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Benchmarking and Goal-Driven Approach for Developers for 4.0 Industrial-level Applications inside Siemens

Murtaza Hussain Shaikh*

Kyungsung University, 309 Suyeong-Ro, Nam-Gu, Busan, Republic of Korea

**Corresponding author: Murtaza Hussain Shaikh, murtaza@ks.ac.kr*

Abstract: Benchmarking, a crucial technique in the context of Siemens' industrial applications, is widely recognized for identifying and enhancing key skills. This work presents a goal-driven approach to requirement interpretation, explicitly focusing on the role of benchmarking within the company. It explores the benchmarking methodology, the process of developing new industrial applications through benchmarking, and the essential steps involved. The findings indicate that benchmarking can be a fundamental learning tool for skill development and optimization, ultimately contributing to long-term competitive advantage. The study examines various aspects of Siemens' operations and proposes an alternative framework for categorizing benchmarking activities. The methodology outlined in this research is designed to support specialists, academicians, and professionals in assessing the evolution and relevance of benchmarking as a strategic tool, given Siemens' prominent role in industrial development. The proposed benchmarking methodology offers several remunerations, such as improved user engagement and creating more effective and aesthetically appealing interfaces. Despite its significance, existing literature provides limited insights into integrating benchmarking techniques into industrial applications development strategies. This study introduces a methodology particularly beneficial for front-end developers, enabling them to implement visually engaging and interactive elements within industrial-level applications. By enhancing user engagement, the proposed approach supports the creation of more effective and aesthetically appealing interfaces. While the study provides a descriptive analysis of benchmarking techniques, further refinement is needed in the current target selection and computation methods. Future research should focus on sharpening these aspects to enhance the practical application of benchmarking in industrial web development.

Keywords: Applications; Benchmarking; Industrial; Interface; Methodology; User interfaces

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1. Introduction

The benchmarking idea is often perceived as a demonstration of mimicking or replicating. However, in reality, this concept facilitates advancement rather than impersonation. Benchmarking is a relative strategy in which a firm

identifies accepted procedures and then seeks to align its performance with best practices. It serves as a reference point for measurement, and when applied to work processes, it yields superior results [1]. To excel, a firm must exceed these benchmarks. Different fields utilize various kinds of benchmarking. For instance, if someone aims to benchmark for service quality improvement, then service quality benchmarking is applied. Benchmarking practices can be implemented in any field, each with its own methodology. This study applies the central concept of benchmarking to create user interfaces for industrial-level applications [2]. Benchmarking, in this context, is not about copying existing interfaces, but about learning from them to create better, more user-friendly interfaces. The significance of this work lies in the importance of user engagement in interface design. By enhancing user engagement, the proposed approach supports the creation of more effective and aesthetically appealing interfaces, making the audience feel the significance of their work [3]. **Figure 1** illustrates the method used in this study and the steps required to perform benchmarking for developing web app interfaces. Organizations employ benchmarking to enhance every aspect, such as service quality and management improvement. The foundational concept in benchmarking is comparison, but the key is identifying the data needed for comparison and what to compare [4]. Data collection is the core principle of the entire benchmarking process. Later in the methodology section, benchmarking will be briefly explained, demonstrating to developers how to conduct benchmarking for creating industrial-level applications. This proposed methodology can also be applied in various fields, such as website creation and improvement. Industrial-level application interfaces involve user interaction with mouse and keyboard devices and are the most critical and adaptable software component [5]. The goal is to create an interface that is easy to use, meets future users' needs, and provides users with the tasks they wish to undertake. User interfaces for industrial-level applications engage users who utilize the web to complete required tasks on the website. Industrial-level applications offer a straightforward interface for accessing web services over the Internet. User interfaces define what users require concerning the look and feel of a software system and what software engineers must grasp based on user requirements [6].

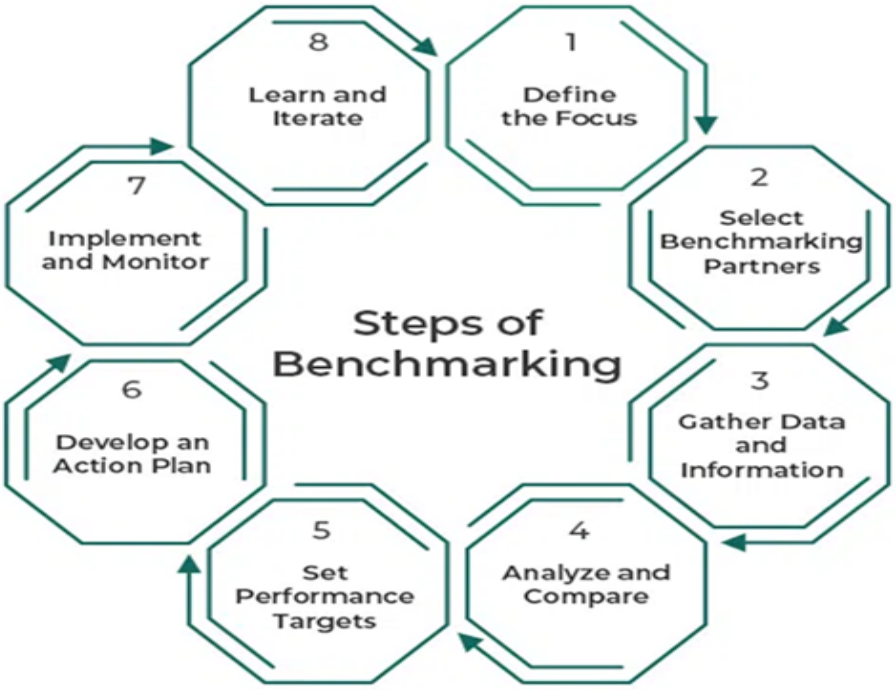

Figure 1. Basic benchmarking

However, software engineers sometimes develop user interfaces with minimal or no support from professional designers. In the ongoing pursuit of business expansion, many companies, including Siemens, are turning to web technology for its potential to drive innovation. This research will explore why these characteristics are relevant for this work. First, external visitors' accessibility to industrial-level applications leads to a diverse user base. Most web apps are designed to cater to various groups of users. Interestingly, web apps may also be visited by unknown users who it was not intended to serve. Second, technologies rapidly evolve to keep up with the competitive Web environment. New types of organization, programming, and hardware advancements are driving progress to meet the increasing traffic [7]. These cutting-edge technologies enable firms to offer new services on their apps that current Internet users have never imagined. This potential for innovation in industrial applications is both inspiring and motivating. These characteristics make website compilation and improvement more tactical, involving more domain ambiguity than traditional information systems [8]. Benchmarking is a valuable tool to address these challenges, providing a structured approach to problem-solving. Web app interface benchmarking creates a single design interface by collecting data from other, superior web apps, identifying their strengths and weaknesses, and determining the creation requirements. The focus is on four key aspects of industrial-level applications interface benchmarking. First, it enables the discovery of sources for new methods of doing things beyond one's party, enlightening the developers and making them open to change. Second, benchmarking can help concretize customer requirements. Third, benchmarking can break from the inspection approach, limiting the improvement scope [9].

2. Methodology and identification

The proposed benchmarking methodology to enhance industrial-level web interfaces will now be presented. The process begins with identifying individuals working on or using similar industrial-level applications. Effective surveys yield significant results, directly influencing the suggested methodology's next phase [10]. Thus, gathering insights from web app users or experts with extensive experience with these applications is essential. The priority vector obtained from the survey is inherently linked to the priorities of the goal list. The outline process quantitatively analyses the results and identifies relationships among varying responses. The conclusions drawn from this analysis can then be communicated to the broader audience from whom the model was derived [10]. Once the results are received, developers should create a comprehensive overview of their objectives and recognize the broader aims they hope to achieve. **Figure 2** depicts the benchmarking methodology development model at Siemens, detailing the entire journey from benchmarking publication to methodology publication at the company. This model is not just a theoretical concept, but a practical guide developers can use to enhance their industrial-level web interfaces.

At this point, focus should be on more modest targets that need to be achieved to accomplish the objectives. First is the prioritized goal list, and the second step is the preliminary analysis of this goal list. When prioritizing the goals, developers must list them [11]. Each goal specifies its category; for example, if the developers have a goal to create an effective interface for the login page, then in this category, they need to benchmark the elements required for the login page of the web app. Several elements, such as a username, ID, or password, are essential for logging into the app. The key is how to design a web application's login page to be more effective for users [11]. Effectiveness can be assessed through benchmarking in further steps. Another essential consideration in this phase is prioritizing goals in the goal list (e.g., most users open new feeds in the web application compared to other fields, so more attention should be paid to creating the new feeds section) [12].

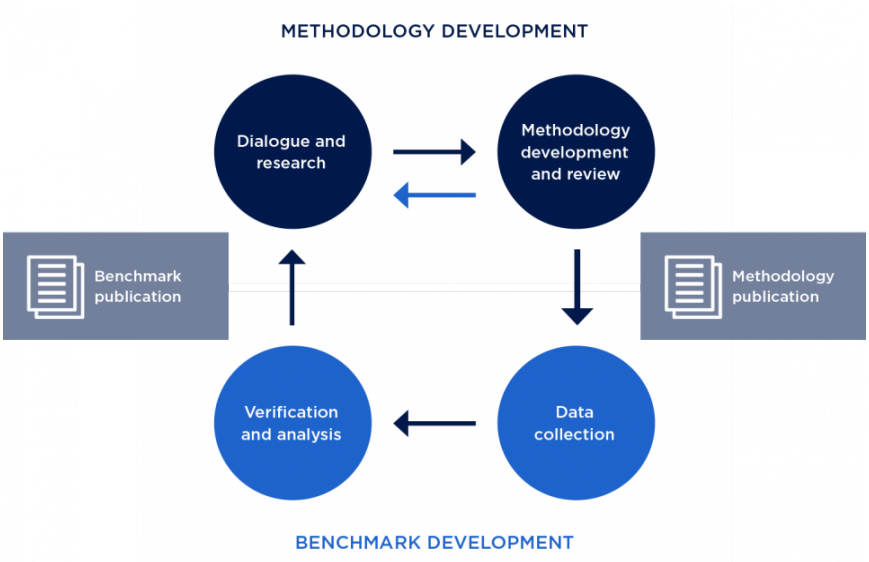

Figure 2. Methodology development of benchmarking at Siemens

3. Preliminary analysis of proprietary benchmarking framework

The central concept of the preliminary analysis step is to uncover goals not identified in the goal identification stage. Second, the priorities of these goals should be measured; third, goals that are not addressed in the methodology for various reasons, such as financial constraints, should be eliminated [12]. Data can be collected differently, but this paper discusses three sub-steps of benchmarking data for creating a new user interface for industrial-level applications. First, developers list the necessary data they wish to benchmark, then identify the data sources, i.e., where to find relevant field data. The third step involves additional data that developers want to include [6]. This extra data refers to unique fields about their organization that may be found on specific websites. Therefore, developers integrate these fields by gathering information from individuals involved with that specific clinical website. In the initial data collection step, developers compile a list of the necessary data for developing interfaces. For example, when creating a clinical website application, developers need fields related to medical terms and those already on the website [11]. In the second step, developers must locate the data sources. In this step, they create data sources with different functionalities and fields, compiling a list of all applicable applications. After selecting additional data from web apps, developers assess their efficiency. In the third step of data collection, supplementary information is compiled. Developers add extra fields after obtaining the benchmark data and data sources. At this stage, developers create a list of the data compiled by the firm's team. Developing a web app is a complex task that requires several steps [13].

The user interface design is essential in appealing to customers, so the firm must include unique additional information compared to other industrial-level applications. This extra data implies that unique fields about their organization are sometimes found on specific websites [3]. Figure 3 shows Siemens' user-centric interface benchmarking process, where different developers, engineers, and administrators gather the evaluation of Mendix and industrial innovations through data collection [14]. The method checks if results meet Siemens KPIs—if yes, it proceeds to continuous monitoring; if no, it triggers re-benchmarking with additional data. The cyclical workflow ensures interfaces are optimized for both usability and technical performance. Benchmarking many web applications is quite challenging; thus, the second step involves selecting target applications. After that, the

developers finally chose the target web apps for the benchmarking activity [10]. During this phase, developers take the interface design from the target web apps and compare those interfaces.

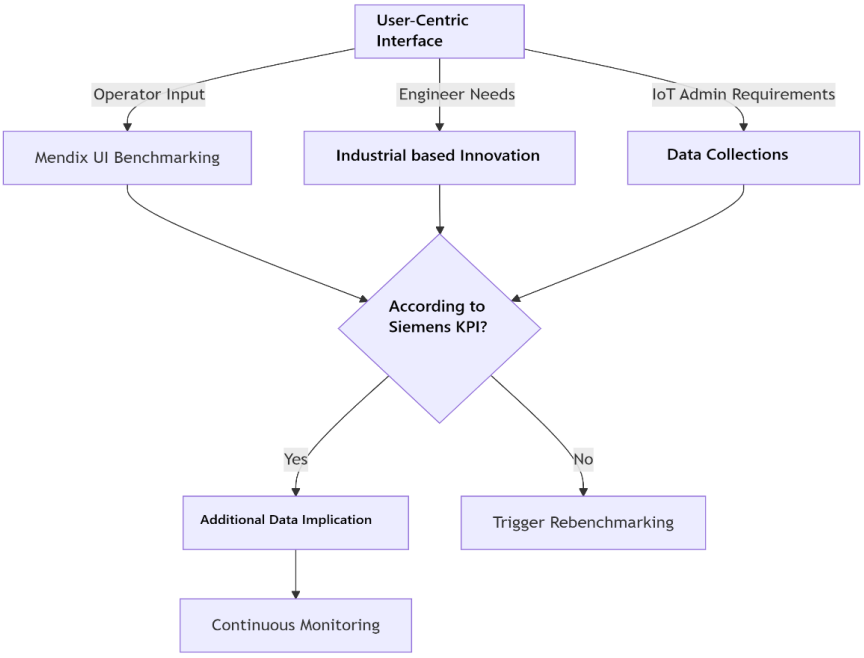

Figure 3. User-centric interface benchmarking

4. Target benchmarking and use case synthesis

This stage produces use cases that consider the objectives. All of the target web destinations inspire use cases that assist each objective. The three most prominent rules are followed in analysing the goals and synthesizing use cases. Rule one corresponds (i.e., every menu or site guide field can relate to one use case). Rule two is splitting (i.e., if one field in a menu contains multiple targets, one use case is shared into many sections). The last rule is coalescing (i.e., if too many use cases are produced, they might be consolidated into one as per the accompanying rules) [5].

A complete use case list of the improved web-based industrial application is generated from synthesizing the use case analysis results. The possibility, execution cost, and relevance of each utilization case should be considered so that infeasible, irrelevant, or costly use cases can be excluded [13]. **Figure 4** outlines a systematic benchmarking process inside Siemens is divided into two key phases: the initial gather data stage, where teams align goals, prepare resources, and define the benchmarking scope; followed by the analyse and assess phase, where collected data is normalized, validated, compared against peers, and transformed into actionable recommendations—creating a straightforward workflow from preparation to data-driven decision-making [14].

The designs are implemented within an organization to develop effectiveness and efficiency. After the analysis step, developers create and implement an action plan. Implementation is the final step in the benchmarking process [1]. In the case of Siemens, they follow the workflow to ensure a measurable benchmarking practice. **Figure 5** outlines Siemens' user-centric benchmarking workflow for industrial software development, which begins by gathering user feedback and setting technical benchmarks for Mendix, MindSphere, and Teamcenter. It then progresses through agile sprints—testing Mendix, optimizing MindSphere APIs, and validating Teamcenter

plugins—before deploying solutions with real-time monitoring (in-app analytics, edge performance tracking, and automated feedback). The process ensures continuous improvement by aligning development with user needs and measurable performance standards [2].

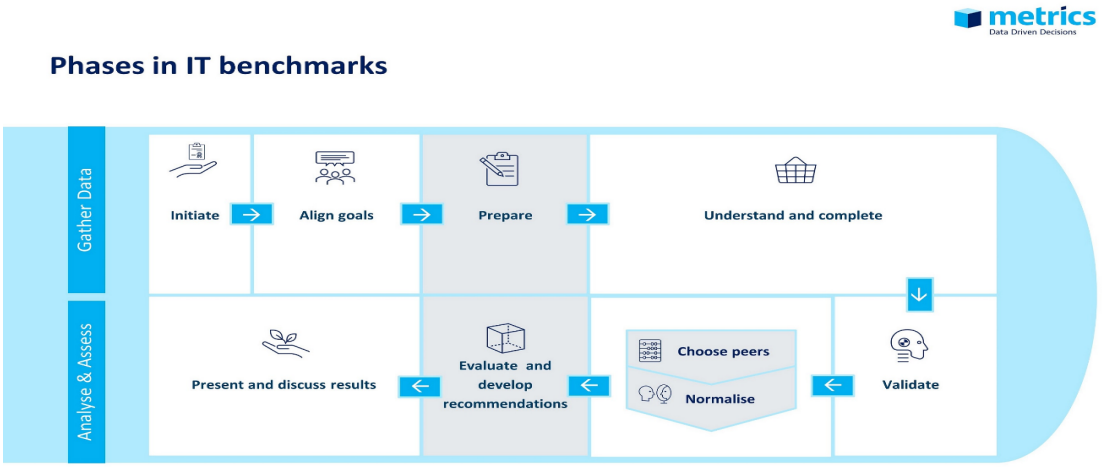

Figure 4. Systematic benchmarking progression

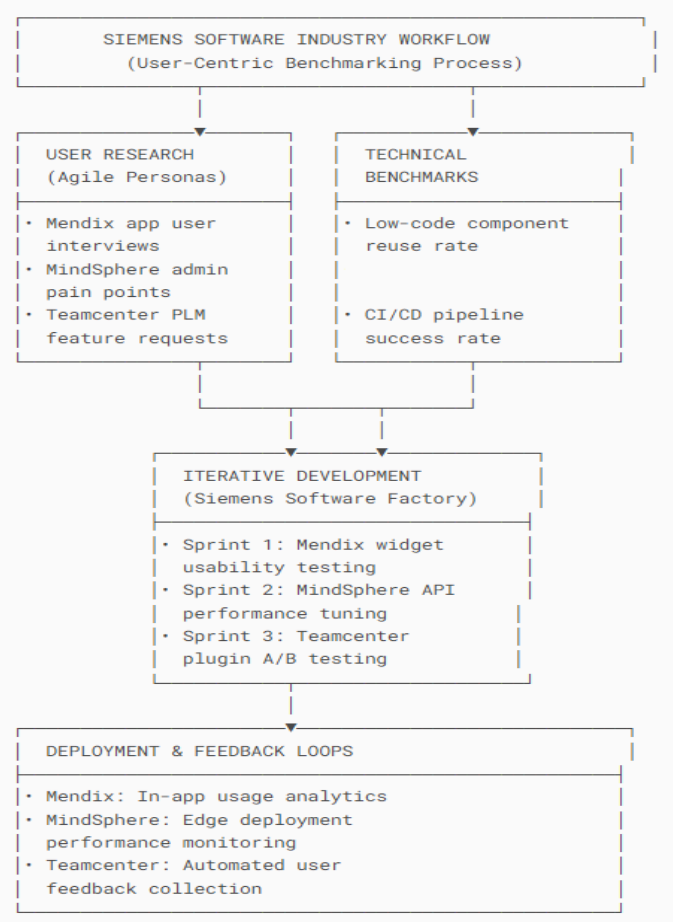

Figure 5. User-centric benchmarking workflow

5. Conclusion

This paper introduces benchmarking as a strategic tool for motivating industrial digital transformation. In this industrial era, benchmarking enables organizations to identify performance gaps, adopt best practices, and accelerate innovation [9]. The literature review examines how leading enterprises leverage benchmarking to achieve competitive advantages in automation, the Internet of Things (IoT), and AI-driven solutions, which are central to Siemens' digital transformation strategy. The paper then focuses on Siemens' proprietary benchmarking framework, which supports the development of cutting-edge industrial applications. This framework begins with rigorous goal identification, where teams define and prioritize objectives aligned with Siemens' innovation roadmap. These may include enhancing interoperability in automation systems, improving predictive maintenance capabilities, or optimizing human-machine interfaces. A preliminary gap analysis follows, ensuring the goals address technical feasibility and market demands across Siemens' industrial domains. Data collection forms the foundation of Siemens' benchmarking methodology. Teams systematically identify critical data requirements for specific applications. For instance, when developing a digital health solution, this process captures medical device interoperability standards, real-time diagnostics protocols, and compliance requirements [8]. These benchmarks are compared against existing Siemens solutions (e.g., Teamcenter for product lifecycle management) and competitor offerings to establish performance baselines. The target selection phase employs a structured approach to evaluate best-in-class industrial applications. Siemens teams analyse platforms like MindSphere (an Internet of Things-based system) and Mendix (low-code development) across key metrics, including system reliability, integration capabilities, and user adoption rates. This comparative analysis informs strategic decisions about which features and architectures Siemens should emulate or surpass in its solutions. Finally, the methodology culminates in design and implementation. Insights from benchmarking are translated into actionable plans for Siemens' Xcelerator portfolio, with particular attention to industrial-grade principles that balance functionality with operator needs; secure interface development following IEC 62443 standards; and seamless integration with existing systems. By institutionalizing this benchmarking approach, Siemens maintains its leadership in industrial innovation while delivering solutions that set new standards for digital transformation [13]. The methodology identifies performance gaps and provides a clear pathway for developing superior industrial applications that meet evolving market demands. Contemporary research demonstrates how industrial leaders leverage benchmarking across multiple dimensions. For capital-intensive industries where Siemens operates, benchmarking provides insights into the technology maturity of automation components and the effective implementation efficiency of innovative factory solutions. Academic studies particularly highlight the growing importance of cross-industry benchmarking, where best practices from sectors like automotive or aerospace inform innovation in healthcare technology or energy systems—a strategy Siemens actively employs through its diverse portfolio [11].

6. Limitations

The methodology presented here will serve as a bridge between today's fragmented innovations and tomorrow's ecosystem of standardized, reusable solutions. However, several areas warrant further investigation to enhance its applicability. Two key limitations of this study are present opportunities for future research: First, the methodology remains primarily descriptive and would benefit from a more prescriptive, actionable framework. Second, the current approaches for target selection and priority computation require refinement to better align with industrial-scale decision-making. Additionally, the existing method focuses on customer-facing front-end

aspects of digital applications. Extending this to internal infrastructure—such as industrial hardware, network administration systems, and enterprise-level operational technologies—poses a greater challenge. Addressing this would necessitate a collaborative benchmarking approach that leverages cross-domain expertise within Siemens' ecosystem.

Disclosure statement

The author declares no conflict of interest.

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