The Need for Web Development Quality to Develop High-Quality Web Applications

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ABSTRACT

In the rapid world of technology, web development faces a complex but significant challenge, particularly in the development of quality web applications. In many cases, end users often assess the quality of web applications based on their error-free performance and user-friendliness as well as enable users to perform tasks quickly anywhere and anytime on any computer devices. Thus, each and every quality issue in the phases of web development process plays a crucial role in the success of a web application and determining the right quality attributes or dimensions can be a challenge. The web development process, carried out in stages based on priorities, presents multiple challenges in communication, management, and teamwork within web development team environments which may adversely impact the overall quality of web applications. This research focuses on the influence of the web development process emphasising quality at each stage of creating high-quality web applications. This will then bring into case studies and quantitative metrics to produce a framework for the web development team to comprehend and adhere to the key quality principles of web application development.

Keywords: Web Development, Web Application, Web System, Web Quality, Information Quality

INTRODUCTION

Web applications continue to evolve with the emergence of new web technology, as does their web development, but they are seldom studied. In recent years, researchers have embraced the web application development particularly looking at quality aspects [1]–[3]. The way the web development team works on a web project at the initial stage of the web development process should focus on the web development requirements as well as quality for creating high-quality web applications. Any approach in the web development process for developing web applications may be successfully adopted, considering its quality [2]. It should be noted that references to web applications includes other terms such as web systems, web information systems, web-based applications and the recent and popular term is web apps [4]. This also includes its web development process which may be referred to as web development methodology and web development life cycle.

Considering the web technology involves in the fast-paced internet landscape, developing a web application can post significant challenges. Web applications encompass, among others, static, dynamic, ecommerce, social media, data-driven applications and content management system (CMS) [5], [6]. The more challenging is that in the sense of taking into account of browsing or accessing via any computer devices as well such as mobile phones and tablets. The terms employed for this pertain to common practices are responsive web design (RWD) or progressive web app (PWA) [7].

WEB DEVELOPMENT PROCESS

Delivering high-quality web applications needs a good web development process. Various approaches and methodologies have emerged to assist and guide the process. It serves as a step-by-step approach, according to stages or phases, or even as a roadmap for how web applications are designed, developed and deployed [6]. In Table I, a representative of each year for five (5) recent years is presented.

TABLE I Recent Web Development Processes

[8]	2019	1) Requirement Elicitation and Analysis; 2) Design;
		3) Development; 4) Testing; 5) Deployment; 6) Maintenance
[9]	2020	1) Information Analysis; 2) Technical Design; 3) User Interface; 4) Work Design; 5) Organisational Analysis
[10]	2021	1) Requirement Analysis; 2) Build Specification; 3) Design & Development; 4) Content Writing; 5) Coding; 6) Testing; 7) SEO & Social Media Marketing; 8) Maintenance & Updating
[11]	2022	1) Ideation; 2) Design UX & UI; 3) Develop; 4) Launch
[12]	2023	1) Requirement Analysis; 2) Design; 3) Development;
		4) Testing; 5) Deployment; 6) Maintenance
[13]	2024	1) Planning and Designing; 2) Web Application Development;
		3) Deployment and Launch; 4) Maintenance & Updates

Each web development process has its unique approach, pros and cons, making it essential for a web development team to choose the right process and its most likely easy to manage and control the web project based on the team capabilities. However, having large or small number of stages is not always indicative of conflict. This is presumably because, as a distinct stage, it is more comprehensible and understandable by the web development team and their clients. The general web development processes are refined to derive a comprehensive process with four (4) stages – planning, design, implementation and operation (see Fig. 1).

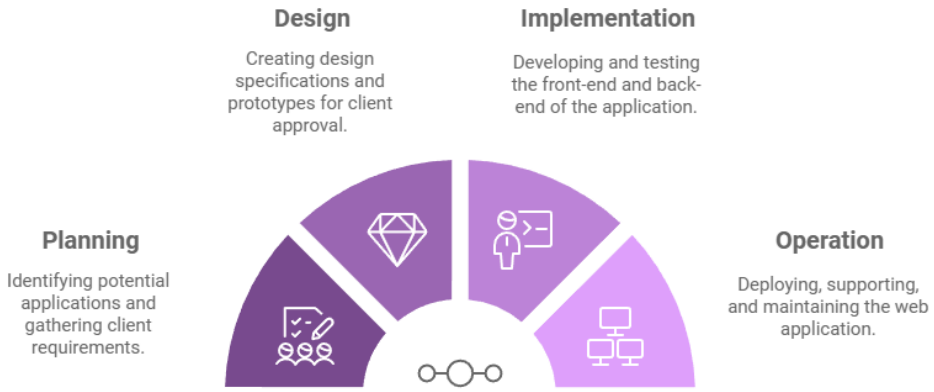

Fig. 1: Derived stages for the web development process

1. *Planning:* This stage allows the project manager to discuss with clients for designing and developing possible web applications. This involves gathering the client's needs and producing requirement specifications.
2. *Design:* This stage is where web development teams and clients are actively working together to produce design specifications based on the requirement specifications. A prototype may be developed for the client's approval.
3. *Implementation:* This stage involves the entire process of developing web applications – front-end and back-end functionality. Testing will take place once the web applications are ready as per specifications.
4. *Operation:* This stage deploys the web applications onto a hosting server for production running. Accordingly, support and maintenance for improvement.

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The derived four stages have been demonstrated not limited to by two (2) real-world web development companies, iTechnoLabs and iProgrammer, with their development expertise and competence as well as their track record of successful web project implementations across the world. At the iTechnoLabs [11], four steps must be taken – Ideation, Design UX & UI, Develop and Launch (see Fig. 2) when developing fully-functional web applications.

Fig. 2: The Process of Web Application Development – *adapted from [11]*

At the iProgrammer [13], there are four stages of the development cycle to follow (see Fig. 3) – Planning and Designing, Application Development, Deployment and Launch and Maintenance and Updates – for developing from single-page websites to complex applications with defined features and integrations.

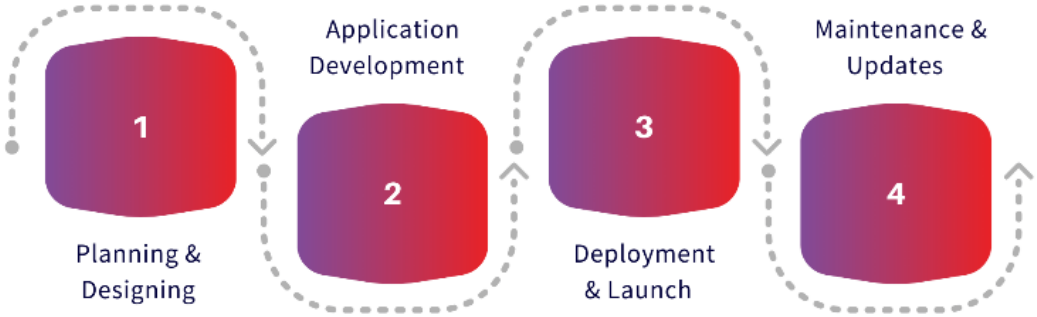

Fig. 3: Web Application Development Process – *adapted from [13]*

Through these four stages, developing web applications is quite a challenge based on the nature and characteristics which related to web or internet technology. The development process refers to the degree of formalisation of processes, which can be either lightweight or heavyweight. Both face the key challenges as follow [16]: -

- *handling short development cycles* – delivering of web projects in a short period of time,
- *handling changing requirements* – web projects are frequently modified,
- *parallel development process* – web development team works concurrently since the initial stage,
- *reuse and integration* – codes are reusable and require integration with existing applications.

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INFORMATION QUALITY

When it comes to quality, it should not be compromised. In fact, quality is all about fit for purpose or fitness for use according to which context it is applied. In the web development context, the first basic information that web development team will have is the user requirements for developing web applications. When all requirements are verified to be complete, they are said to be of good quality [17]. Otherwise, poor requirements can lead to poor decision-making [18], in which the web development team will suffer to redevelop the application features as they do not conform to the user requirements.

Information quality (IQ) is dependent on the context of the application that is being used [19]. For this reason, it is critical to look into the IQ perspective involving dimensions and frameworks. It is noted that information quality also covers the aspect of data quality, as many researchers consider these terms as synonymous.

A. IQ Dimension

The fundamentals of IQ are looking at its characteristic, called dimension which are critical for conforming to the quality of information based on the context of use. The well-known IQ dimension is about data consumers [20]. There are 15 IQ dimensions classified into four (4) main categories: intrinsic, contextual, accessibility and representational (see Fig. 4).

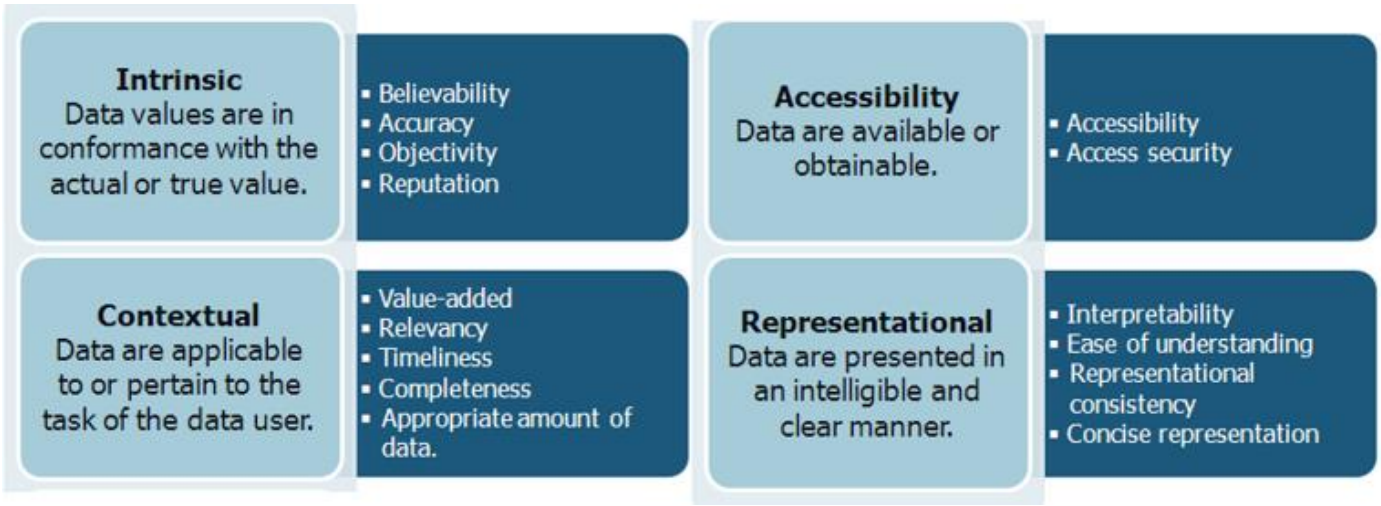

Fig. 4: IQ/DQ categories and associate dimensions – *adapted from [20]*

It is apparent that when analysing the literature, there was no general agreement on IQ dimensions due to context specific and according to its purposes. For this research, the IQ aspect in the context of the web development process will be investigated. However, other IQ-related dimensions are also taken into consideration.

B. IQ Framework

Various research fields seeking to improve IQ standards resulted in a new IQ framework [21], [22]. They have studied and applied the IQ aspect within the context of their study in a specific situation and with the characteristics of the information given. IQ can be influenced by individuals' or organisations' insight to develop a dedicated IQ framework for a desired context. This IQ framework includes a key principle that underpins all framework elements, which serves as a guideline or tool to inform or guide quality across the context [22].

In addition, some primary methodologies for managing IQ activities can be considered for further analysis and incorporated into the web development process. Those methodologies are identified by acronyms with its abbreviated name and reference as presented in the Table II. The popular methodologies cited in the IQ

literature are TDQM, TIQM and AIMQ, regarded as general-purpose methodologies restricted to only their fixed set of IQ dimensions. The recent methodologies are BDQMF and Q Methodology in which although with a focus on the activities assessing and improving IQ, it still requires changes to meet the settings and goals of an intended context. This means that a specific IQ framework and methodology should be considered to incorporate into web development process to effectively develop web applications.

TABLE II IQ Methodologies

[23]	1998	TDQM (Total Data Quality Management)
[24]	1999	TIQM (Total Information Quality Methodology)
[25]	2002	AIMQ (Assessment and Improvement Methodology - Quality)
[26]	2021	BDQMF (Big Data Quality Management Framework)
[27]	2024	Q Methodology

WEB DEVELOPMENT QUALITY

The web development process comprises four (4) phases (see Section II) that outline the process from the planning phase through operation. It begins with planning a web project by identifying a potential need and progresses through all phases up to the operation of the project once the web application is complete. This development process acts as the blueprint for developing high-quality web applications. Thus, throughout the web development process, it is crucial for the web development team to include managers, analysts, designers and developers, to consider IQ, which eventually creates a well-defined and executed process that significantly impacts web application quality [23] (see Fig. 5). Researchers worldwide have studied the importance of web applications quality and IQ relating to the web context is deemed necessary [24]. The most common approach is to look on the web development team perspective [13] because it is believed that the team with good competence will bring good process that works well. In practice, the team perspective is primarily looking for quality before and after development as well as post-deployment.

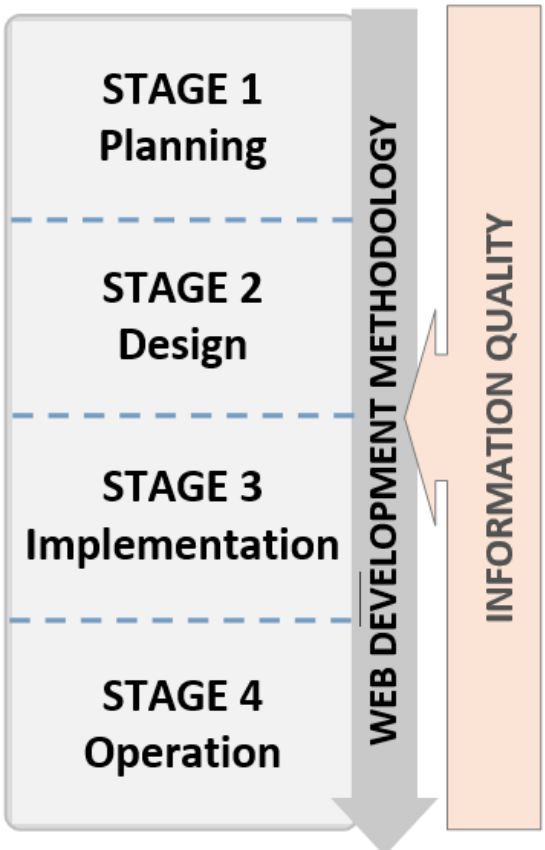

Fig. 5: Proposed Conceptual Research Framework

The web development team which involves complex and critical functions requiring managerial skills (managers/ analysts) and in-depth technical knowledge (designers/ developers/ testers) pertinent to the phases of the web development process [25], [26]. In general, it is what the web development team should consider or concern on quality when they carry out their roles and responsibilities which they need to form constructive viewpoints for what data and information is required [26]. The viewpoints also include within the work on all aspects that involved in the development of web applications.

1. *Focus on Quality*: All team, where everyone involved, with a mindset consistently focused on quality, must establish clear and well-defined requirements throughout the early stages of web development. Otherwise, quality will be compromised when the application's purpose, features and user needs are not complied. Furthermore, integrating quality from which defects can be quickly identified and addressed early is able to avoid major problems later in the web development.
2. *Establish Open Communication*: The main thing is that all communication should be clear and to the point between stakeholders involved in the distinct phases of the web development process. Tasks and activities should be performed and completed logically according to roles and responsibilities, with a better understanding of what is being developed, leading to more cohesive and high-quality web applications.
3. *Learn to Improve*: It is critical for the web development team to adopt best practices for learning and sharing knowledge as well as experiences when working throughout the web development process. This encourages the team to continuously give feedback, allowing for iterative development and improvement to refine the current web application development and future web development efforts.

Beside these viewpoints, as web development continues to evolve, there are emerging challenges that expected to substantially impact on web development in the near future. One of the challenges is the security concerns. Nowadays in the era of cyber-attacks and data breaches, security is a paramount importance, as evidenced by the Open Web Application Security Project (OWASP), which shows how coding changes, configuration modifications, and patch applications can reduce web application vulnerabilities [27]. Moreover, a very recent technology is the rise of Artificial Intelligence (AI), which would be beneficial for integration in web development. One suggested that some form of AI could be only just assist throughout the web development process due to its lack of ability to generate full and coherent code during web design and development [28].

CONCLUSION & FUTURE WORK

It is evident from the literature that the web development team, including managers, analysts, designers and developers, must work collaboratively in all the development activities at every phase just to ensure the web applications developed with quality in mind. In order to achieve this, the future work or for extensions of the research presented here should examine how web development team perceive and interpret IQ inside the web development process. The insights and understanding about IQ need to be investigated and analysed through case studies, utilising the wide knowledge and experiences of the team members obtained through interviews and relevant documents for content analysis. In addition to that, using quantitative metrics to evaluate the success of IQ integration in the web development process will establish a more robust foundation for the proposed framework. It is envisioned that a comprehensive IQ framework for the web development process will be derived to assist and guide the web development team in developing high-quality web applications for current and future web projects.

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