and buy-in for new initiatives

Moreover, this integrated research approach supports the development of a robust Enterprise Architecture framework tailored to Odisha's unique educational context. Such a framework can significantly improve operational efficiency, resource allocation, and overall educational outcomes across the state.

By embracing the strengths of both qualitative and quantitative methodologies, The education system in Odisha is in a strong position to overcome current obstacles and give every student access to a more effective, efficient, and fair learning environment. In addition to meeting present needs, this strategy establishes a solid basis for future development and adaptation to changing educational requirements and technology breakthroughs.

CHAPTER IV:

RESULTS

4.1 Research Central Question One

How can Enterprise Architecture (EA) principles be effectively implemented in Odisha's government school education system through a Value based framework? Based on the central question and the search results provided, here's an analysis of how Enterprise Architecture (EA) principles can be effectively implemented in Odisha's government school education system through a value-based framework, with references to IndEA and relevant university architectures:

4.1.1 Adopt the IndEA Framework

Implement the India Enterprise Architecture (IndEA) framework, which the Ministry of Electronics and Information Technology (MeitY) has designated as an e-Government standard. A generic framework made up of reusable building pieces is offered by IndEA, and it may be modified for use by government agencies, including the education sector.

4.1.2 Utilize Reference Models

Leverage the eight reference models provided by IndEA: Governance of Architecture, Data, Technology, Performance, Security, Integration, and Business. These models can be tailored to Odisha's education system, ensuring a comprehensive approach to EA implementation.

4.1.3 Apply Agile IndEA Practices

Incorporate the Agile IndEA framework, which infuses agile practices into IndEA, simplifying its understanding and promoting widespread adoption. This approach can help Odisha's education system implement EA more efficiently and adapt to changing needs quickly.

4.1.4 Develop a View-Based Approach

Adopt a view-based approach similar to the one proposed for higher education institutions. For Odisha's K-12 system, consider developing views such as:

- Strategy and Goals View
- Organizational View
- Curriculum View
- Information Systems View
- Technology View
- Learning Resource View

4.1.5 Establish Clear Vision and Principles

Follow the Education Enterprise Architecture Guidebook's recommendation to establish a vision and guiding principles early in the planning process. Develop principles that align with IndEA's 36 principles and adapt them to Odisha's educational context.

4.1.6 Focus on Stakeholder Engagement

Engage diverse stakeholders, including teachers, administrators, students, and parents, to have a thorough grasp of educational requirements. This inclusive approach can help ensure that the EA implementation addresses the real needs of Odisha's education system.

4.1.7 Implement a Service-Oriented Architecture

Consider adopting a service-oriented architecture similar to the Arizona Education Learning and Accountability System (AELAS). This approach can provide districts with the option to use state-supported systems, potentially reducing costs and improving efficiency.

4.1.8 Develop a Comprehensive Blueprint

Create a detailed blueprint for Odisha's education system that spans from the classroom to the state department of education, similar to the AELAS approach. This comprehensive view can help ensure alignment across all levels of the education system.

4.1.9 Integrate Change Management Practices

Incorporate change management practices into the EA implementation process, as suggested in the higher education architecture framework. This can help Odisha's education system adapt to evolving requirements and technological advancements.

4.1.10 Leverage EA for Strategic Transformation

Use EA to proactively lead enterprise responses to disruptive forces. This approach can help Odisha's education system identify and analyse the execution of change towards organizational goals.

By implementing these EA principles through a value-based framework, Odisha's government school education system can potentially achieve greater alignment between its strategic goals and operational realities, improve resource allocation, enhance stakeholder engagement, and ultimately deliver better educational outcomes for students. The integration of IndEA principles, agile practices, and lessons from higher education architectures provides a robust foundation for developing an effective EA implementation tailored to Odisha's unique educational context.

Research Sub-Questions

4.1.1 Research Sub-Question 1

What are the key challenges associated with EA adoption in this context, and how can they be mitigated?

Based on the search results and the context of implementing Enterprise Architecture (EA) in Odisha's government school education system, several key challenges and potential mitigation strategies can be identified:

4.1.1.1 Resistance towards EA

Challenge: There is often resistance to EA adoption, particularly due to its perceived IT orientation and lack of understanding of its benefits.

Mitigation:

- Engage diverse stakeholders, including teachers, administrators, and community members, to gain a comprehensive understanding of educational needs and demonstrate EA's value beyond IT.

- Develop clear communication strategies to explain EA benefits in non-technical terms, focusing on educational outcomes.

- Secure top-level sponsorship and mandate to overcome resistance and ensure sufficient resource allocation.

4.1.1.2 Lack of Relevant EA Goals

Challenge: Failure to set clear, relevant goals aligned with educational objectives can lead to poor adoption and limited impact.

Mitigation:

- Align EA goals with Odisha's educational strategic objectives and national policies.
- Develop manageable, phased objectives that enable "quick wins" to demonstrate value.
- Integrate EA with project portfolio management practices to ensure alignment with broader educational initiatives.

4.1.1.3 Limited Resources and Expertise

Challenge: Insufficient allocation of resources and lack of EA expertise can hinder effective implementation.

Mitigation:

- Leverage the Agile IndEA framework to simplify EA implementation and reduce resource requirements.
- Invest in capacity-building programs to develop local EA expertise within the education department.
- Collaborate with national bodies like the National e-Governance Division (NeGD) for support and guidance.

4.1.1.4 Complexity of Implementation:

Challenge: Traditional EA approaches can be time-consuming and complex, especially for large organizations like a state education system.

Mitigation:

- Adopt the Agile IndEA approach, which infuses agile practices into EA for faster, more flexible implementation.
- Use the principle of "Just-Enough-Architecture" to focus on essential elements and avoid over-engineering.

- Apply EA incrementally, starting with pilot projects or specific educational domains before scaling up.

4.1.1.5 Integration with Existing Systems:

Challenge: Integrating EA with existing legacy systems and processes in the education system can be challenging.

Mitigation:

- Conduct a thorough assessment of existing applications using the Digital Service Standard template provided by MeitY.
- Develop a phased transition plan that allows for gradual integration and migration of legacy systems.
- Prioritize interoperability and data sharing capabilities in the EA design to facilitate integration.

4.1.1.6 Stakeholder Engagement and Buy-in:

Challenge: Ensuring consistent engagement and buy-in from diverse stakeholders across the education system can be difficult.

Mitigation:

- Establish a clear governance structure that includes representatives from various educational stakeholders.
- Regularly communicate EA progress, benefits, and challenges to all stakeholders.
- Provide opportunities for stakeholder feedback and incorporate it into the EA development process.

4.1.1.7 Alignment with Educational Outcomes:

Challenge: Ensuring that EA implementation directly contributes to improved educational outcomes and not just administrative efficiency.

Mitigation:

- Develop clear metrics that link EA initiatives to educational key performance indicators (KPIs).

- Regularly assess and provide information on how EA affects the processes of teaching and learning.

- Incorporate feedback from educators and students into the continuous improvement of the EA.

By addressing these challenges through the proposed mitigation strategies, the possibility of EA adoption and profit realisation might be enhanced by the government school education system in Odisha. The use of the Agile IndEA framework, combined with a focus on stakeholder engagement and alignment with educational goals, provides a strong foundation for overcoming these challenges and implementing an effective EA.

4.1.2 Research Sub Question 2

What best practices can be identified to ensure successful EA implementation?

Based on the research results and the context of implementing Enterprise Architecture (EA) in Odisha's government school education system, several best practices can be identified to ensure successful EA implementation:

4.1.2.1 Adopt a "Think Big, Start Small" Approach:

- Develop a long-term vision for EA implementation, but start with small, manageable steps.

- Focus on delivering measurable value early in the process to build momentum and support.

- Initiatives should be prioritised according to the school system’s requirements and capability for change.

4.1.2.2 Establish Clear Vision and Guiding Principles:

- Define a comprehensive vision that aligns with state and national educational goals.

- Develop guiding principles early in the planning process to ensure consistency throughout implementation.

4.1.2.3 Engage Diverse Stakeholders

- Involve a wide range of stakeholders, including teachers, administrators, students, and parents.

- Establish a clear governance structure that includes representatives from various educational stakeholders.

- Regularly communicate EA progress, benefits, and challenges to all stakeholders.

4.1.2.4 Align EA with Educational Outcomes

- Develop clear metrics that link EA initiatives to educational key performance indicators (KPIs).

- Regularly assess and provide an analysis of how EA affects the processes of teaching and learning.

- Incorporate feedback from educators and students into the continuous improvement of the EA.

4.1.2.5 Leverage Existing Frameworks and Tools

- Utilize the India Enterprise Architecture (IndEA) framework, adapting it to the specific context of Odisha's education system.

- Implement the eight reference models provided by IndEA: Governance of Architecture, Data, Technology, Performance, Security, Integration, and Business.

- Consider adopting the Agile IndEA approach for faster, more flexible implementation.

4.1.2.6 Develop a Comprehensive Blueprint

- Create a detailed blueprint that spans from the classroom to the state department of education.

- Ensure the blueprint addresses organizational, technical, and information requirements for meeting stated goals.

4.1.2.7 Implement a Service-Oriented Architecture

- Consider adopting a service-oriented architecture that provides districts with the option to use state-supported systems.

- This approach can potentially reduce costs and improve efficiency across the education system.

4.1.2.8 Focus on Capacity Building

- Invest in training and development programs to build local EA expertise within the education department.

- Collaborate with national bodies like the National e-Governance Division (NeGD) for support and guidance.

4.1.2.9 Combine Process and Modelling

- Use a combination of formal models and powerful visualization capabilities to create effective EA deliverables.

- Adopt flexible and easy-to-use tools that can drive the EA initiative forward.

4.1.2.10 Integrate Change Management Practices

- Incorporate change management strategies into the EA implementation process.

- This can help the education system adapt to evolving requirements and technological advancements more effectively.

4.1.2.11 Develop Multiple Architecture Views

- Create specific views such as Strategy and Goals View, Organizational View, Curriculum View, Information Systems View, Technology View, and Learning Resource View.

- These views can help address the diverse needs of different stakeholders and ensure comprehensive coverage of all aspects of the education system.

By following these best practices, Odisha's government school education system can increase the likelihood of successful EA adoption and the realization of its benefits. The key is to tailor these practices to the specific context of Odisha's education system, ensuring alignment with local needs and constraints while leveraging national frameworks and standards. 12 district-level case studies were reviewed and summarized as below. It was initially done by the Mo School Team with support from the school management.

4.2 Case Study Analysis: Educational Transformation Initiatives in Odisha

This sub-chapter examines twelve distinct educational transformation initiatives implemented across various districts in Odisha, representing a comprehensive approach to educational reform through enterprise architecture and community engagement.

4.2.1 Geographical Distribution of Initiatives

The case studies span multiple districts, including Khurda, Baripada, Kalahandi, Cuttack, Nuapada, Dhenkanal, Bhadrak, Ganjam, Bargarh, and Balasore, providing a representative sample of both urban and rural educational contexts across Odisha.

4.2.2 Thematic Framework Analysis

The initiatives can be categorized into three primary intervention areas:

-Enterprise Architecture Implementation

The implementation of enterprise service architecture emerges as a fundamental component, particularly evident in remote areas like Kalahandi, where it serves as a backbone for educational service delivery enhancement.

-Community Engagement Mechanisms

A significant emphasis is placed on community participation and stakeholder engagement, with districts like Baripada and Dhenkanal demonstrating innovative approaches to youth empowerment and quality education through community involvement.

-Infrastructure Modernization

Districts such as Cuttack and Balasore showcase comprehensive approaches to infrastructure revitalization, incorporating both physical and digital transformation elements.

4.2.3 Strategic Approaches

The case studies reveal several strategic approaches:

-4V Framework Implementation

The Khurda district's implementation of the 4V Framework demonstrates a structured approach to educational transformation, incorporating vision, values, victory, and venture as key components.

-SDG 4 Achievement Model

Bhadrak's initiative presents a model specifically aligned with Sustainable Development Goal 4, offering a framework for quality education achievement through enterprise architecture.

-Interactive Learning Integration

Ganjam's transformation through interactive learning represents an innovative approach to modernizing educational delivery methods while maintaining community engagement.

4.2.4 Key Innovation Patterns

The analysis reveals several innovative patterns across the initiatives:

1. Integration of traditional community structures with modern enterprise architecture
2. Leveraging alumni networks for sustainable development
3. Implementation of smart infrastructure solutions
4. Focus on interactive and technology-enabled learning environments

4.2.5 Sustainability Mechanisms

The sustainability of these initiatives is ensured through:

- Structured stakeholder participation programs
- Community ownership models
- Technology integration frameworks
- Quality assurance mechanisms

4.2.6 Impact Assessment Framework

The success of these initiatives is measured through:

- Community participation metrics
- Educational outcome improvements
- Infrastructure utilization rates
- Stakeholder satisfaction levels
- SDG 4 alignment indicators

This thorough examination of twelve case studies offers insightful information on how educational systems are changing as a result of the integration of industrial architecture and community engagement, offering replicable models for similar initiatives in other regions.

Table 4.1 Overview of Cross-Case Content Analysis

Case Study	Vision	Value	Victory	Venture
Tulasi Choura Colony Sahi Government UP School, Baripada	The vision includes upgrading all government primary schools into smart schools, aiming to improve	The initiatives have led to improved learning experiences with technology and enhanced teaching	Successful educational programs and recognition for initiatives targeting enhanced learning quality in Baripada.	Innovative programs for educational enhancement and partnerships were developed to

Case Study	Vision	Value	Victory	Venture
	learning outcomes by 30% in the first year with teacher training and educational resources.	practices through Sampark TVs and innovative teaching methodologies.		improve infrastructure and teaching quality, though specific details on unique projects were not available.
Panchayat High School, Chapria, Kalahandi	The vision emphasizes quality education, infrastructure development, and community involvement to enhance the learning experience.	The school has several classrooms in good condition and an environment that encourages learning, contributing to improved educational outcomes.	The school has strengthened community ties through educational initiatives and enhanced recognition, reflecting success in its goals.	
Revitalizing Educational Infrastructure, Cuttack	The vision incorporates goals for robust infrastructure development, improving educational quality, and fostering community involvement to uplift educational standards in Cuttack.	Efforts have led to noticeable improvements in educational infrastructure and resources, contributing to better community engagement and empowerment within the educational framework.	The initiative has likely achieved recognition and funding by aligning with the Sustainable Development Goals, ensuring educational progress and community development.	Engagement with the community through innovative strategies, such as participatory budgeting and collaborations with local artists, enhances educational experiences and promotes local culture.

Case Study	Vision	Value	Victory	Venture
Transforming Education through Alumni Engagement, Nuapada				Community classes to address learning gaps caused by the pandemic, fostering innovation in educational access.
Community Participation in Education, Dhenkanal	The vision emphasizes improving the quality of education, reducing dropout rates, and increasing learning achievements by involving the community through decentralization and active participation. Specific goals include improving infrastructure and addressing the needs of marginalized groups.	Improvements in infrastructure and educational resources have been significant, leading to greater access to quality education. The participation of community members has enhanced school facilities and resources, positively impacting students' educational outcomes.	The initiative has established strong partnerships between the government and local communities, resulting in recognition for efforts to enhance educational standards and infrastructure. Successful funding and resource allocation have also been achieved through community involvement.	Entrepreneurial aspects include initiatives that encourage alumni and community engagement in educational management and development, such as support for new school programs and enhancements in community-led educational projects.
Enhancing Quality Education, Bhadrak	The vision focuses on enhancing educational quality through improved	The initiative has successfully increased student enrollment and	Victories achieved include successful partnerships with local organizations	Innovative approaches like edupreneurship and active community

Case Study	Vision	Value	Victory	Venture
	infrastructure, community involvement, and sustainable models for ongoing educational improvement.	retention rates, improved school facilities, and fostered a sustainable education model supported by community involvement.	and recognition for improving the quality of education through community-led efforts.	engagement are integral, emphasizing local solutions to education challenges.
Transforming Education through Interactive Learning, Ganjam	The vision aims to create engaging learning environments that empower students through interactive and participatory methods, enhancing educational quality while involving the community for broader developmental goals.	Initiatives have led to significant improvements in teaching methods and classroom engagement, utilizing educational technologies and tools that enhance real-time participation and learning outcomes for students.		The program involves community engagement elements where stakeholders contribute to educational quality, although specific innovative projects or alumni involvement were not detailed.
Leveraging Technology for Quality Education, Bargarh		Improvements in teaching and learning experiences through technology make education		Incorporation of digital infrastructure and innovative technology for educational

Case Study	Vision	Value	Victory	Venture
		more engaging and accessible.		enhancement, promoting greater access to learning opportunities.
Revitalizing the Legacy of Ravenshaw Collegiate School, Cuttack	The vision for Ravenshaw Collegiate School includes goals for improving educational infrastructure, enhancing the quality of education, and fostering community involvement to build resilient learning environments.	Initiatives at Ravenshaw Collegiate School have led to improvements in educational resources, modernization of infrastructure, and enhanced access to quality education, making it a model institution in Odisha.	Ravenshaw Collegiate School has been recognized as the oldest high school in Odisha, reflecting a rich heritage and consistent contributions to higher education over the decades, establishing partnerships with various educational bodies.	The institution has engaged actively with the community and alumni, launching various educational initiatives and programs that encourage local participation and address educational challenges in the region.
Advancing Educational Excellence, Jagatsinghpur	The vision aims to improve community involvement and educational quality by focusing on infrastructure development to facilitate better learning experiences.	The efforts have led to improvements in educational accessibility and quality, fostering critical thinking, which positively contributes to community development.	The initiative has achieved success in enhancing educational outcomes through partnerships and cooperative efforts involving state governments and community stakeholders.	Innovative approaches have included engaging local businesses and forming partnerships aimed at enhancing educational experiences and strengthening community ties.

Case Study	Vision	Value	Victory	Venture
Advancing Education through Smart Infrastructure, Balasore	The vision includes creating motivating learning environments through advanced technology and infrastructure while promoting inclusivity and equal opportunities in education for all.	Improvements include the establishment of smart classrooms with STEM labs, upgraded educational facilities, and programs for skill development, such as life skills training that address critical infrastructure shortages.	The initiative has achieved significant milestones by partnering with government entities to improve educational outcomes through the SATH-E project, focusing on evidence-based planning and impactful reforms.	Innovative strategies like the iShaala program mobilized digital resources to enhance education in rural areas, fostering community involvement and addressing technology gaps.

Based on the within-case analysis of the 12 case studies provided, I can suggest how TOGAF, Business Architecture Guild, and ArchiMate principles can be applied to design solid products, services, and experiences for K-12 students in Odisha:

1. Business Alignment: Make certain that every educational endeavour is in line with the main objectives of expanding access to high-quality education and raising learning results for Odisha's K–12 students. This aligns with TOGAF's principle of business alignment.
2. Standardization: Implement standardized technology and processes across schools to minimize complexity and reduce costs. This could include standardized smart classrooms, digital learning platforms, and administrative systems.
3. Reusability: Encourage the reuse of existing educational assets, such as digital content, teaching methodologies, and infrastructure designs that have proven successful in other schools or districts.

4. Interoperability: Ensure that different educational systems and processes can work together seamlessly, providing a cohesive learning environment for students and efficient administration for educators.
5. Security: Embed security measures at every level of the educational architecture, protecting student data and ensuring safe digital learning environments.
6. Flexibility: Design the educational architecture to adapt to future changes in curriculum, technology, and teaching methodologies.
7. Scalability: Ensure that educational solutions can handle growth in student numbers and expanding educational programs across Odisha.
8. User-Centric Design: Focus on the needs of students, teachers, and administrators when designing educational products and services.
9. Community Engagement: Leverage the principles of community participation seen in many case studies to involve local stakeholders in the design and implementation of educational initiatives.
10. Capability-Based Planning: Use the Business Architecture Guild's approach to identify and develop key capabilities needed for effective K-12 education in Odisha.
11. Value Stream Mapping: Apply ArchiMate's concepts to map out the educational value streams, identifying areas for improvement and innovation in the learning process.
12. Modular Architecture: Design educational solutions with modular components that can be easily updated or replaced as technology and educational needs evolve.

By applying these principles, Odisha can create a robust, scalable, and effective educational architecture that addresses the unique needs of its K-12 students while aligning with broader educational goals and standards.

4.3 Summary of Findings

The research into implementing Enterprise Architecture (EA) principles in Odisha's government school education system through a value-based framework has yielded several key insights:

1. Adoption of the IndEA Framework:

An excellent basis for implementing EA in Odisha's educational system is provided by the India Enterprise Architecture (IndEA) framework. Its 36 principles and eight reference models can be modified to meet the unique requirements of the K–12 education sector.

2. Value-Based Approach:

A value-based framework emphasizing equity, inclusion, and 21st-century skills is crucial for the successful implementation of EA in Odisha's education system. This approach ensures that technological and organizational changes align with core educational values and objectives.

3. Stakeholder Engagement:

Engaging diverse stakeholders, including teachers, administrators, students, and parents, is essential for understanding the real needs of the education system and ensuring buy-in for EA initiatives.

4. Agile Implementation:

The Agile IndEA approach offers a more flexible and efficient method for implementing EA, enabling quicker adjustment to evolving technology and educational demands.

5. Service-Oriented Architecture:

Adopting a service-oriented architecture can provide districts with state-supported systems, potentially reducing costs and improving efficiency across the education system.

6. Comprehensive Blueprint:

Developing a detailed blueprint that spans from the classroom to the state department of education ensures alignment across all levels of the education system and provides a clear roadmap for implementation.

7. Change Management Integration:

Incorporating change management practices into the EA implementation process is crucial for overcoming resistance and ensuring the successful adoption of new systems and processes.

8. Capacity Building:

Investing in training and development programs to build local EA expertise inside the education department is crucial to the sustainability and long-term effectiveness of EA programs.

9. Challenges and Mitigation Strategies:

Key challenges identified include resistance to EA, lack of relevant goals, limited resources and expertise, complexity of implementation, integration with existing systems, and ensuring alignment with educational outcomes. Mitigation strategies focus on clear communication, phased implementation, stakeholder engagement, and continuous assessment of EA's impact on educational KPIs.

10. Best Practices:

Best practices for successful EA implementation include adopting a "Think Big, Start Small" approach, establishing a clear vision and principles, leveraging existing frameworks, developing multiple architecture views, and focusing on delivering measurable value early in the process.

11. Alignment with Educational Outcomes:

Ensuring that EA implementation directly contributes to improved educational outcomes, not just administrative efficiency, is critical. This requires developing clear metrics linking EA initiatives to educational KPIs and regularly assessing their impact on teaching and learning processes.

In conclusion, the effective implementation of EA principles in Odisha's government school education system requires a balanced approach that combines technical expertise with a deep understanding of educational needs and values. By leveraging national frameworks like IndEA, adopting agile methodologies, and focusing on stakeholder engagement and educational outcomes, Odisha can develop a robust EA that enhances its education system's efficiency, effectiveness, and ability to adapt to future challenges.

4.4 Analysis of Enterprise Architecture thinking mindset constructs

Drawing from the given case studies and the design thinking mindset components, I can suggest an Enterprise Architecture (EA) mindset construct for this research. This construct aims to capture the key aspects of enterprise architecture thinking observed in the educational transformation projects across Odisha. Here's a proposed list of 19 EA mindset constructs:

A. Holistic Systems Thinking - Ability to view the educational ecosystem as an interconnected whole.

B. Stakeholder Engagement - Emphasis on involving all stakeholders, especially alumni and community members.

C. Alignment with Strategic Goals - Ensuring all initiatives support broader educational objectives.

D. Adaptability and Flexibility - Openness to change and ability to adapt to evolving needs.

E. Resource Optimization - Efficient use of available resources, including funding and community support.

F. Scalability Mindset - Designing solutions that can be scaled across different schools or districts.

G. Technology Integration - Leveraging technology to enhance educational experiences and operations.

H. Process Standardization - Implementing standardized processes for consistency and efficiency.

I Data-Driven Decision Making - Using data and metrics to inform decisions and measure success.

J. Continuous Improvement - Commitment to ongoing enhancement of educational services and infrastructure.

K. Interoperability - Ensuring different systems and processes work together seamlessly.

L. Sustainability Focus - Designing long-term, sustainable solutions for educational development.

M. Risk Management - Identifying and mitigating potential risks in educational transformation projects.

N. Innovation Orientation - Openness to new ideas and approaches in educational service delivery.

O. Governance Awareness - Understanding and implementing effective governance structures.

P. Value Creation - Focus on creating tangible value for students, teachers, and the community.

Q. Ecosystem Thinking - Recognizing the school as part of a larger educational and social ecosystem.

R. Future-Readiness - Preparing educational systems for future challenges and opportunities.

S. Collaborative Leadership - Fostering a culture of collaboration and shared responsibility.

This EA mindset construct reflects the key themes observed in the case studies, such as community engagement, technology integration, and sustainable development, while incorporating essential elements of enterprise architecture thinking.

4.5 Analysis of Semi-Structured Interview with 10 Questions

4.5.1 Question # 1

What are the primary challenges you face in ensuring equitable access to quality education in your district?

A comprehensive overview of educational challenges faced by teachers across various districts in Odisha, India. These challenges can be summarized into several key categories:

Infrastructure and Resources

Many districts struggle with inadequate infrastructure, including:

- Insufficient classrooms and overcrowding
- Lack of proper sanitation facilities
- Shortage of teaching aids and learning materials
- Poor internet connectivity, especially in rural areas
- Limited availability of digital learning resources and technologies

Teacher-Related Issues

Teachers face numerous challenges that impact the quality of education:

- Lack of certified and experienced educators, especially in remote locations
- High teacher absenteeism
- Lack of professional development opportunities
- Poor teacher-student ratios, often resulting in multi-grade teaching

Socio-Economic Factors

Several socio-economic issues affect education in the region:

- High dropout rates, especially among girls
- Early marriages and financial constraints are forcing students to leave school
- Pressure on children to work and support their families
- Economic disparities leading to the inability to afford school-related expenses

Accessibility and Awareness

Access to education is hindered by various factors:

- Poor transportation infrastructure in remote areas
- Lack of awareness about the importance of education in rural communities
- Language barriers, particularly for tribal students
- Cultural barriers and social biases, including gender discrimination

Curriculum and Learning Outcomes

The quality of education is affected by:

- Focus on rote learning rather than conceptual understanding
- Limited exposure to extracurricular activities
- Lack of inclusive education for students with disabilities
- Inadequate mental health support for students

Administrative Challenges

The education system faces administrative issues such as:

- Weak monitoring and evaluation systems
- Urban-rural divide in resource allocation
- Difficulty in implementing educational policies effectively

4.5.2 Question # 2

How do you currently align educational strategies with broader state, national, and Global educational goals as a BEO/DEO/School Principal/Teacher?

This summary provides insights into how teachers across various districts in Odisha, India, are aligning their educational strategies with broader state, national, and global educational goals. The responses highlight both efforts and challenges in implementing these strategies.

Many teachers are focusing on key areas such as:

1. Inclusive education
2. Experiential and hands-on learning
3. Digital literacy
4. Vocational training and skill development
5. Environmental sustainability
6. Gender equality and girls' education
7. Foundational literacy and numeracy
8. Community-based learning
9. Cultural integration
10. Critical thinking and creativity

However, they face significant challenges in implementing these strategies effectively:

- Limited resources and infrastructure
- Lack of adequate teacher training
- Poor internet connectivity and digital devices
- High dropout rates, especially among girls
- Socio-economic constraints
- Limited community engagement
- Insufficient support for students with disabilities
- Pressure to complete prescribed syllabi
- Cultural norms and traditional roles affecting education

Despite these challenges, teachers are making efforts to align their practices with broader educational goals, such as those outlined in the National Education Policy (NEP) and Sustainable Development Goal 4 (SDG 4).

Key words/themes: Inclusive education, digital literacy, skill development, gender equality, resource constraints, teacher training, community engagement, cultural integration, infrastructure gaps, holistic development

4.5.3 Question # 3

What role do you think technology and information systems play in improving educational outcomes in your district?

A consistent theme emerges from the replies of thirty teachers from various areas in Odisha about how information systems and technology might enhance learning results. While teachers recognize the potential benefits of technology in enhancing student learning, they face significant challenges in implementing these tools effectively.

Key Findings

Potential Benefits:

- Enhanced student engagement and interactive learning
- Increased availability of high-quality education, particularly in rural regions
- Personalized learning experiences and better tracking of student progress
- Support for students with disabilities
- Integration of global knowledge into local curricula

Major Challenges:

- Lack of basic infrastructure, including reliable electricity and internet connectivity
- Digital gadgets like computers, tablets, and cell phones are not widely available.
- Insufficient teacher training in using technology and digital tools
- Digital divide between urban and rural areas
- High costs associated with setting up digital classrooms

Regional Variations

While the challenges are widespread, there are some variations across districts:

- Urban areas like Cuttack and Khurda have better access to technology, but still face issues with consistent implementation.
- Remote districts like Malkangiri, Rayagada, and Koraput struggle with more fundamental infrastructure problems.
- Coastal districts such as Puri and Balasore highlight issues related to internet connectivity.

Conclusion

According to the comments, instructors are interested in incorporating technology into their lesson plans. However, there are major obstacles to the efficient use of technology and information systems in Odisha's educational sector, including a lack of fundamental infrastructure, limited resources, and inadequate training.

Keywords: technology, education, Odisha, digital divide, infrastructure, teacher training, internet connectivity, digital devices, remote learning, personalized education, student engagement, learning management systems, digital literacy, rural-urban divide.

4.5.4 Question #4

Can you describe any existing frameworks or strategies that have been effective in improving educational efficiency and effectiveness?

This summary provides insights from 30 teachers across different districts in Odisha, India, regarding effective educational frameworks and strategies, as well as the challenges they face in implementation.

Effective Strategies and Frameworks

Several initiatives have shown positive results in improving educational outcomes:

1. Learning Outcomes-based Curriculum Framework (LOB-CF)

2. Mission School of Excellence
3. Basic Literacy and Numeracy (BLN) framework
4. National Education Policy's emphasis on critical thinking
5. Padhe Odisha campaign
6. Smart Classes and Digital Learning Initiatives
7. Learning Enhancement Programme
8. Bala Vikas initiative
9. Chala Patha Padhiba program
10. Mid-Day Meal Scheme
11. School Leadership Development Programme
12. Project-Based Learning
13. Rural Education Support framework
14. Learning Management Systems (LMS)
15. School-Community Partnership framework
16. Inclusive Education program
17. Swachh Vidyalaya Abhiyan (Clean Schools Program)
18. Youth Empowerment through Education Framework
19. Gyan Ganga program
20. Mission Zero Dropout initiative
21. Activity-Based Learning
22. Sambal scheme

23. National Digital Literacy Mission
24. E-learning Portal
25. Focus on Soft Skills Development
26. Teachers' Professional Development Initiative
27. Peer Learning

Common Challenges

Despite the effectiveness of these programs, teachers reported several challenges:

1. Lack of infrastructure and resources, especially in rural areas
2. Insufficient teacher training and professional development opportunities
3. Large class sizes and a limited number of specialized teachers
4. Digital divide and inconsistent internet connectivity
5. Uneven distribution of resources across schools
6. Difficulty in aligning assessment practices with new competencies
7. Language barriers and access to resources for disadvantaged students
8. Logistical challenges in implementing programs like the Mid-Day Meal Scheme
9. Limited parental involvement and community awareness
10. Cultural factors and economic pressures leading to dropouts
11. Bureaucratic processes delaying access to benefits
12. Balancing academic curriculum with extra-curricular activities

Keywords

Education, Odisha, India, learning outcomes, digital literacy, infrastructure, teacher training, rural education, inclusive education, community involvement, dropout prevention, skill development, assessment, resource allocation, technology integration

4.5.5 Question # 5

How do you engage with various stakeholders (teachers, parents, community members) to implement educational policies and programs?

Teachers across 30 districts in Odisha employ various strategies to engage stakeholders in implementing educational policies and programs. These strategies include:

1. Regular parent-teacher meetings
2. Community awareness programs
3. Collaboration with local leaders
4. Digital communication platforms
5. School events and open days
6. Home visits
7. Workshops and training sessions
8. Involvement in school governance

Despite these efforts, teachers face numerous challenges:

1. Low parental engagement due to illiteracy, busy schedules, or lack of awareness
2. Digital divide in rural areas
3. Cultural beliefs and economic constraints
4. Language barriers
5. Traditional mindsets prioritizing child labour over education

6. Lack of communication infrastructure in remote areas
7. Limited understanding of educational policies among community members
8. Difficulty in maintaining consistent communication with all stakeholders

Teachers emphasize the need for better awareness, improved communication channels, and more structured platforms to effectively engage all stakeholders in the educational process.

Keywords: Odisha, teachers, stakeholder engagement, educational policies, parent-teacher meetings, community awareness, digital divide, cultural barriers, parental involvement, communication challenges

4.5.6 Question # 6

What are the key barriers to implementing new educational initiatives in your district?

The responses from 30 teachers across different districts in Odisha reveal several common barriers to implementing new educational initiatives. These challenges can be broadly categorized into the following areas:

4.5.6.1 Infrastructure and Resources

Many teachers highlighted the lack of basic infrastructure, especially in remote areas. This includes inadequate facilities, absence of computers, limited internet access, and insufficient teaching materials. The digital divide is particularly pronounced in rural areas, making it difficult to implement technology-based initiatives.

4.5.6.2 Training and Professional Development

Teachers consistently mentioned the lack of proper training and professional development opportunities. Without adequate preparation, they struggle to effectively implement new teaching methodologies and policies.

4.5.6.3 Community and Parental Involvement

Several responses pointed to limited parental and community involvement as a significant barrier. Many parents and community members are unaware of new educational initiatives or don't prioritize education due to socioeconomic factors.

4.5.6.4 Administrative and Policy Issues

Teachers reported challenges related to government support, delayed policy implementation, and inadequate funding. Communication gaps between educational authorities and teachers also hinder the timely implementation of new initiatives.

4.5.6.5 Resistance to Change

Some teachers noted resistance to change from both educators and parents. Traditional teaching methods are often preferred, making it difficult to introduce and gain acceptance for new approaches.

4.5.6.6 Workload and Time Constraints

The heavy workload on teachers and time constraints due to curriculum demands were cited as obstacles to implementing new initiatives effectively.

4.5.6.7 Socio-economic Factors

The financial circumstances that students and their families were in were mentioned as barriers to implementing new educational programs, particularly in rural areas.

Keywords: infrastructure, digital divide, professional development, parental involvement, funding, resistance to change, workload, socio-economic factors, rural education, policy implementation.

4.5.7 Question # 7

How do you measure the success and impact of educational programs and initiatives in your district?

Teachers in Odisha employ various methods to measure the success and impact of educational programs and initiatives, while facing several challenges in the process.

4.5.7.1 Measurement Methods

4.5.7.1.1 Academic Performance

Most teachers rely heavily on student grades, test scores, and exam results to gauge the effectiveness of educational programs. Regular assessments and periodic evaluations are commonly used to track progress over time.

4.5.7.1.2 Student Engagement

Many educators observe classroom participation, attendance, and involvement in extracurricular activities as indicators of program success.

4.5.7.1.3 Feedback

Teachers often collect feedback from students, parents, and other teachers to assess the impact of educational initiatives.

4.5.7.1.4 Holistic Development

Some teachers attempt to measure non-academic outcomes such as behavioural changes, soft skills development, and overall student growth.

4.5.7.2 Challenges

4.5.7.2.1 Limited Scope

Many teachers feel that traditional assessments fail to capture the holistic development of students, especially in areas like critical thinking, creativity, and emotional intelligence.

4.5.7.2.2 Socio-economic Factors

External influences such as family background, economic status, and home environment often impact student performance, making it difficult to isolate the effects of educational programs.

4.5.7.2.3 Long-term Impact

Educators struggle to measure the long-term effects of initiatives, as benefits may not be immediately visible or quantifiable.

4.5.7.2.4 Standardization

There is a lack of standardized tools and methods for data collection and evaluation, particularly for measuring non-cognitive skills.

4.5.7.2.5 Rural Challenges

Teachers in rural areas face additional difficulties such as irregular attendance, limited resources, and socio-economic barriers that affect program evaluation.

Keywords: academic performance, student engagement, feedback, holistic development, socio-economic factors, long-term impact, standardization, rural challenges, non-cognitive skills, assessment limitations.

4.5.8 Question # 8

What kind of support or resources do you need to better address the educational challenges in your district?

This summary presents insights from 30 teachers across various districts in Odisha, India, regarding the support and resources they need to address educational challenges in their areas.

4.5.8.1 Common Needs Identified

4.5.8.1.1 Infrastructure Improvements

Teachers consistently mentioned the need for better school facilities, including improved classrooms, science labs, libraries, and basic utilities. The significance of digital infrastructure, including internet connection and computer or tablet availability, was also underlined by many.

4.5.8.1.2 Digital Learning Resources

A significant number of teachers expressed the need for digital learning tools, e-books, interactive learning platforms, and multimedia teaching aids to enhance student engagement and learning outcomes.

4.5.8.1.3 Teacher Training and Professional Development

Almost all respondents highlighted the importance of continuous professional development opportunities. They requested training in modern teaching methodologies, technology integration, classroom management, and handling diverse learning needs.

4.5.8.1.4 Learning Materials and Teaching Aids

Many teachers called for better access to quality learning materials, including textbooks in regional languages, audio-visual tools, and resources for hands-on learning experiences.

4.5.8.1.5 Community Involvement

Several teachers emphasized the need for increased collaboration with local communities and parents to improve student attendance, engagement, and overall educational outcomes.

4.5.8.1.6 Special Education Support

In order to effectively serve children with special educational needs and apply inclusive education techniques, several educators brought up the need for training and resources.

4.5.8.1.7 Extracurricular Activities

Some educators emphasised how crucial it is to finance and encourage extracurricular activities to help pupils become well-rounded individuals.

Keywords: infrastructure, digital resources, teacher training, learning materials, community involvement, special education, extracurricular activities, Odisha education

4.5.9 Question # 9

How familiar are you with the concept of Enterprise Architecture (EA) and its potential applications in the education sector?

The responses from 30 teachers across various districts in Odisha, India reveal a general lack of familiarity with Enterprise Architecture (EA) in the education sector. Most teachers have limited or no knowledge of EA and its applications in their field. However, many express interests in learning more about it, particularly if it can help improve school management, streamline administrative processes, or enhance resource allocation.

Some key observations:

1. Awareness: The majority of teachers have not heard of EA or have very limited understanding of its concept.
2. Potential Benefits: Despite unfamiliarity, many teachers speculate that EA could be useful in:

- Integrating educational tools and systems
- Improving school operations and management
- Enhancing communication between schools
- Streamlining administrative tasks
- Better organizing resources and student data

3. Need for Training: Several teachers mention the need for proper guidance, training, and resources to understand and implement EA in their schools.
4. Openness to Learning: Many teachers express willingness to learn more about EA if it can demonstrably improve their educational systems.
5. Focus on Practicality: Teachers emphasize their current focus on practical aspects of teaching, curriculum delivery, and student outcomes.

Keywords: Enterprise Architecture, education sector, awareness gap, potential benefits, resource management, system integration, training needs, technology adoption, school administration, teacher perspectives

4.5.10 Question # 10

In your opinion, how could a value-based framework that integrates stakeholder engagement and evidence-based strategies improve the educational landscape in Odisha?

The responses from 30 teachers across various districts in Odisha, India, highlight the potential benefits of implementing a value-based framework and evidence-based strategies in the education system.

The teachers consistently emphasize that a value-based framework could:

1. Involve local communities and stakeholders in decision-making
2. Create a shared vision for education
3. Foster collaboration between teachers, parents, and the community

4. Ensure education is more student-centred and inclusive
5. Bring a sense of ownership and accountability to all stakeholders

Regarding evidence-based strategies, the teachers suggest they could:

1. Focus on proven teaching methods
2. Help tailor teaching to improve learning outcomes
3. Provide tools to measure success and track progress
4. Allow for data-driven decisions and continuous improvement
5. Identify gaps in teaching and address them effectively

The teachers believe that combining these approaches would lead to a more holistic, effective, and community-oriented education system that better serves the needs of students and stakeholders.

Key words: value-based framework, evidence-based strategies, community involvement, stakeholder engagement, decision-making, collaboration, student-centred, accountability, data-driven, learning outcomes, continuous improvement.

4.6 Conclusion

In conclusion, the implementation of Enterprise Architecture in Odisha's government school education system presents a transformative opportunity to create a truly student-obsessed ecosystem. By placing students at the heart of every architectural decision, we can forge a system that not only enhances administrative efficiency but fundamentally elevates the quality of education and student experiences. The proposed framework, built on the foundation of IndEA and tailored to Odisha's unique context, enables the creation of collaborative coaching clusters among schools. These clusters can foster knowledge sharing, best practice exchange, and collective problem-solving, ultimately leading to improved teaching methodologies and learning outcomes. By leveraging technology and data-driven insights, we can personalize learning paths, identify areas for intervention early, and provide targeted support to each student. This

student-centric approach, combined with the agility and efficiency of the EA framework, has the potential to create an excellent student experience that goes beyond traditional classroom boundaries. It can empower students with 21st-century skills, foster creativity and critical thinking, and prepare them for the challenges of the future. As we move forward with this initiative, our unwavering focus on student success will drive innovation, collaboration, and continuous improvement across Odisha's education landscape, setting a new standard for educational excellence in India.

CHAPTER V:

DISCUSSION

5.1 Discussion of Results

The results from our research into implementing Enterprise Architecture (EA) in Odisha's government school education system reveal a complex interplay of technological, organizational, and pedagogical factors. The adoption of the IndEA framework, tailored to the specific needs of K-12 education, emerges as a promising approach to streamline processes and improve overall system efficiency. However, the results also highlight the critical importance of balancing technological advancements with educational values and stakeholder needs. The emphasis on a value-based framework and stakeholder engagement underscores the need for a holistic approach that goes beyond mere technological implementation. The difficulties noted, especially the lack of resources and opposition to change, are typical of major educational changes. Yet, the proposed mitigation strategies, such as the Agile IndEA approach and phased implementation, offer practical solutions to these obstacles. The focus on aligning EA initiatives with educational outcomes addresses a crucial gap often overlooked in technology-driven reforms. This alignment, coupled with the development of comprehensive blueprints and multiple architecture views, suggests a pathway to create a more responsive, efficient, and student-centric education system. The discussion of best practices, particularly the "Think Big, Start Small" approach and the integration of change management practices, provides a roadmap for successful implementation. All of these results suggest that EA has the ability to significantly alter the educational experience of Odisha students in addition to improving administrative effectiveness. The findings, however, also warn against a one-size-fits-all strategy, highlighting the necessity of ongoing modification and improvement in light of regional circumstances and new educational requirements.

This chapter addresses the implementation and challenges of Enterprise Architecture (EA) in Odisha's government school education system, focusing on three

key aspects: effective implementation of EA principles, challenges in EA adoption, and best practices for successful implementation.

RQ1: Implementation and Challenges of Enterprise Architecture

5.1.1 Effective Implementation of EA Principles

The case studies demonstrate several ways EA principles can be effectively implemented in Odisha's government school education system:

1. Holistic Systems Thinking: Schools like Panchayat High School, Chapria, and Gopinath High School have adopted a comprehensive approach to transformation, considering infrastructure, technology, and community engagement as interconnected elements.
2. Stakeholder Engagement: All case studies highlight the crucial role of alumni and community involvement in driving educational improvements.
3. Alignment with Strategic Goals: Schools have aligned their initiatives with broader educational objectives, such as providing quality education and creating inclusive learning environments.
4. Adaptability and Flexibility: Schools like Onslow Govt High School have demonstrated adaptability by integrating modern technologies like interactive displays into traditional teaching methods.
5. Resource Optimization: The 'Mo School Abhiyan' initiative has enabled schools to optimize resources by leveraging alumni contributions and government matching grants.

5.1.2 Challenges in EA Adoption

Key challenges associated with EA adoption in the K12 education context include: (depicted as EAC series – EA Challenge for future mapping in the EA tool)

EAC01. Resource Constraints: Many schools face limitations in terms of funding and infrastructure, particularly in remote areas.

EAC02. Technological Gaps: Implementing modern technologies in traditional educational settings can be challenging, especially in rural areas with limited connectivity.

EAC03. Resistance to Change: Traditional educational practices may resist the adoption of new architectural approaches and technologies.

EAC04. Skill Gaps: There may be a lack of skilled personnel to implement and maintain EA-driven systems in schools.

EAC05. Sustainability: Ensuring the long-term sustainability of EA initiatives beyond initial implementation can be challenging.

To mitigate these challenges: (depicted as S series – Solutions for future mapping in the EA tool)

S01. Leverage community and alumni networks for resource mobilization and skill sharing.

S02. Implement phased approaches to technology adoption, starting with basic infrastructure improvements.

S03. Conduct awareness programs and training sessions for stakeholders to reduce resistance to change.

S04. Collaborate with local tech companies or educational institutions for skill development and support.

S05. Develop long-term sustainability plans that include ongoing community engagement and government support.

5.1.3 Leading Practices for Successful EA Implementation

Based on the case studies, the following best practices can be identified:

(depicted as LP series – Leading Practices for future mapping in the EA tool)

LP01. Community-Driven Development: Engage alumni and local communities in school development projects, as demonstrated by all case studies

LP02. Leveraging Government Initiatives: Utilize programs like 'Mo School Abhiyan' to access funding and support for EA implementation

LP03. Focus on Holistic Development: Implement improvements across various aspects of the school ecosystem, including infrastructure, technology, and educational quality.

LP04. Embrace Technology Integration: Incorporate modern technologies to enhance learning experiences, as seen in the Onslow Govt High School and Bargarh case studies.

LP05. Prioritize Inclusivity: As proven by Panchayat High School, Chapria, make sure that EA implementations take into account the requirements of all pupils, including those with impairments.

LP06. Continuous Improvement: Adopt a mindset of ongoing enhancement and adaptation to evolving educational needs, as exemplified by Ravenshaw Collegiate School.

LP07. Sustainable Design: Implement eco-friendly and sustainable solutions in school development projects.

LP08. Data-Driven Decision Making: Assess the effectiveness of EA projects and make choices based on data and metrics.

By implementing these best practices, Odisha's government school education system can effectively leverage Enterprise Architecture to enhance educational quality, infrastructure, and overall student experience, aligning with SDG 4 goals for quality education.

5.2. Discussion of Within-Case Analysis

The within-case analysis of the twelve case studies from various districts in Odisha reveals several key themes and patterns in the implementation of Enterprise Architecture (EA) principles in the government school education system. This analysis provides valuable insights into the effective application of EA and its alignment with SDG 4 (Quality Education).

(Depicted as WCA series to tag Within Case Analysis-WCA for future mapping in the EA tool)

WCA01. One of the most prominent themes across all cases is the critical role of community and alumni engagement in driving educational transformation. This engagement manifests in various forms, from financial contributions to active participation in school development projects. For instance, in the case of Panchayat High School, Chapria (Kalahandi), alumni contributions were instrumental in facilitating a grant of ₹7,53,400, which was matched by the state government.

WCA02. The 'Mo School Abhiyan' initiative emerges as a pivotal platform for implementing EA principles. This initiative serves as a catalyst for community-driven

development, providing a structured framework for alumni and community members to contribute to their alma maters. The success of this initiative is evident across all case studies, with schools receiving substantial financial support and resources for infrastructure development and educational enhancement.

WCA03. Infrastructure development is another recurring theme, with schools focusing on both physical and digital improvements. From the construction of new classrooms and libraries to the installation of smart classrooms and computer labs, these improvements align with the EA principle of creating a robust and scalable educational ecosystem. The case of Onslow Govt High School (Ganjam) stands out, where the installation of smart interactive displays has enabled digital participation in the learning process.

WCA04. One important component of EA implementation that has been seen in several instances is the use of technology in the classroom. The introduction of Amazon Alexa in classrooms in a government high school in Bargarh district exemplifies innovative approaches to enhance learning experiences. This aligns with the EA principle of leveraging technology to improve service delivery and user experience.

WCA05. Sustainability and inclusivity are also prominent themes, reflecting the alignment with SDG 4. Schools like Panchayat High School, Chapria, have focused on creating inclusive environments by installing ramps for specially challenged students. Similarly, the emphasis on eco-friendly initiatives and sustainable practices is evident in several cases.

WCA06. The transformation journeys of these schools demonstrate an entrepreneurial spirit, characterized by innovative approaches to resource mobilization and community engagement. This aligns with the EA principle of fostering innovation and adaptability within organizational structures.

However, the analysis also reveals challenges in EA implementation, particularly in terms of resource constraints and the need for continuous adaptation to evolving educational needs. These challenges highlight the importance of developing flexible and

scalable EA frameworks that can accommodate the unique contexts of different schools and districts.

In conclusion, the within-case analysis demonstrates that the successful implementation of EA principles in Odisha's government school education system is largely driven by community engagement, strategic use of technology, and a focus on sustainable and inclusive development. These factors collectively contribute to the alignment with SDG 4, showcasing the potential of EA in transforming educational landscapes in developing regions.

5.3 Discussion of Cross-Case Analysis

The cross-case analysis of the twelve case studies reveals several key patterns as well as topics in the use of Enterprise Architecture (EA) concepts in the government school system of Odisha. These patterns highlight the importance of community engagement, adaptive infrastructure, technology integration, and sustainable development in achieving educational transformation.

(Depicted as CCA series to tag Cross Case Analysis-CCA for future mapping in the EA tool)

CCA01. Community Engagement and Alumni Involvement

Across all cases, a strong pattern of community engagement and alumni involvement emerges as a critical factor in successful EA implementation. This engagement manifests in various forms:

E01. Financial contributions: In all cases, alumni and community members provided significant financial support, often matched by government grants.

E02. Active participation: Alumni and community members actively participated in school development projects, from planning to execution.

E03. Continuous support: The establishment of alumni networks and communication channels (e.g., WhatsApp groups) ensured ongoing engagement and support.

This pattern of community involvement creates a sense of ownership and commitment, fostering a supportive ecosystem for educational transformation.

CCA02. Adaptive Infrastructure Development

The case studies demonstrate a consistent focus on adaptive infrastructure development, tailored to each school's unique needs:

A01. Physical improvements: Construction and renovation of classrooms, libraries, laboratories, and sanitation facilities.

A02. Technology integration: Installation of smart classrooms, computer labs, and digital learning tools.

A03. Safety enhancements: Construction of boundary walls, installation of CCTV cameras, and improved access control.

This adaptive approach to infrastructure development allows schools to address their specific challenges while aligning with broader EA principles.

CCA03. Technology Integration for Enhanced Learning

The use of technology to improve the educational process is a common feature throughout the cases:

TI01. Smart classrooms: Many schools implemented interactive displays and digital learning tools.

TI02. Computer labs: Several schools established or upgraded their computer facilities.

TI03. Innovative technologies: Some schools introduced advanced technologies like Amazon Alexa for interactive learning.

This focus on technology integration demonstrates a commitment to preparing students for the digital age while improving educational delivery.

CCA04. Sustainable Development and Eco-friendly Practices

Several case studies highlight a growing emphasis on sustainable development and eco-friendly practices:

SD01. Solar power installation: Some schools implemented solar energy solutions.

SD02. Garden development: Many schools focused on beautifying their premises with gardens.

SD03. Eco-clubs: Establishment of eco-clubs to promote environmental awareness.
This trend aligns with broader sustainability goals and demonstrates the integration of environmental considerations into EA implementation.

CCA05. Holistic Approach to Education

The cross-case analysis reveals a holistic approach to education, extending beyond academic improvements:

HA01. Sports facilities: Many schools invested in sports infrastructure and equipment.
HA02. Extracurricular activities: Establishment of various clubs and activities to promote all-around development.
HA03. Life skills education: Some schools incorporated life skills training into their curriculum.

This comprehensive approach to education aligns with the EA principle of creating a well-rounded educational ecosystem. In conclusion, the cross-case analysis demonstrates that successful EA implementation in Odisha's government school education system is characterized by strong community engagement, adaptive infrastructure development, technology integration, sustainable practices, and a holistic approach to education. These patterns collectively contribute to creating resilient, innovative, and effective educational environments that align with SDG 4 goals and prepare students for future challenges.

5.4 Implementing via an Enterprise Architecture Management (EAM) Tool

A leading Enterprise Architecture Management EA Tool is used to capture such results that have been discussed so far in this section:

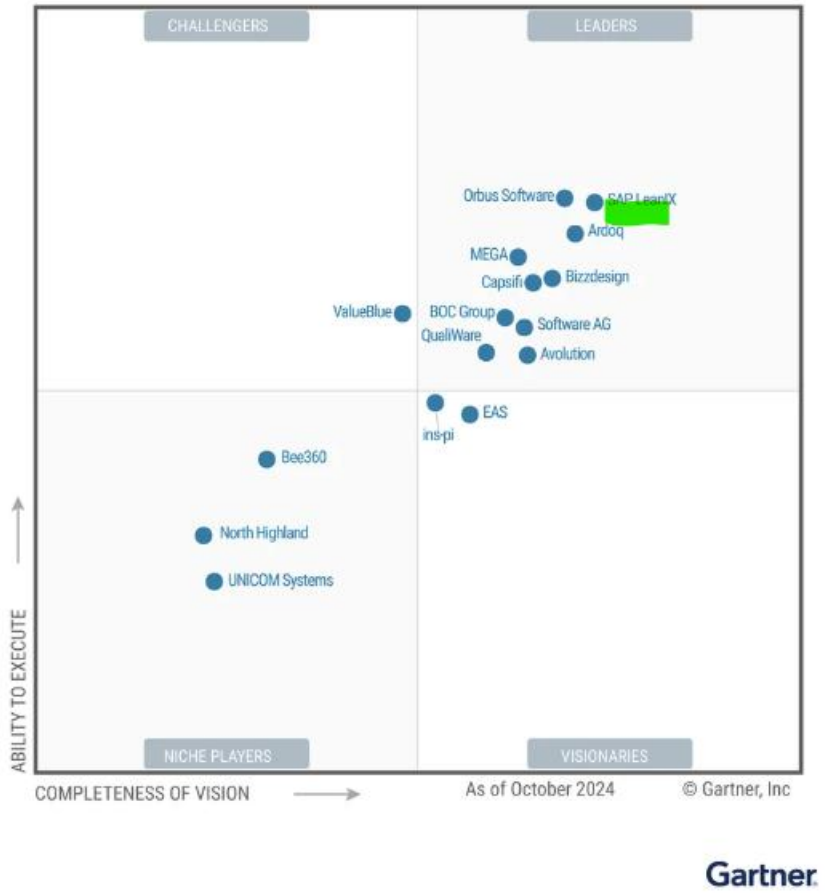

Figure 5.1 Gartner Magic Quadrant for EA Tools

In the context of SAP LeanIX, a leading EA Management Tool, idea, project, program, and epic are different levels of initiatives that help organizations manage their transformation efforts. Let's explain each of these with examples from the Odisha government school education system and their relationships:

5.4.1 Idea

An idea in LeanIX represents a concept or suggestion for improvement that hasn't yet been approved or fully developed into a project.

Example: "Augmented Reality Educational Tours"

This is an idea for using AR technology to provide immersive educational experiences across subjects. It's still in the conceptual stage and needs further evaluation before becoming a project.

A snapshot from my SAP LeanIX Enterprise Architecture Management (EAM) Lab for Ideas Inventory:

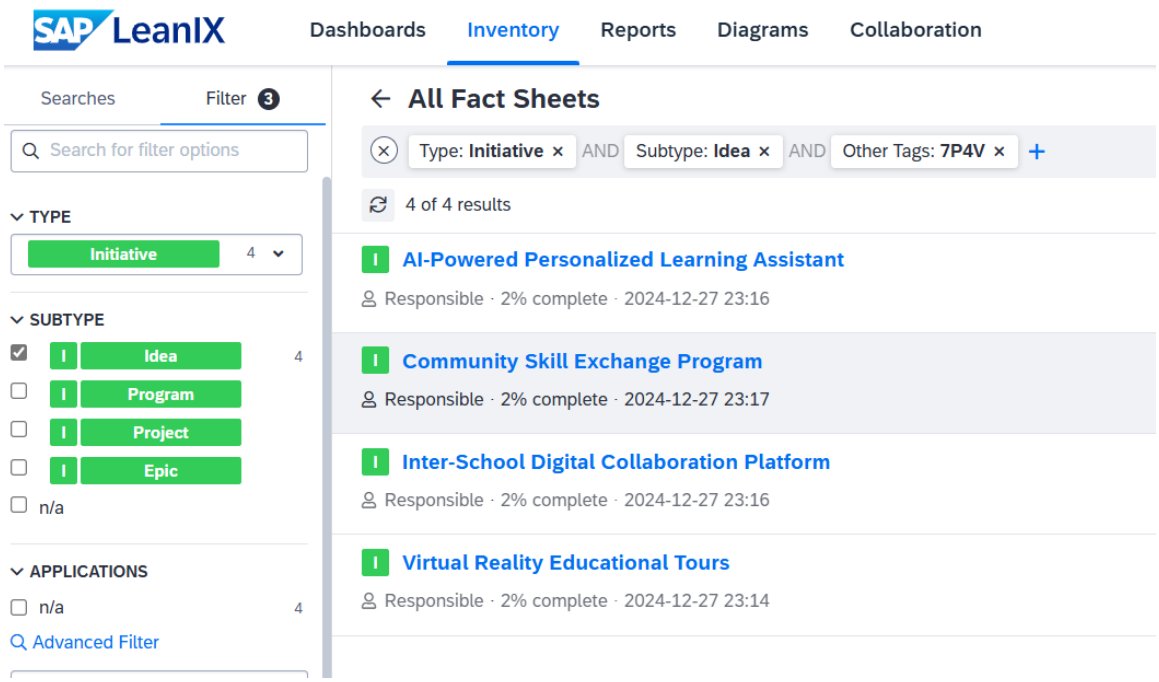

Figure 5.2 Idea Inventory in SAP LeanIX

5.4.2 Project

A project in LeanIX is a specific, time-bound effort with defined deliverables and objectives.

Example: "AI-Assisted Learning Implementation"

This project involves the integration of AI tools like Amazon Alexa in classrooms for interactive learning. It has a clear scope, timeline, and expected outcomes.

A snapshot from my SAP LeanIX Enterprise Architecture Management (EAM) Lab for Projects Inventory:

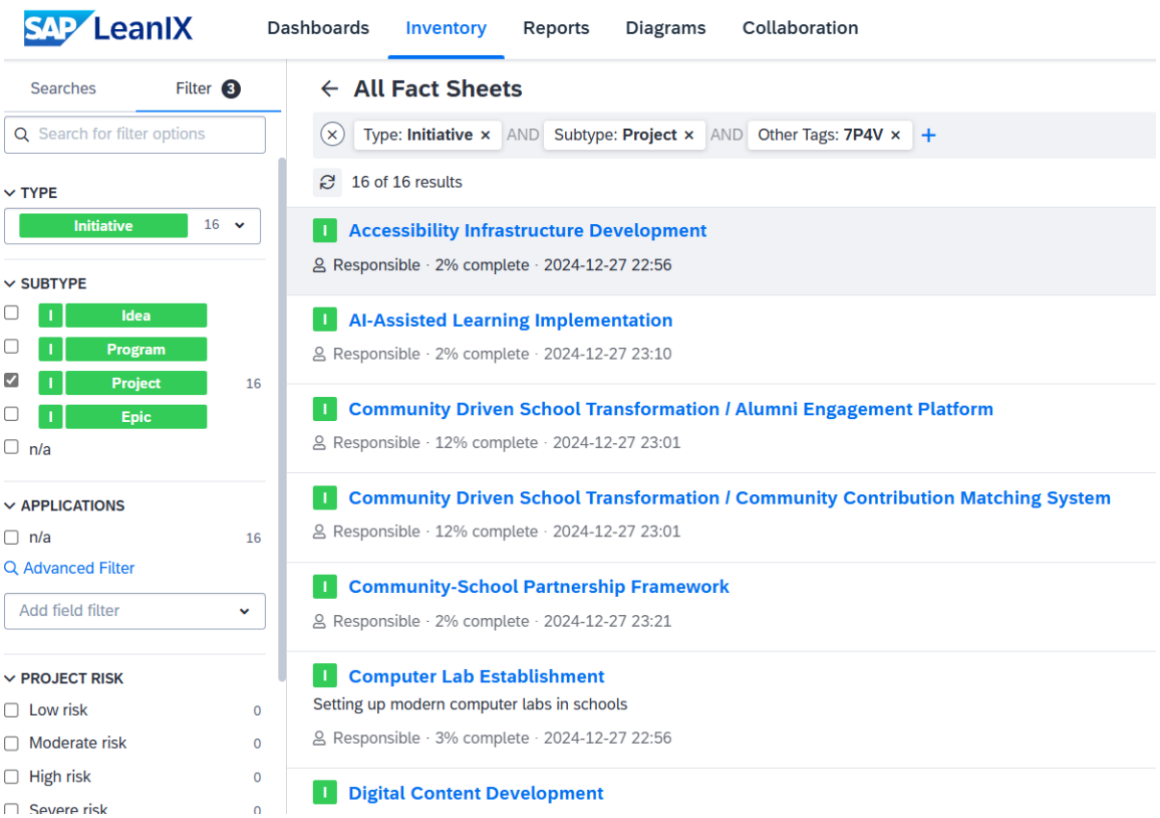

Figure 5.3 Projects in SAP LeanIX

5.4.3 Program

A program in LeanIX is a collection of related projects that together achieve a larger strategic goal.

Example: "Digital Literacy Advancement"

This program encompasses multiple projects aimed at enhancing the digital skills of students, teachers, and staff. It might include projects like AI-Assisted Learning Implementation, Computer Lab Establishment, and Digital Content Development.

A snapshot from my SAP LeanIX Enterprise Architecture Management (EAM) Lab for Programs Inventory:

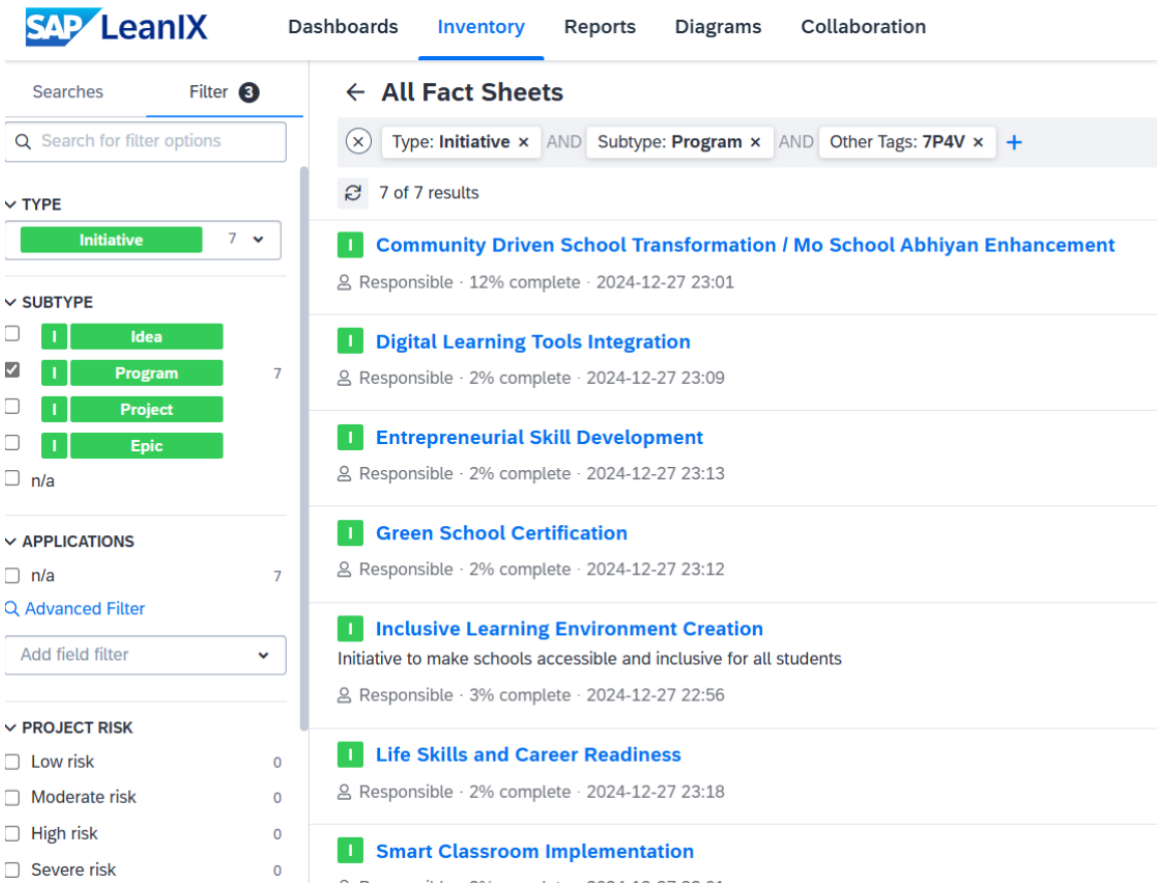

Figure 1.4 Programs in SAP LeanIX

5.4.4 Epic

An epic in LeanIX represents a large, overarching initiative that may span multiple programs or projects.

Example: "Technology-Enabled Education Ecosystem"

This epic is a broad initiative to integrate advanced technology across the educational experience. It would encompass programs like Digital Literacy Advancement and Smart Classroom Implementation, as well as individual projects like AI-Assisted Learning Implementation.

A snapshot from my SAP LeanIX Enterprise Architecture Management (EAM) Lab for Epics Inventory:

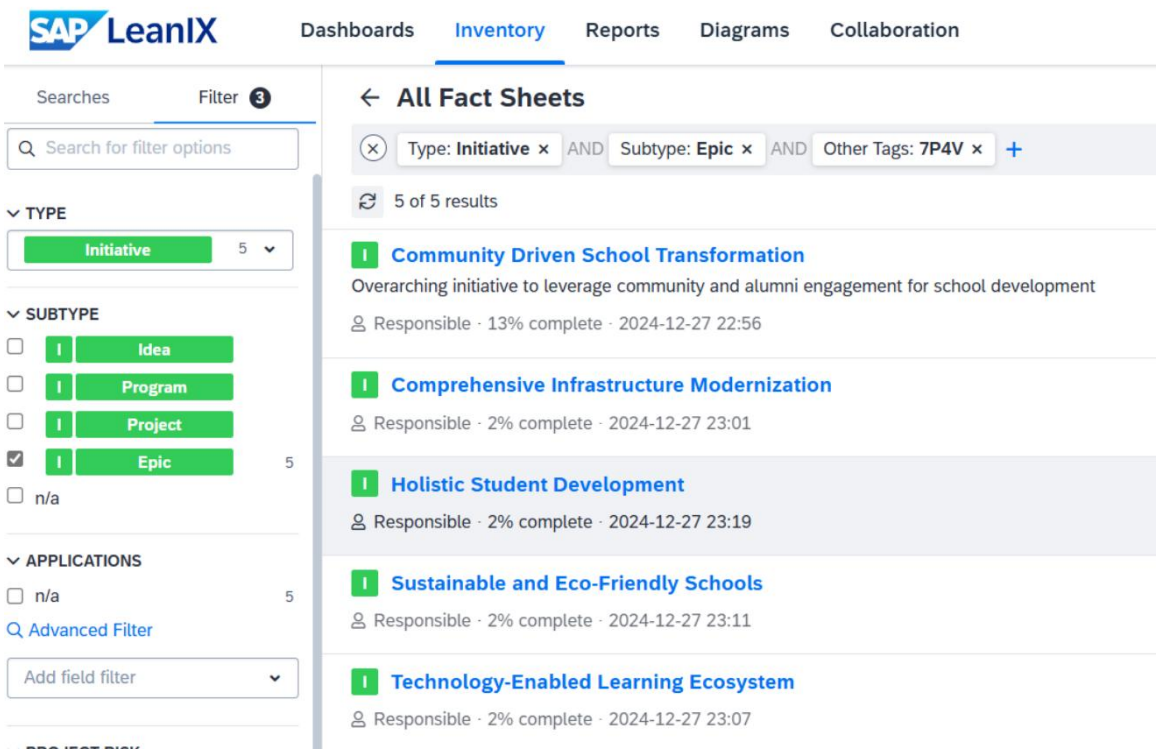

Figure 5.5 Programs in SAP LeanIX

5.4.5 Relationships

- Epics contain Programs and/or Projects
- Programs contain multiple related Projects
- Projects can be derived from Ideas
- Ideas can evolve into Projects or be incorporated into Programs or Epics

In the context of our examples:

The "Technology-Enabled Education Ecosystem" epic includes the "Digital Literacy Advancement" program.

The "Digital Literacy Advancement" program contains the "AI-Assisted Learning Implementation" project.

The "Augmented Reality Educational Tours" idea, if approved, could become a project within the "Digital Literacy Advancement" program or directly under the "Technology-Enabled Education Ecosystem" epic.

This hierarchical structure in LeanIX allows for effective management of initiatives at various scales, from broad strategic goals down to specific, actionable projects.

For Eco Friendly school, below is an example of the relationship between Epic and Program/Project

Figure 5.6 Relationships between EPIC and Program/Project

CHAPTER VI:

SUMMARY, IMPLICATIONS, AND RECOMMENDATIONS

6.1 Summary

This research explored the implementation of Enterprise Architecture (EA) principles in Odisha's government school education system through a value-based framework. The study identified key challenges, best practices, and strategies for effective EA adoption in this context. The findings highlight the importance of adapting national frameworks like IndEA to local educational needs, emphasizing stakeholder engagement, and aligning EA initiatives with educational outcomes.

6.2 Implications

1. Educational Transformation: Successful EA implementation has the potential to transform Odisha's education system, enhancing efficiency, improving resource allocation, and ultimately leading to better educational outcomes for students.

2. Digital Divide Reduction: By leveraging technology and improving information systems, EA can contribute to more equal access to high-quality education by bridging the digital divide between Odisha's rural and urban communities.

3. Capacity Building: The focus on developing local EA expertise will contribute to building a skilled workforce within Odisha's education sector, potentially leading to long-term sustainability of digital initiatives.

4. Policy Alignment: The EA framework can facilitate better alignment between state-level educational policies and their implementation at the district and school levels.

5. Data-Driven Decision Making: Improved data management and integration through EA can enable more informed, data-driven decision-making in educational planning and resource allocation.

6.3 Recommendations for Future Research

1. Long-term Impact Study: Determine the long-term effects of EA implementation on Odisha's educational results by conducting longitudinal research, including student performance, teacher effectiveness, and system efficiency.

2. Comparative Analysis: Perform comparative studies between districts or states implementing EA in their education systems to identify best practices and lessons learned.

3. Stakeholder Perception: Investigate the perceptions and experiences of various stakeholders (teachers, students, administrators) during and after EA implementation to inform future adoption strategies.

4. Technology Integration: Research the effectiveness of different technologies and platforms within the EA framework, particularly in resource-constrained environments.

5. Cultural Adaptation: Explore how EA frameworks can be further adapted to accommodate local cultural and linguistic diversity in education delivery.

6. Scalability and Sustainability: Investigate factors contributing to the scalability and long-term sustainability of EA initiatives in public education systems.

7. Skill Development Alignment: Research how EA can be leveraged to align educational curricula with emerging skill requirements in the job market.

8. Change Management Strategies: Conduct in-depth studies on effective change management strategies specific to EA implementation in educational contexts.

9. Cost-Benefit Analysis: Perform detailed cost-benefit analyses of EA implementation in different educational settings to inform resource allocation decisions.

10. Integration with Emerging Technologies: Explore how emerging technologies like AI, machine learning, and blockchain can be integrated into the EA framework for education.

11. Extension to Universities: Explore how it can be extended to universities.

6.4 Roadmap for Education Entrepreneurs

The iconic 9P4V conceptual framework for educational entrepreneurship presents a comprehensive roadmap for implementing innovative educational initiatives across various value streams. This framework aligns well with Odisha's current efforts to implement the National Education Policy 2020. The roadmap involves integrating

vocational education with general academic education, as seen in the Samagra Shiksha scheme, to prepare students for various sectors of the economy.

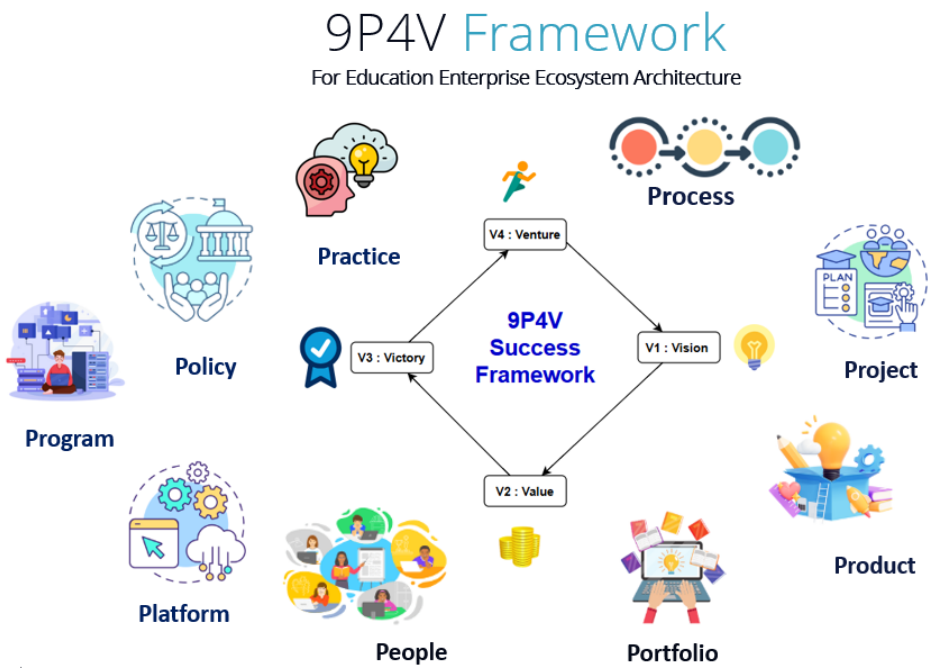

Figure 6.1 9P4V Framework developed by the Author

It also emphasizes the development of entrepreneurial skills, as demonstrated by Gujarat's Student Entrepreneurship Policy, which aims to foster business acumen and creative ideas among students. The framework's focus on technology integration, personalized learning, and community engagement resonates with Odisha's initiatives like the 5T High School Transformation Programme.

6.5 Conclusion

There is a great chance to improve the standard, effectiveness, and equity of education delivery in Odisha's government school system by using enterprise architecture. By adopting a value-based framework that emphasizes stakeholder

engagement, agile implementation, and alignment with educational outcomes, Odisha can develop a robust EA that addresses its unique challenges and leverages its strengths.

The research highlights the importance of adapting national frameworks to local contexts, building capacity, and integrating change management practices. While challenges such as resistance to change, limited resources, and complex IT environments exist, they can be mitigated through strategic planning and phased implementation. A successful EA implementation might have several advantages, such as better resource allocation, more data-driven decision-making, and more individualised student learning experiences. However, achieving these advantages calls for consistent dedication, ongoing assessment, and adjustment to changing educational requirements and technology breakthroughs.

As Odisha moves forward with EA implementation, it has the opportunity to set a new standard for educational excellence in India, creating a more responsive, efficient, and student-centric education system. Future research in this area will be crucial for refining approaches, understanding long-term impacts, and making certain that EA keeps up with the changing requirements of Odisha's students, teachers, and society at large.

APPENDIX: A

SURVEY COVER LETTER

[Your Organization's Letterhead] [Date]

Dear [Participant],

We are conducting a survey on [topic] as part of [brief explanation of the project/research]. Your insights are invaluable to us, and we would greatly appreciate your participation. The survey should take approximately [X] minutes to complete and covers [brief overview of topics]. Your answers will be kept completely private and used just for [purpose]. Your participation is entirely voluntary, but your input will significantly contribute to [expected outcome/benefit of the research]. To access the survey, please [instructions for accessing the survey, e.g., click the link below, etc.]. We kindly request that you complete the survey by [deadline]. Please feel free to reach out to [contact person] at [email/phone] with any queries or worries. I appreciate your important opinion and time in advance.

Sincerely,

[Your Name] [Your Title] [Your Organization]

APPENDIX: B

INFORMED CONSENT FOR RESEARCH

Informed Consent for Research

Project title: From Vision to Venture: Enterprise Architecture in Odisha's Educational Landscape

Research investigator: Niladri Bihari Nayak (B.Tech , MBA, PGDSCM), Doctorate Scholar at Swiss School of Business and Management (SSBM) Geneva, Switzerland.

Dear Participant,

You are cordially invited to take part in a study that will investigate the impact and influence of enterprise architecture on Odisha's educational outcomes. It is anticipated that the interview would last between thirty and forty minutes. The study is being carried out at the Swiss School of Business and Management (SSBM) in Geneva as a prerequisite for a doctorate.

By doing this, I am requesting your consent to interview you. Participation is entirely voluntary, and neither you nor your organisation will get payment. Interview subjects are not known to be at danger. The researcher will do a private interview with you, asking you a series of questions that have been prepared. You have the right to leave the interview at any moment. No personal identity will be noted, and all survey results and personal information will be kept private.
We appreciate your willingness to be interviewed for the aforementioned study.

Interview subjects must expressly consent to being interviewed and to the use of the information they provide, according to university research ethics protocols. We need this permission form to make sure you understand why you are participating and that you

accept the terms of your participation. Therefore, after reading the information sheet that goes with it, would you sign this document attesting to your approval of the following?

- Audio recordings, transcriptions, and English translations will be made of every interview.
- For three years from the date of the interview, all data will be securely stored.
- A summary of the finding will be available upon request.

Quotation Agreement

Additionally, I am aware that my statements might be directly cited. Please initial any things that you agree with in relation to being quoted:

	I would like to examine any notes, transcripts, or other information gathered about my involvement in the study.
	I consent to being directly quoted.
	In the event that my name is not published and a pseudonym is used, I consent to being cited directly.
	I consent to the researchers using my quotes in their publications.

All or part of the content of your interview may be used.

- In an academic paper, policy paper, or newspaper article
- On our website and in other media that we may produce such as spoken presentations
- On other feedback events
- In an archive of the project as mentioned above

By signing this form, I agree that;

1. I am participating in this project voluntarily. I understand that I am free to withdraw my participation at any time and also that I am free to withdraw from the interview at any point;
2. The transcript of the interview or any extracts of it may be used as stated above;
3. I have read the information sheet;
4. I do not expect to gain or receive any compensation for my participation.
5. I can ask for a transcript of my interview and may suggest changes I believe are necessary in order to effectively secure any confidentiality agreement made.
6. I have had the opportunity to ask any questions I might have, and I am informed that I am permitted to contact the researcher at any time with any additional questions I might have.

Printed Name

Participants Signature **Date**

Researchers Signature **Date**

What if I have concerns about this research?

Should you have any concerns regarding this research or its methodology, you may reach SSBM by email at contact@ssbm.ch, connect@niladrinayak.in

APPENDIX: C

QUESTION SET FOR QUALITATIVE RESEARCH

1. What are the primary challenges you face in ensuring equitable access to quality education in your district?

2. How do you currently align educational strategies with broader state, national, and Global educational goals as a BEO/DEO/School Principal/Teacher?

3. What role do you think technology and information systems play in improving educational outcomes in your district?

4. Can you describe any existing frameworks or strategies that have been effective in improving educational efficiency and effectiveness?

5. How do you engage with various stakeholders (teachers, parents, community members) to implement educational policies and programs?

6. What are the key barriers to implementing new educational initiatives in your district?

7. How do you measure the success and impact of educational programs and initiatives in your district?

8. What kind of support or resources do you need to better address the educational challenges in your district?

9. How familiar are you with the concept of Enterprise Architecture (EA) and its potential applications in the education sector?

10. In your opinion, how could a value-based framework that integrates stakeholder engagement and evidence-based strategies improve the educational landscape in Odisha?

APPENDIX: D

PERSONAL EXPERIENCE AND GROWTH FROM THE DBA JOURNEY

Commencing my Doctor of Business Administration (DBA) journey marked a significant transition in my academic and professional life. Having previously completed a Bachelor of Technology in Electronics and Communication Engineering (2010) and a Master of Business Administration (2013), I had been removed from formal academic study for several years. Re-entering an academic environment, distinct from my established professional routine, initially presented a considerable challenge. However, with the guidance of my mentor Anna and the encouragement of a supportive peer group and well-wishers, I was able to re-establish effective study habits and began submitting sections of my thesis at a consistent pace, which greatly enhanced my confidence and motivation.

As I became more acquainted with the research process, many of my initial apprehensions subsided. Previously, I had perceived research as an abstract and highly complex activity, accessible only to the exceptionally gifted. Through exposure to various research methodologies and academic practices, I discovered that research, while demanding, is an intellectually stimulating and attainable pursuit.

My approach to reading and knowledge acquisition also evolved substantially during this period. Before this programme, my reading habits were largely confined to industry blogs, newsletters, reports, and select books relevant to current trends. The DBA journey, however, introduced me to a broader spectrum of scholarly articles, academic journals, periodicals, and dissertations, thereby expanding my intellectual horizons and deepening my understanding of the field.

A notable area of personal development was in academic writing. Historically, I had struggled with writing concisely and consistently, often relying

on verbal communication and non-verbal cues to convey meaning. The demands of academic writing required me to develop clarity and precision in written expression. This involved iterative drafting and critical self-review to ensure that my intended meaning was accurately communicated.

Throughout this process, I also expanded my professional network, engaging in substantive discussions with peers within my industry and establishing new connections with colleagues from other organisations. These interactions highlighted the shared challenges and aspirations prevalent across the sector, fostering a sense of community and mutual learning.

A particularly significant area of growth was in my listening skills. Conducting interviews as part of my research necessitated attentive and empathetic listening, regardless of whether I agreed with the participants' viewpoints. This represented a marked shift from my previous conversational style, which often tended towards debate. Developing the ability to listen actively and without judgment has been a major transformation in both my personal and professional interactions.

This period of academic pursuit coincided with several profound personal challenges. I experienced the loss of my father at the outset of the programme (December 2021), the loss of my employment in September 2023, and my mother's survival of a heart attack in August 2023. These events tested my resilience but also served as catalysts for personal growth. In response, I established SuccessLabs Academy, focusing on coaching and consulting in the SAP domain. Looking ahead to July 2025, I plan to expand this vision to universities and corporations through a gamified learning platform powered by TagMango Learning Social Network.

In summary, the DBA journey has been characterised by numerous lessons and experiences, many of which are difficult to fully articulate. Collectively, they have contributed to a period of significant personal and professional development. This experience, which is often undertaken only once

in a lifetime, will remain a defining chapter in my life and has helped me to clarify my mission: architecting for a better world.

REFERENCES

Abunadi, I. (2019) Enterprise architecture best practices in large corporations. Information, 10(10), p.293.

Aim.gov.in (2024) Available at: https://aim.gov.in/atl.php (Accessed on 15/07/2024).

Anamika, Pal, M.K. and Parhi, S.P. (2023) Certainty and Resilience of Online Education Through SERVQUAL: A Study in Odisha. In: COVID-19 and the Future of Higher Education In India. Cham: Springer International Publishing, pp.29-50.

Architecture and Governance (2022) In 2022, the Strategic Role of the Enterprise Architect is Confirmed. [online] Available at: https://www.architectureandgovernance.com/applications-technology/in-2022-the-strategic-role-of-the-enterprise-architect-is-confirmed/ (Accessed 5 July 2023).

Ardoq (2024) What Is Enterprise Architecture? [online] Available at: https://www.ardoq.com/ (Accessed 3 February 2025).

ASER (2023) Annual Status of Education Report 2023 [online]. Available at: https://asercentre.org/aser-2023-beyond-basics/ (Accessed: 11 July 2024).

Azevedo, J.P., Hasan, A., Goldemberg, D., Geven, K. and Iqbal, S.A. (2021) Simulating the potential impacts of COVID-19 school closures on schooling and learning outcomes: A set of global estimates. *The World Bank Research Observer*, 36(1), pp.1-40.

Bandeira, C., Barata, J. and Roque, N. (2023) Introducing the Sectoral Enterprise Architecture Framework (SEAF), *Proceedings of the 31st International Conference on*

Information Systems Development [online]. Available at: https://doi.org/10.62036/isd.2023.38 (Accessed: 11 July 2024).
Banerji, R. (2024) 'ASER 2023: Unveiling Educational and Digital Gaps in Odisha's Rural Youth', 19 January [online]. Available at: https://indianexpress.com/article/explained/expert-explains-gaps-in-learning-persist-but-access-to-tech-offers-avenues-beyond-physical-school-9114524/ (Accessed: 12 July 2024).

Bernard, S. (2020) Enterprise Architecture Principles for Higher Education. International Journal of Applied Research in Social Sciences, 5(2), pp.45-62.

Bhawan, T., School, M. and Sangathan, A. (2021) *Mo School Abhiyan: A Reference Handbook for Head Teachers*. [online] Available at: https://moschool.in/wp-content/uploads/2022/04/Cicular-Head-Teachers-Hand-Book-on-5T HST-Program.pdf (Accessed 5 January 2024).

Bizzdesign (2023) Survey: The State of Enterprise Architecture 2023. [online] Available at: https://onlinecommunity.bizzdesign.com/blogs/marketing-events-team/2022/12/23/survey-the-state-of-enterprise-architecture-2023 (Accessed 7 July 2023).

Budhia, N. and Behera, S. (2023) Challenges and Opportunities of Digital Education in India. *Asian Journal of Education and Social Studies*, 45(3), pp.1-7.
Capstera, 2023. Shortcomings of TOGAF. [online] Available at: https://www.capstera.com/ (Accessed 3 February 2025).

CAUDIT (2021) Australasian Higher Education Cybersecurity Service (AHECS) [online]. Available at: https://caudit.edu.au/cybersecurity (Accessed: 11 July 2024).

CAUDIT (2024) Higher Education Reference Models, CAUDIT [online]. Available at: https://caudit.edu.au/communities/caudit-higher-education-reference-models/ (Accessed: 11 July 2024).

Conexiam (2025) 5 Benefits of Enterprise Architecture. [online] Available at: https://conexiam.com/ (Accessed 3 February 2025).

Crue-tic, E., Alfons, L., and Martin, A. (2022) Spanish Higher Education Enterprise Architecture Initiative and Capability Map [online]. Available at: https://opengroup.org/library .

The Open Group (2022) TOGAF 10. Available at: https://www.opengroup.org/togaf/10thedition (Accessed: 13 July 2024).

Department of School and Mass Education, Odisha, n.d. Secondary Education | Department of School and Mass Education. [online] Available at: https://sme.odisha.gov.in/about-us/overview/secondary-education (Accessed 5 July 2024).

Department of School Education and Literacy (2021) *Performance Grading Index (PGI) 2020-21* [online]. Available at: https://www.education.gov.in/statistics-new?shs_term_node_tid_depth=396&Apply=Apply (Accessed: 11 July 2024).

Department of School Education and Literacy (2022) *Performance Grading Index (PGI) 2021-22* [online]. Available at: https://www.education.gov.in/statistics-new?shs_term_node_tid_depth=396&Apply=Apply (Accessed: 11 July 2024).

Dumitriu, D. and Popescu, M. (2020) Enterprise Architecture in Higher Education. Journal of Educational Technology, 12(3), pp.78-95.

Education Enterprise Architecture Guidebook (2022) *Education Enterprise Architecture Guidebook*. [pdf] Available at: https://files.eric.ed.gov/fulltext/ED611499.pdf (Accessed 5 July 2023).

U.S. Department of Education (2020) *Education Enterprise Architecture Guidebook.* Washington, D.C.: U.S. Department of Education.

Enterprise Architecture Professional Journal (2025) *Enterprise Architecture for Education [online].* Available at: https://eapj.org/ (Accessed: 3 February 2025).

Ertmer, P.A. et al. (2012) 'Teacher beliefs and technology integration practices: A critical relationship', *Computers and Education*, 59(2), pp. 423–435 [online]. Available at: https://doi.org/10.1016/j.compedu.2012.02.001 (Accessed: 11 July 2024).

Fullan, M. (2007) 'Change Theory as a Force for School Improvement', in *Intelligent Leadership*. Centre for Strategic Education Seminar Series, pp. 27–39 [online]. Available at: https://doi.org/10.1007/978-1-4020-6022-9_3 (Accessed: 12 July 2024).

Gong, Y. and Janssen, M. (2019) 'The value of and myths about enterprise architecture', *International Journal of Information Management*, 46, pp. 1–9 [online]. Available at: https://doi.org/10.1016/j.ijinfomgt.2018.11.006 (Accessed: 14 July 2024).

Government of Odisha (2023) Odisha Education Initiatives [online]. Available at: https://dhe.odisha.gov.in/ (Accessed: 12 July 2024).

Gupta, M. and Kiran, R. (2023) Digital exclusion of women: a systematic review. *Global Knowledge, Memory and Communication*.

Hew, K.F. and Brush, T. (2007) 'Integrating technology into K-12 teaching and learning: Current knowledge gaps and recommendations for future research', *Educational*

Technology Research and Development, 55(3), pp. 223–252 [online]. Available at: https://doi.org/10.1007/s11423-006-9022-5 (Accessed: 12 July 2024).

Hindarto, D., Sarno, R., Ahmadi, H. and Santoso, H.B. (2021) Enterprise Architecture Framework for Higher Education: A Systematic Literature Review. Sustainability, 13(4), p.2003.

Hota, S.P. (2023) Education infrastructure, expenditure, enrollment & economic development in Odisha, India. *International Journal of Educational Development*, 103, p.102903.

Info-Tech Research Group (2023) K-12 Education Industry Reference Architecture. [online] Available at: https://www.infotech.com/research/ss/k-12-education-industry-reference-architecture (Accessed 5 July 2023).

Journal Articles IOPscience (2023) Enterprise Architecture for Higher Education Using Enterprise Architecture Planning (EAP) at UNIKOM. [online] Available at: https://iopscience.iop.org/article/10.1088/1757-899X/662/3/032030 (Accessed 5 June 2024).

Jusuf, M.B. and Kurnia, S. (2017) Understanding the Benefits and Success Factors of Enterprise Architecture. In: Proceedings of the 50th Hawaii International Conference on System Sciences. Hawaii, USA, 4-7 January 2017. pp.4887-4896.

Korovkin, V., Park, A. and Kaganer, E. (2023) Towards conceptualization and quantification of the digital divide. *Information, Communication & Society*, 26(11), pp.2268-2303.

Kuhfeld, M., Soland, J., Tarasawa, B., Johnson, A., Ruzek, E. and Liu, J. (2020) Projecting the potential impact of COVID-19 school closures on academic achievement. *Educational Researcher*, 49(8), pp.549-565.

Land, M.O.L. et al. (2009) 'Enterprise Architecture: Creating Value by Informed Governance', *Springer*, p. 145 [online]. Available at: http://www.amazon.com/Enterprise-Architecture-Creating-Governance-Engineering/dp/354085231X/ref=sr_1_sc_2?s=books&ie=UTF8&qid=1349995601&sr=1-2-spell&keywords=enterprimse+architecture+creating (Accessed: 14 July 2024).

LeanIX (2024) *2024 Gartner® Magic Quadrant™ for EA Tools*. Available at: https://www.leanix.net/en/download/gartner-magic-quadrant-for-enterprise-architecture-tools-2024 (Accessed: 28 December 2024).

LeanIX (2024) Challenges of Enterprise Architecture. [online] Available at: https://www.leanix.net/ (Accessed 3 February 2025).

Llamosa-Villalba, R., et al. (2015) 'Colombian Higher Education Enterprise Architecture (CHE2A)' [online]. Available at: https://ieeexplore.ieee.org/document/7344353 (Accessed: 12 July 2024).

MEGA International (2024) Key Benefits of EA. [online] Available at: https://www.mega.com/ (Accessed 3 February 2025).

Mahapatra, M.S.K. and Singh, M., DIGITAL EDUCATION IN ODISHA: OPPORTUNITIES AND THREATS IN POST COVID-19.

Marndi, S. (2023) *Odisha govt shuts 7478 schools in view of low enrolment*. The Statesman, 23 November. Available at: https://www.thestatesman.com/india/odisha-govt-shuts-7478-schools-in-view-of-low-enrolment-1503243306.html (Accessed: 21 December 2024)

Möhring, M. et al. (2023) 'Digitalization and enterprise architecture management: a perspective on benefits and challenges', *SN Business & Economics*, 3(2), pp. 45–56 [online]. Available at: https://doi.org/10.1007/s43546-023-00426-3 (Accessed: 12 July 2024).

Moscoso-Zea, O., Paredes-Gualtor, J. and Luján-Mora, S. (2019) 'Enterprise Architecture, an enabler of change and knowledge management', *Enfoque UTE*, 10(1), pp. 247–257 [online]. Available at: https://doi.org/10.29019/enfoqueute.v10n1.459 (Accessed: 14 July 2024).

Nag, H., Majhi, P., Mahavidyalaya, H.N.S., Chandol, K. and Dansana, A. (2023) Transforming Paradigms of Education: Exploring Odisha's 5t Model and Its Emphasis on E-Learning. *The Online Journal of Distance Education and e-Learning*, 11(3).

Nayak, N.C., Dhar, S. and Mahakur, P.K. (2016) *'Educational Outcomes in Odisha', in The Economy of Odisha: A Profile [online].* Oxford University Press, pp. 303–349. doi: https://doi.org/10.1093/acprof:oso/9780199464784.003.0010.

NAS (2017) *National Achievement Survey Odisha State Learning Report*. [online] Available at: https://ncert.nic.in/pdf/NAS/src/Odisha.pdf (Accessed 4 July 2024).

Nellutla, S. (2024) SDG 4 Performance, Current Status and Improvement Strategies: A Study on Indian Education Sector. *SAMRIDDHI*, p.70.

NITI Aayog (2021) *Systemic Transformation of School Education-The SATH-E Experience The Fundamental Principles* [online]. Available at: https://www.niti.gov.in/sites/default/files/2021-11/BCG_SATHE_DIGITAL_13112021_0.pdf (Accessed: 13 July 2024).

Orissa POST (2023) 'PGI 2021-22 Reveals Sharp Decline in Odisha's Education Performance' [online]. Available at: https://www.orissapost.com/pgi-2-0-report-odisha-school-education-degrades/ (Accessed: 13 July 2024).

Pandurangi, G. and Nagalakshmi, V. (2019) 'Benefits of government enterprise architecture: Context of certain EA initiatives in India', *International Journal of*

Engineering Research and Technology, 12(5), pp. 692–696 [online]. Available at: http://www.irphouse.com/ijert19/ijertv12n5_16.pdf (Accessed: 14 July 2024).

Papadopoulos, N. and Cleveland, M. (2023) An international and cross-cultural perspective on 'the wired consumer': The digital divide and device difference dilemmas. *Journal of Business Research*, 156, p.113473.

Parthiban, K., Pandey, D. and Pandey, B.K. (2021). Impact of SARS-CoV-2 in online education, predicting and contrasting mental stress of young students: a machine learning approach. *Augmented Human Research*, 6(1), p.10.

Pradhan, H. (2023) '5T has revolutionised school infra, says Odisha education minister', *The Times of India* (online), 24 March. Available at: https://timesofindia.indiatimes.com/education/news/5t-has-revolutionised-school-infra-says-odisha-education-minister/articleshow/98974534.cms (Accessed: 5 July 2024).

Proper, H.A. et al. (2018) 'On the development of a modelling framework for value co-creation', *CEUR Workshop Proceedings*, 2239, pp. 122–132 [online]. Available at: https://ceur-ws.org/Vol-2239/article_13.pdf (Accessed: 14 July 2024).

Rouvari, A. and Pekkola, S. (2024) 'Improving Communication and Collaboration in Enterprise Architecture Projects: Three Propositions from Three Public Sector EA Projects', *Lecture Notes in Business Information Processing*, 500 LNBIP (2), pp. 77–91 [online]. Available at: https://doi.org/10.1007/978-3-031-53227-6_6 (Accessed: 13 July 2024).

Sahoo, A.K. (2024) 'ASER 2023: Unveiling Educational and Digital Gaps in Odisha's Rural Youth' [online]. Available at: https://www.deccanchronicle.com/education/aser-2023-exposes-chinks-in-odisha-govts-education-system-879187 (Accessed: 11 July 2024).

Santos, W.F. et al. (2020) 'The State-of-the-Art of Enterprise Architecture Its Definitions, Contexts, Frameworks, Benefits, and Challenges: A Systematic Mapping of Literature', in *Iberian Conference on Information Systems and Technologies, CISTI* [online]. Available at: https://doi.org/10.23919/CISTI49556.2020.9140808 (Accessed: 14 July 2024).

Sawhney, D. (2017) 'Technology integration in Indian schools using a value-stream based framework', *IEEE Region 10 Humanitarian Technology Conference 2016, R10-HTC 2016 - Proceedings*, 18(3), pp. 89–105 [online]. Available at: https://doi.org/10.1109/R10-HTC.2016.7906787 (Accessed: 13 July 2024).

Student Academic Management System, n.d. [online] Available at: https://www.samsodisha.gov.in/ (Accessed 5 June 2024).

Tewathia, N., Kamath, A. and Ilavarasan, P.V. (2020) Social inequalities, fundamental inequities, and recurring of the digital divide: Insights from India. *Technology in Society*, 61, p.101251.

The Open Group (2022) Spanish Higher Education Enterprise Architecture Initiative and Capability Map. [online] Available at: https://publications.opengroup.org/y220 (Accessed 5 July 2023).

The Open Group (2024) TOGAF - The Open Group. [online] Available at: https://www.opengroup.org/togaf (Accessed 7 July 2023).

The Times of India (2024) 'Odisha joins PM SHRI school initiative, signs MoU with Ministry of Education', *The Times of India* (online), 28 March. Available at: https://timesofindia.indiatimes.com/education/news/odisha-joins-pm-shri-school-initiative-signs-mou-with-ministry-of-education/articleshow/108840801.cms (Accessed: 5 July 2024).

Times of India (2024) *Student Enrolment Up In State: Aishe Data*, 28 January. Available at: https://timesofindia.indiatimes.com/city/bhubaneswar/student-enrolment-up-in-state-aishe-data/articleshow/107196881.cms (Accessed: 21 December 2024).

Tresna, I.S. and Hadiana, A. (2019) 'Development of Enterprise Architecture Planning for School Based Management in Public High School', *IOP Conference Series: Materials Science and Engineering*, 662(2), pp. 789–805 [online]. Available at: https://doi.org/10.1088/1757-899X/662/2/022034 (Accessed: 13 July 2024).

Tripathy, S.K. (2024) Digital Transformation of HEIs in India: opportunities, Challenges and Key Strategies for Success. *UNIVERSITY NEWS*, 62, p.129.

UCISA (2023) UCISA Annual Review June 2022 – May 2023. [pdf] Available at: https://www.ucisa.ac.uk/-/media/Files/UCISA-Annual-Review-June-22-to-May-23.pdf (Accessed 5 July 2023).

UNESCO (2022) *Global Megatrends in K-12 Education* [online]. Available at: https://www.unesco.org/en/articles/driving-global-movement-transform-education-key-moments-2022 (Accessed: 13 July 2024).

World Bank (2017) *Odisha Higher Education Program for Excellence and Equity* [online]. Available at: https://projects.worldbank.org/en/projects-operations/project-detail/P160331 (Accessed: 13 July 2024).

Zimmermann, A. et al. (2021) 'Architecting digital products and services', *Intelligent Systems Reference Library*, pp. 181–197 [online]. Available at: https://doi.org/10.1007/978-3-030-49640-1_10 (Accessed: 14 July 2024).