

Illuminating Data-Driven Insights: Leveraging Business Intelligence for Informed Project Planning

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ABSTRACT

In today's world, Business Intelligence (BI) tools have become powerful assets for organizations. They help collect data, analyse it carefully, and most importantly, support better decision-making. This paper presents a new way of using BI techniques to closely examine the different factors that affect project planning. It introduces a complete framework that works together with a BI tool. This combination helps stakeholders gain valuable insights from large amounts of collected data. The main goal is to turn raw data into useful information that improves the accuracy and quality of decisions during project planning. By focusing on specific areas and individual projects, this approach helps organizations better understand what affects project timelines, how resources should be used, and what strategies to choose. What makes this paper important is how it combines BI tools with a clear process for evaluating key project factors. It gives decision-makers the ability to make smarter choices, use resources wisely, and lead projects to success. Overall, the paper offers a modern and effective method that blends the power of BI with careful analysis. It helps organizations plan better, not just in terms of estimation but also in making smart strategic decisions that improve the success of their projects.

Keywords: *Business Intelligence; project planning; project management; software engineering; decision making.*

1. INTRODUCTION

In project evaluation, Business Intelligence (BI) plays an important role by going beyond just looking at how long a project takes. BI allows for a complete evaluation by considering many different factors, not just time.

Why Use Business Intelligence?

- **Better Decision-Making:** BI helps teams make faster and smarter decisions using data.
- **Improved Efficiency:** It makes business operations more efficient by simplifying tasks and boosting productivity.
- **Risk Detection:** BI helps identify possible risks early, allowing better planning and decisions.
- **Resource Management:** It helps in using resources more effectively, which is key for managing projects.
- **Support for Team Members:** BI gives useful guidance to new developers and managers by offering clear and data-based insights.

What Does BI Involve?

BI includes many tools and features like:

- Custom queries and one-time analyses
- Reports across the whole organization

- Online tools to analyse data
- Cloud-based BI (Software as a Service)
- Open-source BI tools
- Team-based (collaborative) BI
- BI based on location data

These tools are especially useful in agile software development. They help teams turn data into insights and share results with everyone involved, allowing for continuous feedback and improvements. The goal is to help users make informed decisions based on data analysis.

Here is a simple step-by-step method:

1. **Import the Data:** Load the dataset that contains the project details to be analysed.
2. **Choose Key Criteria:** Select which factors or aspects of the project you want to study.
3. **Pick the Right Chart:** Choose a chart type that clearly shows your findings.
4. **Create the Chart:** Build the chart and compare the results with the details of a new project.

By using BI in this way, organizations can improve how they evaluate projects, make better decisions, and help project teams stay on the right track.

2 RELATED WORKS

S.No.	Author(s)	Focus Area	Key Insights
1	Torres (1)	BI in Organizations	Explores how BI and analytics influence organizational performance.
2	Sangar (2)	Management Roles & BI	Analyzes strategic decision-making via BI in communication firms using SPSS.
3	Li (3)	Big Data in Manufacturing	Discusses how big data enhances BI and decision-making in manufacturing.
4	Azeroual (4)	BI in Startups	Presents BI solutions tailored for startups and their success factors.
5	Phillips-Wren (5)	Decision Support Systems	Reviews BI & analytics research through a conceptual framework.
6	Bernhard (6)	Academia-Industry Link in BI	Examines BI's role in managerial decisions across academia and industry.
7	Likeoebe (7)	Software Development Orchestration	Explores the current state and future research agenda of software process orchestration.
8	Claudia (8)	Reverse Engineering & Abstraction	Proposes a model to reverse engineer use case diagrams into Java code.

9	Chris (9)	Software Benchmarking	Conducts benchmarking using ISBSG data to compare completed projects.
10	Wang (10)	BI & Business Performance in China	Studies BI's impact on performance in Chinese listed firms.
11	Wang (11)	BI in Construction Safety	Investigates BI use for safety management in construction industry.
12	Zhou (12)	Bibliometric Analysis of BI	Identifies key topics and trends in BI research.
13	Buxmann (13)	BI, Big Data & IoT	Explores integration of BI with IoT and big data for better decisions.
14	Wang (14)	BI in Supply Chain Management	Reviews BI applications in supply chains and suggests future research areas.
15	Duan (15)	BI in Maritime Ports	Studies BI's role in optimizing port operations and addresses challenges.
16	Zhu (16)	BI & Decision-Making	Categorizes BI research with a bibliometric approach for decision-making insights.
17	Ho (17)	BI in Banking	Investigates BI's impact on performance in the banking sector.
18	Gkika (18)	BI in Greek SMEs	Analyzes factors influencing BI adoption in SMEs.
19	Mou (19)	BI for Sustainability	Examines how BI practices influence organizational sustainability across sectors.

This survey report provides a glimpse into recent research on Business Intelligence, highlighting its significance in improving decision-making, organizational performance, and efficiency across various industries. The studies reviewed contribute valuable insights to the expanding field of BI, guiding future research and applications.

3 ANALYSIS WORKFLOW

A data repository is created with data related to the environmental and technical factors that are required to analyze a project. These factors form the basic parameters of the Use Case Method which is generally used to predict the duration of software project. The data for analysis through business intelligence stems from the repository. This repository encapsulates a wealth of 250 project details spanning diverse domains, offering a comprehensive canvas for examination. Among the repository's contents are domain specifics, project particulars, technical and environmental factor values, counts of simple, complex, and average use cases, as well as counts of simple, average, and complex actors. Also, the repository houses information concerning Use Case Points (UCP) and the estimated durations of projects across the 10 distinct domains.

Connecting the framework with Microsoft Power BI is a key part of the analysis process. This connection gives users the flexibility to either:

- Analyse data based on specific domains (like finance, healthcare, etc.), or
- Focus on individual projects.

This choice allows users to easily compare multiple projects within the same field or closely examine the details of a single project.

DOMAIN-WISE ANALYSIS

Within the domain-wise analysis realm, a plethora of insights is unlocked:

- i) Project categorization by simplicity or complexity, accompanied by their respective durations.
- ii) A comprehensive examination of projects through the lens of various environmental factors.
- iii) A holistic scrutiny of projects based on assorted technical factors.

By using data from different areas, the Business Intelligence tool creates useful and easy-to-understand charts. These charts help with comparing different projects. This kind of analysis is a great help for managers and developers, as it allows them to compare their new project estimates and make better, more informed decisions in the complex world of software development.

3.1 ANALYSIS WITH ENVIRONMENTAL FACTORS

Within the repository dataset, a comprehensive domain-wise analysis is conducted, exploring each environmental factor's influence on the project development landscape.

FAMILIARITY WITH DEVELOPMENT PROCESS

This analysis dissects domains where the parameter "familiarity with the development process" spans both high and low values. Developers glean insights to ascertain if the new project's team possesses familiarity with the development process or necessitates specialized training. This equips the team holistically for the project's multifaceted development. Aggregating values assigned to projects in each domain yields the highest and lowest values within each domain.

APPLICATION EXPERIENCE

This facet examines the correlation between expert application knowledge and project development. A team well-versed in application intricacies wields substantial influence over project success within stipulated timelines. Domains bearing considerable influence from these factors are rigorously examined. Assigning values ranging from 1 to 5 during the UCP-based duration estimation delineates the domain-wise analysis, divulging highest and lowest value domains.

OOP EXPERIENCE OF THE TEAM

Team members well-versed in object-oriented programming (OOP) concepts accelerate project completion, as OOP forms the crux of most projects. This factor shapes project effort calculations. The analysis guides managers to assess team members' programming acumen, informing effort estimations. Managers can schedule training or assemble teams well-versed in OOP. Navigating OOP-centric domains empowers resource allocation optimization and programming prowess deployment.

LEAD ANALYST CAPABILITY

This analysis underscores the role of a proficient leader, capable of adept analysis and resource management. A leader's capacity to adapt to evolving technology and domain intricacies is pivotal. Comparative analysis provides developers insights into leadership's significance.

TEAM MOTIVATION

Crucial for project success, this analysis uncovers domains demanding heightened team motivation. A motivated team, bolstered by domain knowledge and experience, exhibits fervor in development. The analysis deciphers domains wielding maximal and minimal motivational impact.

STABILITY OF REQUIREMENTS

Unstable client requirements amplify developers' workload and project duration. Requirement stability influences Use Case Points calculation. Agile methodologies

acknowledge evolving requirements. Comparative stability analysis aids managers in forecasting potential changes within new projects. This insight recalibrates Gantt chart schedules, aligning them with targeted deadlines.

CONTRIBUTION BY PART-TIME STAFF

Certain domains necessitate part-time staff for deployment and development. Analysis based on this factor navigates domains where part-time staff impact is pronounced. This informs task allocation and resource optimization, shaping an efficient allocation strategy.

DIFFICULTY IN PROGRAMMING LANGUAGES

Program complexity can impact development pace. This analysis gauges programming language complexity, offering developers and managers insights into the suitability of chosen languages for a project's development.

3.2 ANALYSIS WITH TECHNICAL FACTORS

The 13 technical factors are analyzed separately based on a domain and based on project. This shows the impact of the various technical factors in the development process.

DISTRIBUTED SYSTEM

Some projects depend upon distributed system where few resources or process needed for computation and execution will be available in remote systems. They are shared among all process for executing the project. The distributed system requirement is a technical factor which is used in calculating the use case points in a project. The chart generated based on this parameter provides the information about the projects and domains where this parameter is highly considered and highly significant.

RESPONSE TIME

The effectiveness and quality of the software also depends on the response time it takes for user queries. Response time means how quickly the software responds to the user queries. In some applications, like on line transactions in banking domain, the response time of the software is trivial. Hence, this analysis across the domains helps to understand where and in which areas of projects, the response time is significant. Therefore, the project manager can provide more effort in those modules which are related to user queries and where immediate response may be required by the users. It also indicates that peak load testing, stress test, smoke testing, regression testing should be more effective and should be done for those projects which falls under the domain which shows user response time is highly significant.

For example, the automatic door opening of a car from remote device must be immediate and quick to maintain the

quality and reliability of the device and software. Hence, this analysis helps to know what should be the significance of response time of the new project by comparing them with similar projects in the same domain.

END USER EFFICIENCY

The end user efficiency is also an important factor to consider while considering the software development process because it indirectly indicates how efficiently the software should be developed to make the users satisfied. The customer domain must be clearly understood before developing the software. This provides a platform to create a more user-friendly software to satisfy the customers who use the software.

INTERNAL PROCESSING CAPABILITY

This value of this parameter shows how the domains and projects where internal processing capability has a major influence in the development process. Few projects may be developed with entirely with external resources and they are least dependent on internal processing capability. Hence, this analysis shows the types of projects and their domains which are highly dependent on internal processing capability. This provides an idea for the manager to think about this factor and to decide whether the project to be developed is dependent on internal or external processing capability.

CODE REUSABILITY

The analysis based on this parameter produce the charts that shows the projects and the domains with code reusability features. Some projects may be developed from the scratch whereas few other projects may reuse the available existing code. Also, the created code in a project may be needed in future for reuse. Thus, this analysis helps to know about think about the concept of reusability. The part of code of that can be reused for any other project can be maintained separately and also can be developed as a reusable software component. By analyzing and identifying the reusability code, resource allocation can be optimized and cost and time of development can be minimized.

EASY TO INSTALL

Comparative analysis based on easy to install feature talks about the projects and the domain that are easy to deploy with simple steps after completing the development process. Analysis based on this feature is significant because many projects may have a complex installation procedure which may require expertise and good training in installing the products at the client site. Hence, while calculating the effort for the projects, this should be considered as a parameter. The charts developed for these provide the idea about the types of projects and domain that are easy to install.

EASY TO USE

This shows the number of projects and the number of domains where the software is developed based on ergonomics. This shows the effort taken to make the software more user friendly. Also, the number of complex simple and average use cases and actors that are involved in developing the software to make it easy to use can be determined.

PORTABILITY

This shows the number of projects and the domain that are easily portable and deployed and can be executed easily in any environment and platform. This comparative analysis with other software in the same domain helps to know about the details of the projects that are easily portable from one place to other. This also provides additional information about the domain which has many numbers of portable projects.

MAINTENANCE

The maintenance of the projects is continuous process in the life time of the software product. The comparative analysis shows the number of products and the domains which needs more maintenance. Few projects may need frequent maintenance and therefore manager must allocate resources for periodic maintenance. Hence, this analysis shows the details of number of projects that require high maintenance. The charts generated during the analysis show the details of the information about the projects and domain where the maintenance is highly required and also important for the life time of the software product.

CONCURRENT PROCESSING

This provides description about the projects which has more concurrent processing feature. Concurrent processing or parallel processing requires few processes to be executed in parallel in same time at different places in program to produce the desired result. It is an important technical factor to be considered because if any one process fails in executing the project, then the entire activity fails resulting in the failure of the project. The comparative analysis shows the domain and the projects which has more value for the concurrent processing parameter.

SECURITY FEATURES

Some projects require high importance to security features like authentication, password protection, granting access privileges etc. This analysis provides the report about those domain and projects in them which are developed with more security features. The developer can know about the domains which need high security features in implementation. Accordingly, the technical experience, skills needed for the new project development can be analyzed and resources can be allocated for implementing the same.

ACCESS TO THIRD-PARTY

It is a technical factor which is used in calculation of use case points for a project. It shows whether the project highly use third party code or libraries to minimize the effort in coding. This helps to find out the domains where the dependency on third-party code is high and low. Accordingly, the resource allocation, utilization can be optimized by the managers. The manager of a new project can now identify the various domains and their dependency on third party code and libraries. It indicates the manager that dependency on third party code highly influence the completion time of the project and also tells that the availability, accessibility, compatibility and security of the code are also to be verified by the manager.

The third-party code may be software components, libraries or packages to be integrated with the existing code. Such integration may be high in few domains or it may not be required in some other domains. As the integration of third-party code minimize the cost and development time, it is essential to know about the domains where the third-party code and components are highly used. Accordingly, the effort estimation can be reviewed by the manager for the new project.

END USER TRAINING

Need for user training is one among the various technical factors considered for calculating the use case points. High percentage shows that the projects in this domain are complex to use immediately and user training is mandatory to master the product and use the software without any external or internal help facilities.

This analysis facilitates the project development team to prepare the schedule including the training period after deploying the software at the client site. It also indicates that supporting documents and help features must be more informative, descriptive and simple for the clients to read and follow. The Effort needed for training should consider scheduling the resources for development and deployment. It also indicates that acceptance testing must be focused more to make the software as more user friendly for the clients to use.

4 RESULTS AND DISCUSSIONS

The ensuing charts present the outcomes of the experimental analysis conducted using the use case repository data. As previously discussed, the repository encompasses information from 250 projects across 10 diverse domains. These details are inputted into the BI tool through Microsoft Power BI. Depending on the user's preference, the BI tool generates comparative analysis charts for various technical and environmental factors, types of use cases, and actors based on duration. The ensuing charts offer a visual representation of the BI-generated insights.

DOMAIN ANALYSIS BASED ON TECHNICAL FACTORS

This section illuminates the outcomes of comparative analysis performed across 13 technical factors. Each factor is assigned a value between 1 to 5. The charts produced through BI demonstrate the average values of these factors across all projects within each domain.

COMPARISON BASED ON RESPONSE TIME

Fig. 1 showcases domains where software response time carries high significance versus those with lower value. Notably, domains like banking, entertainment, and healthcare demand prompt responses due to user expectations.

COMPARISON BASED ON END USER EFFICIENCY

Fig. 2 outlines projects within different domains possessing high weightage for end user efficiency. This aids developers and managers in optimizing software usability and documentation, particularly for domains where efficiency is crucial.

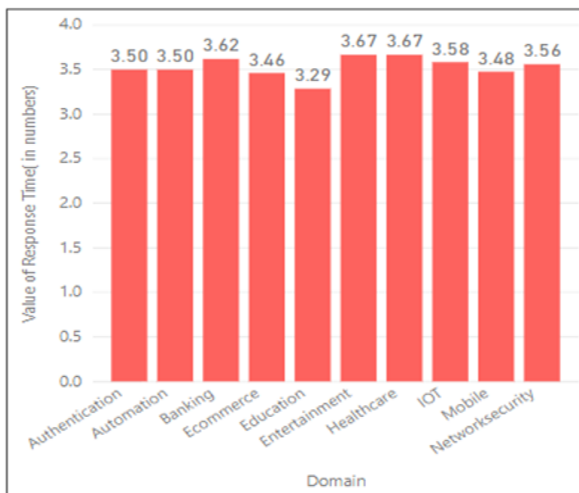


Fig 1 Domain Analysis based on Response Time

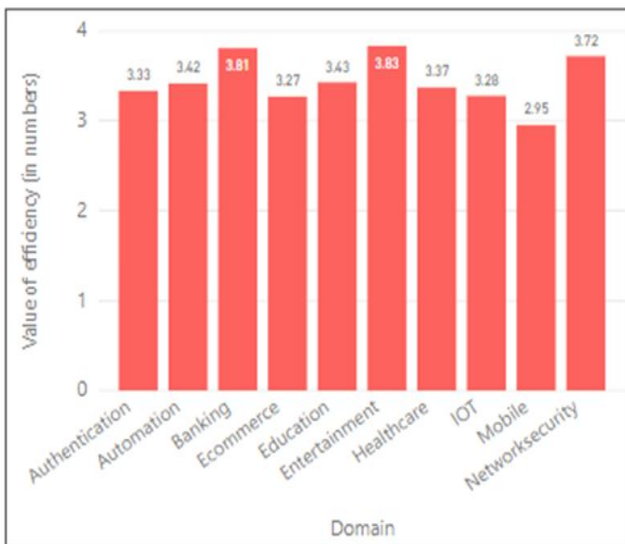


Fig 2 Domain analysis based on end-user efficiency

COMPARISON BASED ON INTER-PROCESSING CAPABILITY

Fig. 3 illustrates the analysis outcome regarding inter-processing capability across domains. Generally, domains display an average value of 3, indicating this feature's early-phase significance and its potential to change as projects progress.

COMPARISON BASED ON CODE REUSABILITY

Fig. 4 depicts a comparative analysis of code reusability, indicating its above-average presence across all domains. This insight guides developers and managers in enhancing program design efficiency

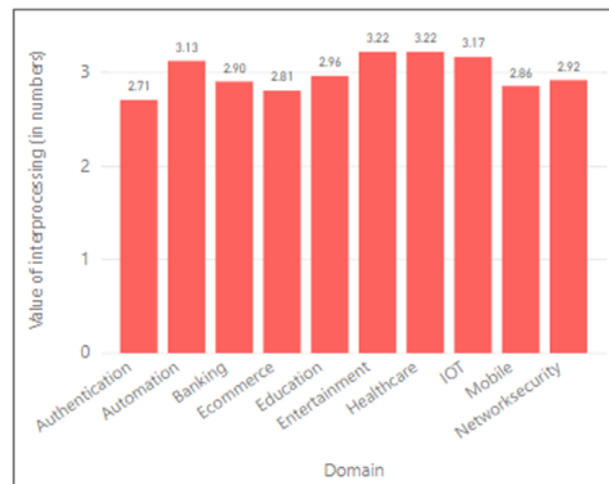


Fig 3 Domain Analysis based on inter-processing capability



Fig 4 Domain Analysis based on code reusability

COMPARISON BASED ON EASE OF INSTALLATION

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Fig. 5 showcases the analysis result for ease of installation. Domains like banking and network security exhibit higher values, suggesting a greater implementation effort for these domains.



Fig 5 Domain analysis based on ease of installation

COMPARISON BASED ON EASE OF USE

Fig. 6 reveals an analysis centered on software usability. It showcases domains where usability is of paramount importance, informing developers to prioritize user-friendly designs.

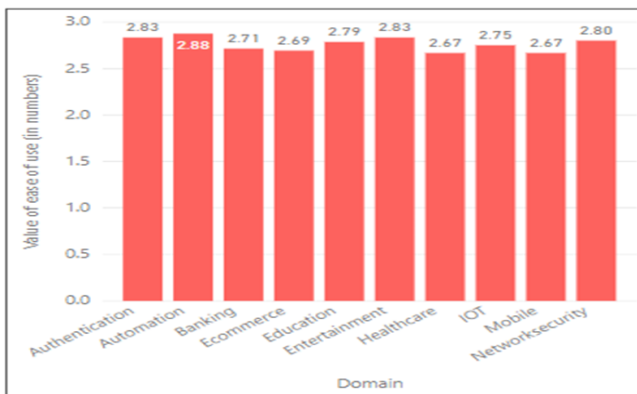


Fig 6 Domain analysis based on usability

COMPARISON BASED ON PORTABILITY

Fig. 7 highlights software compatibility across domains. Banking domains are notably compatible, guiding developers to enhance platform adaptability.

COMPARISON BASED ON MAINTENANCE

Fig. 8 portrays domains with higher software maintenance priority, facilitating resource allocation and periodic maintenance planning.

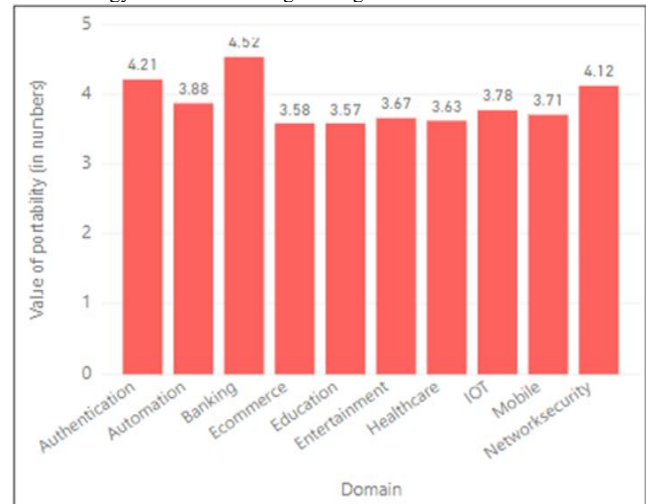


Fig 7 Domain Analysis based on portability

COMPARISON BASED ON CONCURRENT PROCESSING

Fig. 9 unveils domains that require concurrent processing, emphasizing the importance of this feature in domains like entertainment.

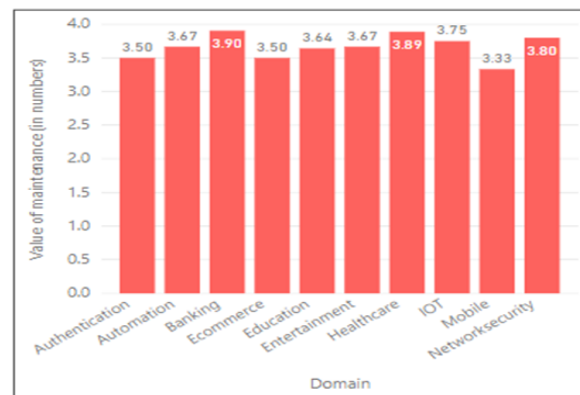


Fig 8 Domain analysis based on maintenance

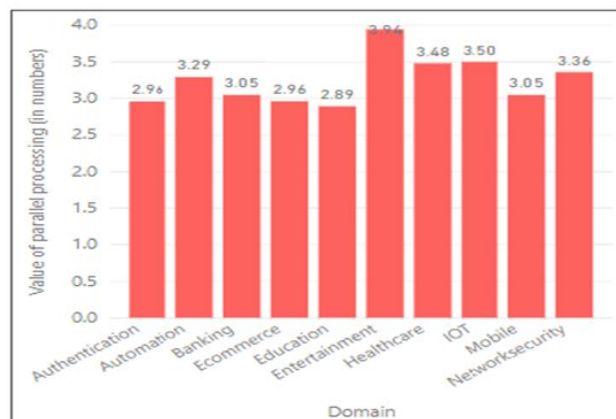


Fig 9 Domain analysis based on parallel processing

COMPARISON BASED ON SECURITY

Fig. 10 shows domains with high security priority, aiding developers in fortifying software applications where sensitive data is involved.

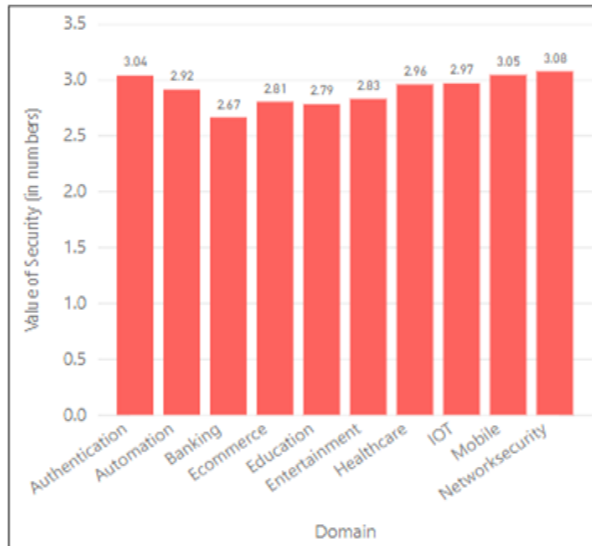


Fig 10 Domain analysis based on security

COMPARISON BASED ON THIRD-PARTY CODE

Fig. 11 underscores the use of third-party code, valuable information for domains where such code usage is predominant.

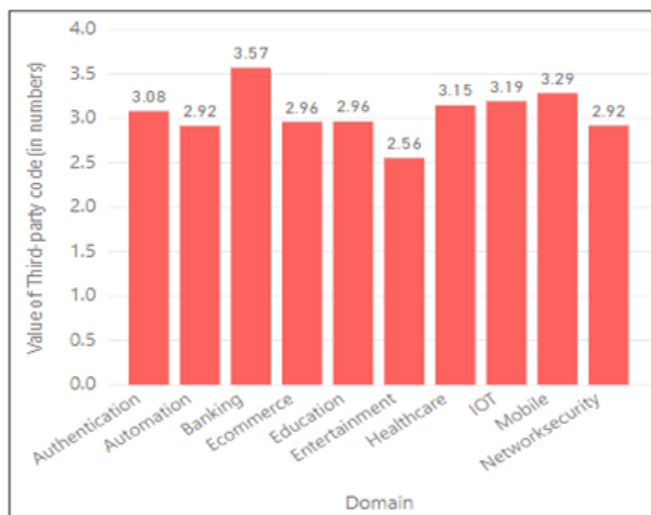


Fig 11 Domain analysis based on third-party code

COMPARISON BASED ON USER TRAINING

Fig. 12 delves into domains requiring extensive user training, guiding developers in assessing user training requirements.

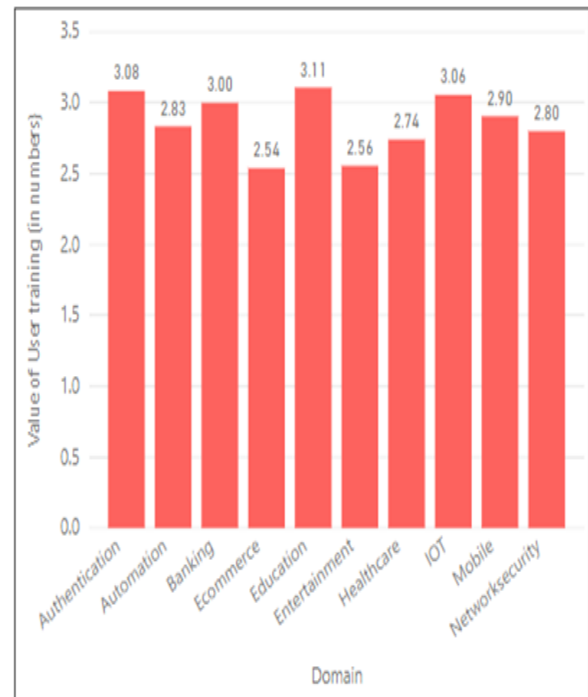


Fig 12 Domain Analysis based on user training

COMPARISON BASED ON DISTRIBUTED SYSTEMS

Fig. 13 showcases domains where distributed systems are crucial, enabling projects to operate across multiple platforms.

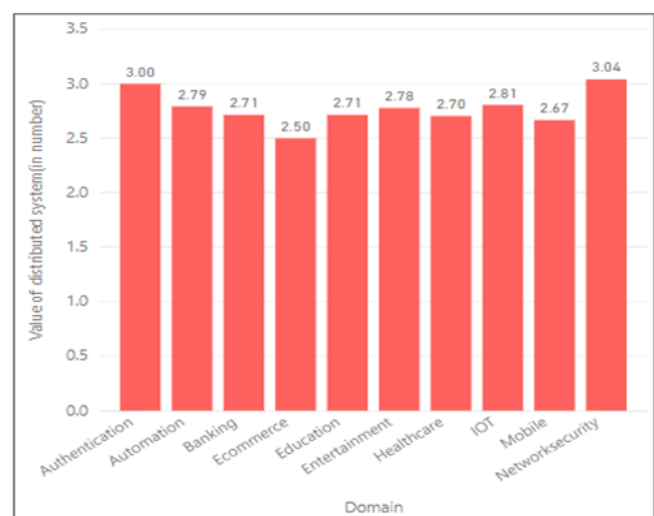


Fig 13 Domain Analysis based on distributed systems

Domain Analysis Based on Environmental Factors

This section shows the analysis outcomes for eight environmental factors, vital in software project development.

COMPARISON BASED ON FAMILIARITY

Fig. 14 indicates domains where project familiarity is pivotal, offering insight for team allocation and project planning.

COMPARISON BASED ON APPLICATION EXPERIENCE

Fig. 15 exposes domains prioritizing application experience, directing developers to bolster teams with domain-specific skills.

COMPARISON BASED ON OOPS EXPERIENCE

Fig. 16 outlines domains requiring OOPS experience, guiding teams to include members with essential programming expertise.

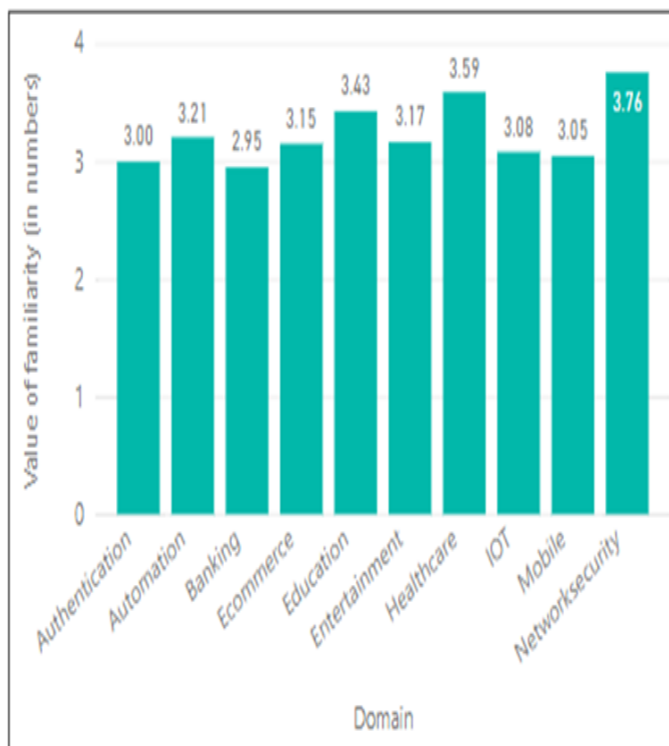


Fig 14 Domain Analysis based on familiarity

COMPARISON BASED ON LEAD ANALYST CAPABILITY

Fig. 17 elucidates the importance of lead analyst capability, aiding efficient resource allocation and task execution.

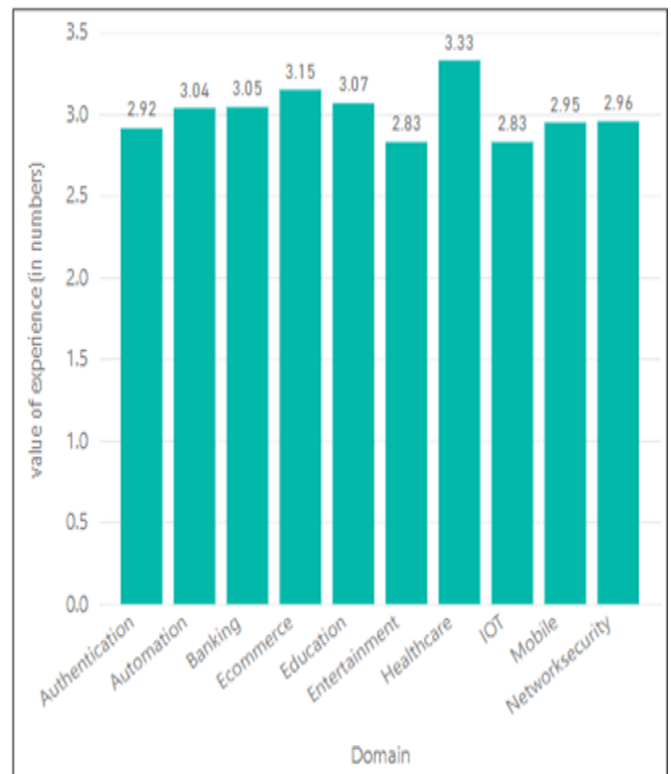


Fig 15 Domain Analysis based on application experience

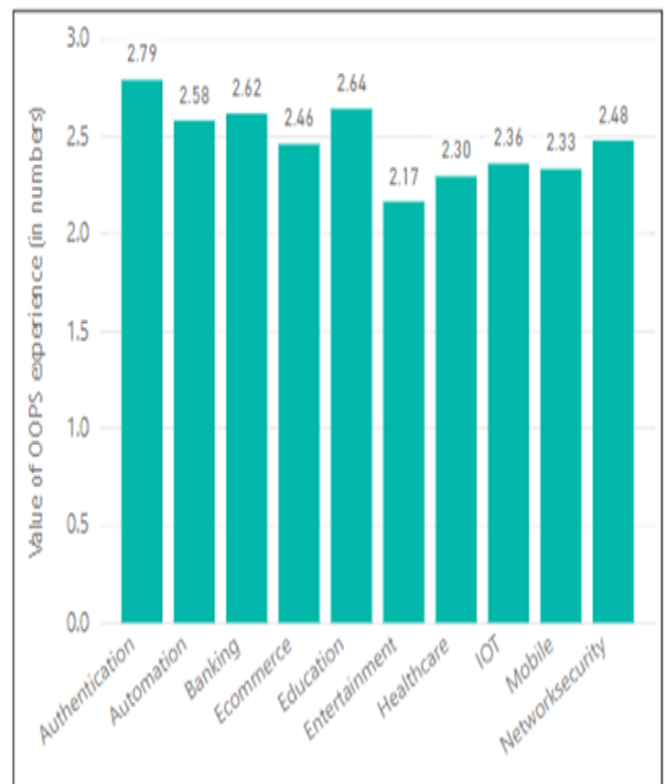


Fig 16 Domain Analysis based on OOPS Experience of the team

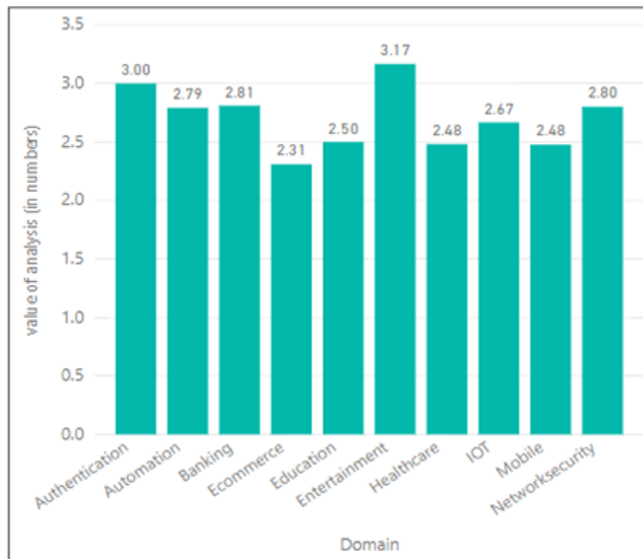


Fig 17 Domain Analysis based on Lead Analyst capability

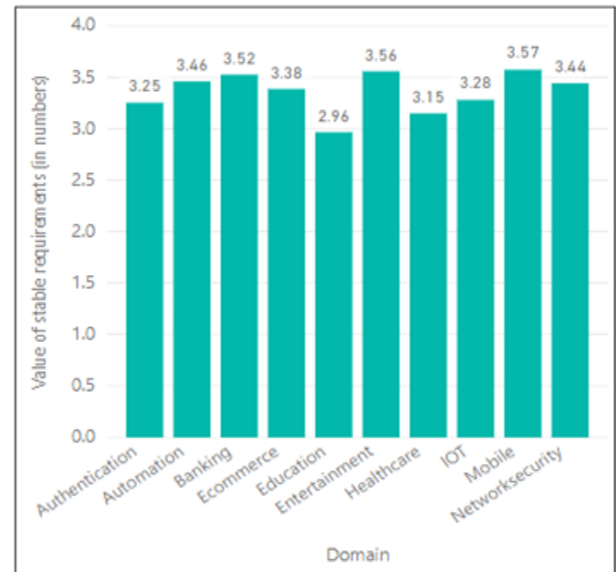


Fig 19 Domain Analysis based on Stable requirements

COMPARISON BASED ON MOTIVATION

Fig. 18 showcases domains necessitating high motivation, informing project leaders of domains where motivation is critical.

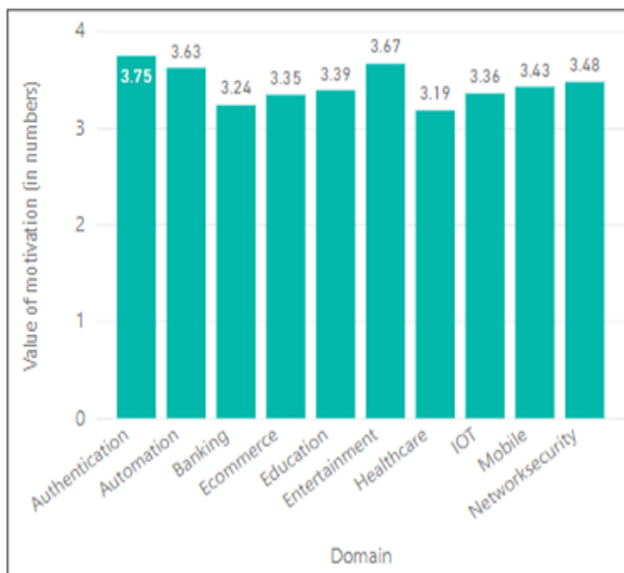


Fig 18 Domain Analysis based on Motivation

COMPARISON BASED ON PART-TIME STAFF

Fig. 20 delves into domains requiring part-time staff involvement, facilitating resource planning and project execution.

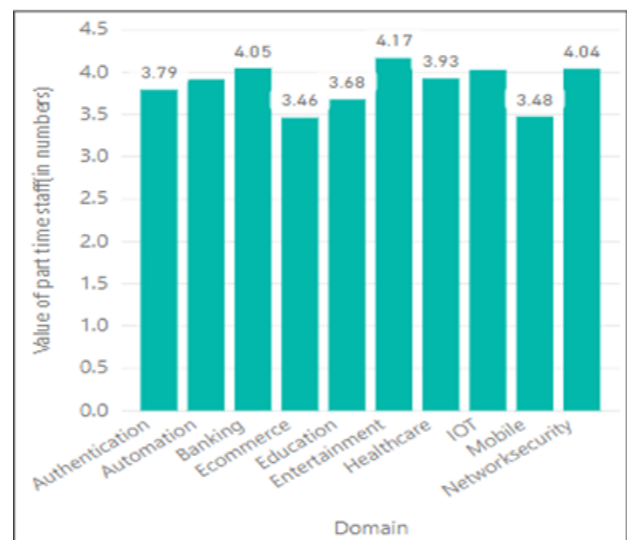


Fig 20 Domain Analysis based on part time staff

COMPARISON BASED ON STABLE REQUIREMENTS

Fig. 19 illustrates domains where requirements stability is above average, highlighting the need for adaptive project management.

COMPARISON BASED ON PROGRAMMING LANGUAGES

Fig. 21 demonstrates the impact of programming language complexity on projects, informing language selection and design considerations.

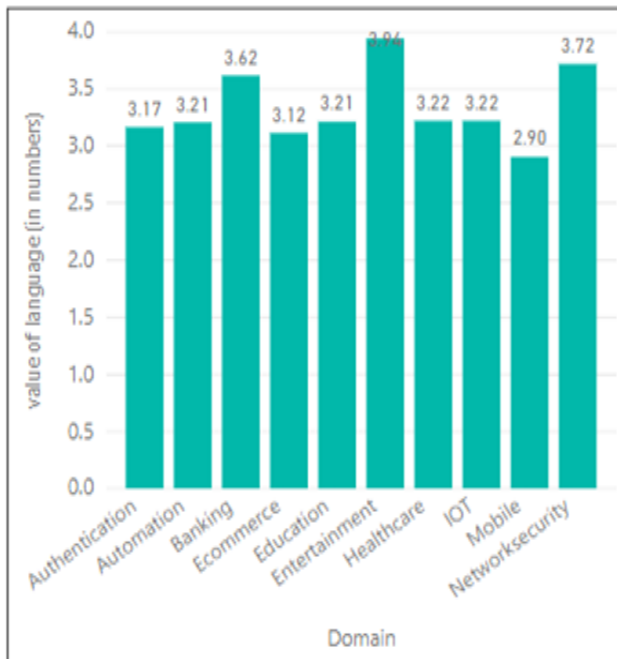


Fig 21 Domain Analysis based on programming languages

In summation, these comprehensive analyses provide actionable insights for developers, managers, and decision-makers across diverse domains. The visualizations crafted with BI tools significantly enhance project planning, resource allocation, and overall software development efficiency.

PROJECT WISE ANALYSIS

Performing a comparative analysis across various project types within the same domain empowers project managers to assess projects based on critical parameters, including environmental factors, technical factors, complexity of use cases and actors, project duration, and more.

COMPARISON BASED ON NUMBER OF USE CASES

As an illustration, consider projects within the banking domain. The ensuing charts (Fig. 22) showcase a sample comparison across specific parameters. Fig. 22 highlights the variance in the number of use cases, with higher counts indicating more intricate programming requirements.

COMPARISON BASED ON DURATION

Fig. 23 illustrates the project comparison based on duration. It differentiates between projects with longer and shorter durations, enabling a direct contrast between new projects and existing ones of similar duration.

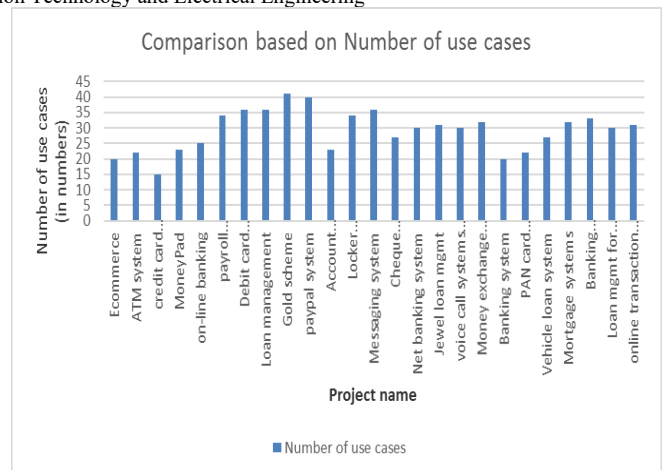


Fig 22 Comparison based on number of use cases

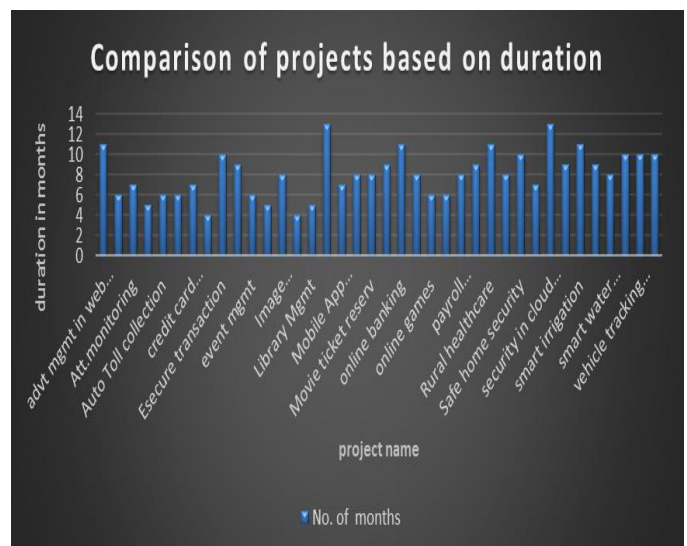


Fig 23 Comparison of projects based on duration

Business intelligence facilitates a thorough analysis and comparison of diverse projects across multiple dimensions and metrics. While only two sample comparisons are depicted here, the potential of BI to explore various facets is evident. These insights guide managers in making informed decisions during the project management lifecycle.

CONCLUSION

This work explains how Business Intelligence (BI) is used along with stored project data to make useful comparisons. It covers both domain-based and individual project analyses, with real examples. The outcomes are shown through different types of charts. This comparison method gives a clear and wide view of project details from different angles. It helps project managers make better decisions. During project estimation, they can compare the new project's expected time, technical aspects, and environmental factors with similar past projects. If there are large differences, it may show issues in the estimation that need to be corrected. This way, risks can be spotted and managed early, avoiding problems later.

In summary, combining Business Intelligence with project development data improves the accuracy of project estimates and supports better decision-making for project managers.

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