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OVERVIEW OF DEFINING KPIS FOR A WEB APPLICATION: EXAMPLES OF PERFORMANCE METRICS

The article examines Key Performance Indicators (KPIs) as a tool for assessing the quality and performance of web applications. A classification of KPIs is proposed based on technical, user-oriented, and business-related criteria. The paper analyzes current approaches to measuring each of these categories and provides examples of KPI implementation in various types of web systems. Special attention is given to the relationship between technical metrics and the quality of user perception. The findings may be useful for software engineers, analysts, and project managers in planning the development and optimization of web applications.
Keywords: key performance indicators, KPIs, web application, technical KPIs, user KPIs, business KPIs.

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ОГЛЯД ВИЗНАЧЕННЯ KPI ДЛЯ ВЕБЗАСТОСУНКУ: ПРИКЛАДИ МЕТРИК ЕФЕКТИВНОСТІ

У статті розглянуто ключові показники ефективності (Key Performance Indicators, KPI) як інструмент вимірювання якості та продуктивності вебзастосунків. Дослідження ґрунтується на необхідності комплексної оцінки вебсистем, яка враховує технічні характеристики, поведінку користувачів та бізнес-показники. Запропоновано класифікацію KPI за трьома групами: технічні (швидкість завантаження сторінок, доступність системи, відсоток помилок), користувацькі (показник відмов, середня тривалість сесії, коефіцієнт клікабельності) та бізнес-орієнтовані (конверсія, середній дохід на користувача, довічна цінність клієнта, вартість залучення користувача).

Особливу увагу приділено взаємозв’язку між технічними метриками та якістю сприйняття кінцевим користувачем, а також їхньому впливу на бізнес-результати. Показано, що навіть незначні технічні збої або повільне завантаження суттєво знижують рівень задоволеності користувачів, конверсію та довіру до бренду. У статті наведено приклади застосування KPI в електронній комерції, SaaS-рішеннях та інформаційних порталах, що підтверджує універсальність підходу.

Проаналізовано проблеми відсутності уніфікованого переліку KPI для різних типів систем, труднощі інтеграції метрик у єдину модель управління та недостатню автоматизацію збору даних. Запропонований підхід дозволяє формувати збалансовану систему оцінювання, яка одночасно враховує технічні параметри, поведінку користувачів і фінансові показники. Це створює підґрунтя для більш точного прогнозування наслідків технічних змін, оптимізації бізнес-стратегії та підвищення якості користувацького досвіду.

Результати дослідження можуть бути використані інженерами програмного забезпечення, аналітиками та менеджерами проєктів у процесі планування розвитку та вдосконалення вебзастосунків. Використання KPI як інтегрованої системи моніторингу та прийняття рішень забезпечує можливість швидко реагувати на проблеми, визначати напрями зростання та підвищувати конкурентоспроможність цифрових продуктів.
Ключові слова: ключові показники ефективності, КПЕ, вебзастосунок, техніні КПЕ, користувацькі КПЕ, бізес КПЕ.

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INTRODUCTION

In the current context of rapid advancements in information technologies and the growing volume of data processed on the Internet, the issue of objectively evaluating the performance of web applications has become particularly relevant. The quality and efficiency of web systems directly influence the success of e-commerce, the effectiveness of distance learning, and the reliability of digital services in healthcare and public administration [1]. At the same time, unstable network speeds, the diversity of user devices, and the need for service scalability present numerous scientific and practical challenges related to developing universal yet flexible tools for monitoring and evaluating web application performance.

Early research in the field of IT system performance assessment focused primarily on technical metrics (such as server response time and network throughput) and was reflected in works based on the ISO/IEC 25010 standards and load testing studies [2, 3]. Later, attention shifted toward more comprehensive approaches that consider user experience (UX) and business-oriented indicators (such as conversion rates and user retention), as highlighted by publications like Google Web Vitals and reports from analytical firms [4]. However, these approaches often evolved

in isolation: technical metrics did not always correlate with business outcomes, and UX research often overlooked internal system infrastructure, although there there are still several ways to measure user behaviour and optimize service [5].

Despite significant progress, several unresolved issues remain: the lack of a unified KPI list tailored to different types of web applications (e.g., e-commerce, SaaS, informational portals); difficulties integrating diverse metrics into a single management system; and insufficient automation of data collection and analysis from various sources. Moreover, the mechanisms for building models capable of predicting the impact of technical changes on business indicators and user satisfaction are still underexplored.

The goal of this article is to formalize a systematic approach to the use of Key Performance Indicators (KPIs) in the context of developing, monitoring, and optimizing web applications [6]. The study proposes a classification of KPIs based on technical, user-oriented, and business-related features, describes methods for collecting and analyzing the corresponding metrics, and provides practical examples of implementing the proposed approach in real-world projects. This research aims to bridge existing gaps in KPI standardization and to equip IT professionals with the tools necessary for making informed decisions at all stages of the web application lifecycle.

MAIN PART

To ensure a systematic approach to evaluating the effectiveness of web applications, it is advisable to classify Key Performance Indicators into three main categories: technical, user-oriented, and business-oriented. This approach allows for the consideration of not only the internal characteristics of the system but also external manifestations—such as the quality of user perception—which have a direct impact on business outcomes [7].

1.1. Technical KPIs

Technical KPIs play a key role in ensuring the stable operation of a web application and meeting user expectations. They allow for assessing how well the system handles load, whether it functions without failures, and if it provides adequate request processing speed. Successful management of these indicators is essential for a positive user experience and minimizing technical risks.

These metrics enable monitoring the performance and reliability of the infrastructure, identifying bottlenecks in the architecture, and its ability to respond promptly to anomalies. Regular monitoring helps maintain a high level of service availability, reduce downtime, and prevent critical errors that could impact business outcomes.

Technical indicators are especially important for scalable solutions or services with a large user base, where even short-term failures can lead to significant losses. They also serve as a foundation for infrastructure development planning, resource optimization, and implementing changes with minimal risks.

1.1.1. **Page Load Time**

One of the key factors determining the effectiveness of a website both from the perspective of user experience (UX) and search engine optimization (SEO) is the page load time. Most internet users will just skip a site altogether if it fails to load within an average [8] of 6 seconds. This metric indicates how long it takes for a page to be fully loaded in the user's browser — starting from the moment the user initiates a request (for example, by clicking a link or entering a URL) until all page resources (HTML, CSS, JavaScript, images, etc.) are completely loaded and processed. It is defined as the time elapsed from the initiation of the HTTP request to the full loading of the resource in the user's browser:

$$T_{load} = T_{DNS} + T_{connect} + T_{TTFB} + T_{content} \quad (1)$$

Where:

T_{DNS} – DNS resolution time

$T_{connect}$ – time to establish TCP/SSL connection

T_{TTFB} - time to first byte

$T_{content}$ - time to receive and render content

The page load time is perceived by the user as the moment when the web page is considered fully loaded and ready for viewing.

Наприклад:

If $T_{DNS} = 50ms;\ T_{connect} = 100ms;\ T_{TTFB} = 200ms;\ T_{content} = 800ms$, so:

$$T_{load} = 50 + 100 + 200 + 800 = 1150ms$$

From a UX perspective, studies show that users expect a page to load in less than 2–3 seconds. If the load time exceeds this threshold, there is a high risk that users will leave the site before seeing any content. This can lead to a decrease in retention rate and an increase in bounce rate.

An important aspect is that, for example, Google directly considers page load speed when ranking websites in search results. Slow sites may be ranked lower even if other SEO factors are properly implemented.

1.1.2. **System Uptime**

System uptime is a metric that reflects the stability and continuous availability of a web service or website. It indicates the percentage of time during which the system was accessible to users and operated without failures, typically expressed as, for example, 99.9% or 99.99%. This means the site was available almost all the time, except for a few minutes or seconds per month. The closer this value is to 100%, the higher the platform's reliability. For example, in cloud-hosted systems, especially those built on Infrastructure as a Service (IaaS), uptime is often guaranteed upfront and can be further optimized through clustering strategies and redundancy models tailored for High Availability (HA) [9].

Stability and constant availability are critically important for any web resource, especially for commercial websites, online stores, banking services, or any other resource where round-the-clock access is expected. Even a short downtime can lead to financial losses, decreased customer trust, and damage to the company's reputation. If a user cannot access the site at a needed moment, there is a high chance they will turn to competitors.

The calculation of uptime is as follows:

$$U = \left(1 - \frac{T_{downtime}}{T_{total}}\right) * 100\% \quad (2)$$

Where:

$T_{downtime}$ – the time when the system was unavailable

T_{total} – total observation period

For example: over a 30-day month (43,200 minutes), the system was unavailable for 90 minutes:

$$U = \left(1 - \frac{90}{43200}\right) * 100\% = 99.79\%$$

A value of 99.79% is a decent result, but it may already be considered below the standard requirements for highly reliable systems.

For a deeper understanding, let's present the values of the most common metrics in a table:

Table 1

Uptime Standards and Monthly Downtime Allowances

Uptime value	Allowed downtime per month	Comment
99.95%	~22 minutes	Very good, enterprise-level
99.9%	~43 minutes	Good, the standard for many services
99.79%	~90 minutes	Acceptable, but below the ideal standard
99.5%	~216 minutes (3.6 hours)	May cause user complaints
99%	~432 minutes (7.2 hours)	Low metric, critical level

Thus, uptime is one of the key indicators of a web service's reliability. A high level of uptime directly impacts user satisfaction, brand trust, and the company's financial performance. Therefore, monitoring uptime and responding promptly to outages is not just a technical task but an important component of the service's quality and stability strategy.

1.1.3. **Error Rate**

Error Rate — this metric reflects the proportion of all requests to the system that ended with an error (for example, HTTP status codes 4xx or 5xx). It is an important indicator of service quality and helps identify issues related to availability, stability, or backend logic. Without such metrics, teams may rely on subjective impressions of performance, which are often inaccurate due to common cognitive biases and blind spots in self-assessment [10].

The error rate is calculated as the ratio of the number of failed requests to the total number of requests:

$$ER = \frac{N_{errors}}{N_{total}} * 100\% \quad (3)$$

Where:

N_{errors} – number of requests over a period of K time

N_{total} – total number of requests over a period of K time

For example: if out of 100,000 requests, 2,000 resulted in HTTP errors (4xx or 5xx), then:

$$ER = \frac{2000}{100000} * 100\% = 2\%$$

An error rate of 2% means that every 50th request to the system ends in failure. This can already indicate the presence of technical issues, especially if the service operates under high load or provides critical functions. Common causes of such behavior may include database problems, incorrect handling of user requests, instability of third-party

APIs, server failures, or timeouts. For most stable services, an error rate below 1% is considered acceptable, and ideally — less than 0.1%.

Therefore, regular monitoring of the error rate and a flexible logging mechanism help maintain the stable operation of the web service, respond promptly to technical problems, and improve the overall quality of the product.

1.2. **User KPIs**

User KPIs focus on analyzing how visitors interact with a web application or website. They provide deeper insights into user behavior, their engagement with content, and the effectiveness of the interface design. These metrics help identify the strengths of a digital product as well as areas needing improvement in terms of usability, structure, or information presentation.

Regular tracking of user metrics allows assessing how successfully the resource fulfills its functions in terms of user acquisition, retention, and satisfaction. They play a crucial role in shaping UX strategy because they are directly related to how visitors perceive ease of use and intuitive navigation.

User KPIs can also highlight problems that are not always visible from the technical perspective. For example, even if the system operates flawlessly, users may fail to perform expected actions due to confusing structure or unclear interface elements. Therefore, these metrics are an indispensable tool for UX designers, analysts, and marketers striving to create an attractive and effective digital product.

1.2.1. **Bounce Rate**

Bounce Rate is an important metric that characterizes the effectiveness of user interaction with a website. It shows the percentage of sessions that ended after viewing only one page without any further actions—such as navigating to another page, clicking, filling out forms, or interacting with page elements. A high Bounce Rate often signals that the page does not meet visitors' expectations, has low relevance, or fails to encourage further engagement. In this context, user trust in the website's relevance, usefulness, and responsiveness plays a crucial role; if users do not perceive the system as competent or transparent in fulfilling their intent, they are less likely to continue interacting with it [11].

The bounce rate is defined as the percentage of sessions in which the user viewed only a single page and did not perform any additional actions:

$$BR = \frac{N_{single}}{N_{sessions}} * 100\% \quad (4)$$

Where:

N_{single}– the number of sessions in which the user viewed only one page and did not perform any further actions

$N_{sessions}$ – total number of sessions

For example: out of 10,000 sessions, 2,500 were single-page sessions:

$$BR = \frac{2500}{10000} * 100\% = 25\%$$

A 25% result can be considered acceptable, especially for informational or content websites where users can find the needed information right on the first page. Generally, a Bounce Rate between 20% and 40% is regarded as normal for most sites. Rates below 20% might indicate incorrect analytics, while levels above 50–60% are considered problematic and may signal uninteresting or irrelevant content, slow page loading, poor design, or lack of clear calls to action.

A high bounce rate is not always critical—for single-page websites or landing pages, it can be typical. However, for e-commerce sites, blogs, service platforms, or B2B websites, it should be as low as possible, as it reflects user engagement and the likelihood of conversion. Each website should be analyzed individually, taking into account its type, goals, and target audience behavior. Reducing the bounce rate, when necessary, is often achieved by improving design, loading speed, content relevance, and clear calls to action.

1.2.2. **Average Session Duration**

Average session duration is an important metric that allows assessing the total length of user interaction with a website or application. This metric shows how much time, on average, users spend on the site during a single visit. It serves as an indicator of how engaging, useful, and relevant the content or functionality of the resource is to the audience. The longer a user remains active within a session, the higher the likelihood that they are interested in interacting, consuming content, exploring services, or preparing for a conversion. Understanding and improving this metric can benefit from techniques such as Web Usage Mining (WUM), which identifies user browsing patterns by analyzing sessionized web log data and filtering out irrelevant behavior to better reveal genuine user interest and engagement [12].

The duration of user interaction with the application is calculated as the ratio of the sum of all session durations to the total number of sessions:

$$T_{avg} = \frac{\sum_{i-1}^{n} T_i}{n} \quad (5)$$

Where:
T_i – duration of the i-th session
n – number of sessions
Example: for 5 sessions with durations of [300, 400, 500, 200, 600] seconds:

$$T_{avg} = \frac{300 + 400 + 500 + 200 + 600}{5} = \frac{2000}{5} = 400\text{sec}$$

Thus, the average session duration is 400 seconds, or approximately 6 minutes and 40 seconds. This is a fairly high indicator, which suggests good user engagement.

Acceptable average session durations largely depend on the type of resource. For content websites or blogs, an average session duration of over 2–3 minutes is considered good. For online stores and service platforms, it's about 3–5 minutes, depending on the complexity of the structure and the volume of information. If the value is below one minute, it may indicate low interest in the content, usability issues, or a poor match with user expectations. Conversely, an excessively long session duration can sometimes indicate not engagement, but rather difficulties with navigation or a confusing site structure, especially if no target actions are taken during the session.

However, for a comprehensive understanding of the user experience, this metric should always be analyzed in the context of other indicators such as bounce rate, pages per session, and conversion rate..

1.2.3. **Click-Through Rate, CTR**

Click-Through Rate (CTR) is one of the most important marketing metrics that allows evaluating the effectiveness of clickable elements — such as advertising banners, buttons, links, email campaigns, or search ads. It shows the percentage of users who actually clicked on an element after seeing it (impressions). Thus, CTR helps to determine audience interest in a specific message or call to action, as well as to understand how well the interface, headline, or advertising offer is designed. Modern approaches to CTR prediction on e-commerce and social platforms — especially those leveraging deep learning, factorization machines, and user-item interaction modeling — increasingly rely on multi-modal features (e.g., visual, textual, acoustic data) to capture user preferences more accurately. These models address challenges such as data sparsity and dynamic interest shifts through methods like hypergraphs and self-supervised learning to improve prediction performance in complex environments like micro-video platforms [13].

Click-Through Rate (CTR) formula:

$$CTR = \frac{N_{clicks}}{N_{impressions}} * 100\% \quad (6)$$

Where:
N_{clicks} – number of clicks or user actions (click-throughs)
$N_{impressions}$ – total number of ad impressions
For example, a banner ad was displayed 20,000 times and received 600 clicks:

$$CTR = \frac{600}{20000} * 100\% = 3\%$$

This means that 3% of users who saw the banner decided to click on it.

The evaluation of acceptable or unacceptable CTR values depends on the context. For banner ads in a display network, an effective CTR is typically between 0.5% and 1.5%. For search engine contextual ads, where the user has already shown interest in the topic, a CTR of 3–6% is considered good. For email marketing or own websites, the CTR can reach 10% or higher—especially when the offer is clearly formulated and meets the audience's needs.

A CTR below 0.5% usually signals ineffective content, weak visual emphasis, irrelevant messaging, or poor placement of the element within the interface.

Thus, CTR is a key indicator of the impact of a visual or textual element in the digital environment. A high CTR often leads to increased conversions; however, for a full evaluation of effectiveness, it is also important to consider the user's actions after the click: whether they completed the target action or simply left without further interaction.

1.3. Business KPIs

Business KPIs allow you to assess the real economic impact of a web application on a company's operations. They serve as key benchmarks for making strategic decisions by showing how effectively a digital product generates revenue, justifies investments, and supports business growth. These metrics enable comparison of actual results with expected outcomes and help determine whether the digital strategy aligns with overall business goals.

These indicators also help analyze the financial efficiency of user interactions: how much revenue each customer generates, the cost of acquiring them, how long they remain active, and the value they produce over the entire engagement period. This approach allows identifying the most profitable marketing channels, optimizing budgets, and focusing on the development of lucrative segments.

Tracking business KPIs is critical for evaluating the scalability of the model, growth potential, and identifying break-even points. They form the basis for profitability calculations, investment justification, and long-term financial

planning. Altogether, these metrics help build a sustainable and effective business ecosystem around the digital product.

1.3.1. **Conversion Rate, CR**

Conversion Rate (CR) measures the percentage of users who completed a desired action after interacting with a website or advertisement. The target action can vary depending on the business model — it may be a product purchase, registration, subscription, form submission, file download, or any other desired outcome. The conversion rate indicates how effectively a web resource not only attracts traffic but also turns it into concrete results. The success of achieving high conversion rates is closely linked to the website's usability and its communication capacity, as users tend to abandon sites that are difficult to navigate or slow to respond [14].

Therefore, CR is calculated using the formula: the number of users who completed the target action divided by the total number of unique visitors or sessions, multiplied by 100%.

$$CR = \frac{N_{conversions}}{N_{visitors}} * 100\% \quad (7)$$

Where:

$N_{conversions}$ – the number of users who completed the target action

$N_{visitors}$ – total number of users

Example: 150 users out of 5,000 completed the target action (registration, purchase):

$$CR = \frac{150}{5000} * 100\% = 3\%$$

This means that 3% of all visitors converted into active users, achieving the expected business goal.

Conversion rates can vary significantly depending on the industry, type of website, and complexity of the target action. On average, for e-commerce sites, a rate of 2–3% is considered satisfactory. In B2B or SaaS sectors, where decision-making processes are more complex, a normal rate might be as low as 1–2%. Meanwhile, landing pages with simple registrations or subscriptions can see conversion rates of 5–10% or higher.

If the conversion rate falls below 1%, it is a cause for concern and requires deeper analysis — possible reasons include poor UX, an ineffective sales funnel structure, irrelevant traffic, or insufficiently compelling calls to action.

In our example, a 3% conversion rate is quite acceptable and indicates effective interaction between the website and users. This means every 33rd visitor completes the target action, which is a good result for most commercial projects. However, to further improve this metric, it is advisable to regularly test interface elements, copy, page load speed, and traffic sources to reduce barriers to conversion and enhance the value of user interaction.

1.3.2. **Average Revenue Per User, ARPU**

Average Revenue Per User (ARPU) is a key financial metric that reflects how much revenue, on average, one active user of a service or product generates over a certain period of time. This metric is widely used in e-commerce, SaaS services, mobile applications, online platforms, and the telecommunications industry. ARPU helps assess the economic efficiency of the user base, identify profitable audience segments, and make informed decisions regarding monetization, marketing, and pricing strategies. Over time, as technology advances and service penetration increases, ARPU often decreases due to lower prices and broader accessibility. Nevertheless, overall profitability can remain stable or grow thanks to larger subscriber bases, reduced operational costs, and increased adoption of value-added services [15].

$$ARPU = \frac{R}{N_{users}} \quad (8)$$

Where:

R – total revenue

N_{users} – number of active users

Example: The company generated a total revenue of 120,000 UAH over a month with 4,000 active users:

$$ARPU = \frac{120\,000}{4\,000} = 30 \text{ грн.}$$

This means that, on average, one user generated 30 UAH for the company per month.

Evaluating the obtained ARPU value makes sense only in context — by comparing it with previous periods, competitors, or internal business goals. For example, in mobile apps, an ARPU of $1–5 is considered normal, but for SaaS products, where subscriptions can cost tens or hundreds of dollars, acceptable values may start at $30–50. A too low ARPU may indicate weak monetization, an incorrect pricing model, or low quality of paid content. Conversely, a very high ARPU can be misleading if revenue growth relies excessively on a small segment of high-paying users.

Thus, an ARPU of 30 UAH in the given example is an adequate value if the product's goal is mass access with low-cost subscriptions or microtransactions. It demonstrates a stable ability to generate revenue per user.

To increase ARPU, companies usually work on improving their pricing proposals, introducing advanced paid features, enhancing service quality, and optimizing marketing channels to attract more paying customers.

1.3.3. **Lifetime Value, LTV**

Lifetime Value (LTV) — a strategic business metric that shows the average revenue generated by a single user over the entire duration of their interaction with the company. LTV helps assess the economic efficiency of customer acquisition, plan marketing expenses, and understand the long-term profitability of the business model. A high LTV indicates a loyal audience, quality support, a stable product, and an effective pricing strategy, while a low LTV often signals issues with customer acquisition or retention. The growing importance of LTV in business stems from its ability to provide disaggregated insights into customer profitability, enabling companies to allocate resources more effectively and tailor marketing efforts. Advances in information technology have facilitated the collection and analysis of detailed customer data, allowing firms to better model and predict LTV for improved decision-making [16].

The metric is calculated using the formula:

$$LTV = ARPU * \bar{t} = \frac{R}{N_{users}} * \bar{t} \tag{9}$$

Where:

$\bar{t}$ – average duration of customer engagement (in months or years)

Example: ARPU is 100 UAH, and the average duration of customer engagement is 12 months:

$$LTV = 100 * 12 = 1200 \text{ UAH}$$

This means that each customer, on average, brings the company 1,200 UAH over the entire period of using the product or service.

The LTV value should be considered in relation to the Customer Acquisition Cost (CAC). If LTV significantly exceeds CAC (by 2–3 times or more), the business has potential for growth and profitability. Conversely, if LTV is less than or nearly equal to CAC, it means the costs of acquiring users are not being recovered — such a model is unprofitable in the long term. For example, if CAC is 800 UAH and LTV is only 1,000 UAH, the company will make very little profit or may not cover operating costs at all. On the other hand, if with the same acquisition cost, LTV is 2,500 UAH, this indicates a high potential for scaling.

Acceptable and unacceptable LTV values depend heavily on the business sector. In mobile apps, LTV may range between $10–100, in SaaS solutions — from $500 to several thousand dollars, and in online education or financial services — even higher. A low LTV can indicate poor retention, lack of additional value after the first contact, or monetization problems.

In conclusion, LTV is a comprehensive metric that reflects the financial value of a customer to the business. In our example, the value of 1,200 UAH is a good benchmark for planning acquisition costs, developing marketing strategies, and determining growth economics. Continuous work on increasing LTV through improving service, introducing new features, retaining customers, and increasing their activity is one of the most effective strategies for long-term success.

1.3.4. **Customer Acquisition Cost, CAC**

Customer Acquisition Cost (CAC) is a metric that reflects how much, on average, a company spends on marketing and sales to acquire one new user or customer. This metric is critically important for evaluating the effectiveness of advertising campaigns, marketing strategies, and the overall viability of the business model. If the acquisition cost is too high, the company risks spending more on each customer than the revenue that customer generates, leading to losses even if the user base is growing.

The rapid expansion of e-commerce and online commerce has increased the significance of CAC, as businesses compete in a digital marketplace where customer acquisition is crucial but also challenging. Recent trends show a steady rise in online shopping, accelerated further by global events that restricted offline purchases, emphasizing the need for efficient and cost-effective customer acquisition strategies [17].

The formula for calculating CAC is:

$$CAC = \frac{C_{marketing}}{N_{new\_users}} \tag{10}$$

Where:

$C_{marketing}$ – total marketing expenses

N_{new_users} – number of acquired users

Example: The company spent 50,000 UAH on marketing during the month and acquired 1,000 new users:

$$CAC = \frac{50\,000}{1\,000} = 50 \text{ UAH}$$

This means that acquiring one new customer costs the business 50 UAH.

To evaluate the effectiveness of this metric, it should be compared with the customer lifetime value (LTV). If LTV significantly exceeds CAC, for example at a ratio of 3:1 or higher, the company can afford to scale marketing efforts without risking financial losses. In our example, if the LTV is 1,200 UAH, then a CAC of 50 UAH is very acceptable and indicates a profitable model. At the same time, if CAC exceeds or equals LTV, it signals ineffective marketing or low customer value — such a situation requires a revision of the acquisition strategy.

Acceptable CAC values depend on the business sector. It is considered unacceptable when a company spends more on acquiring a customer than it earns from them during their lifetime, especially if this continues over a long period.

In summary, CAC is a fundamental metric that helps control marketing budgets and make informed decisions about business scaling. The value of 50 UAH in our example is considered efficient if it corresponds to a sufficiently high LTV. Continuously reducing CAC by optimizing advertising channels, improving conversion funnels, and enhancing targeting accuracy is a critical step in building a sustainable business model.

CONCLUSIONS

KPI allow for a comprehensive evaluation of a web project's performance from various perspectives — technical, user-oriented, and business-related. Together, these metrics form a system of interrelated indicators that not only measure the current state of the product but also enable quick responses to issues, identification of growth opportunities, and optimization of strategies.

Based on the formulas provided above, a KPI table can be created:

Table 2

Key Performance Indicators (KPIs) for Evaluating Web Project Efficiency

Category	Metric	Formula	Units of Measurement
Technical	Page Load Time	$T_{load} = T_{DNS} + T_{connect} + T_{TTFB} + T_{content}$	seconds
Technical	System Uptime	$U = \left(1 - \frac{T_{downtime}}{T_{total}}\right) * 100\%$	%
Technical	Error Rate	$ER = \frac{N_{errors}}{N_{total}} * 100\%$	%
User-related	Bounce Rate	$BR = \frac{N_{single}}{N_{sessions}} * 100\%$	%
User-related	Average Session Duration	$T_{avg} = \frac{\sum_{i-1}^{n} T_i}{n}$	seconds
User-related	Click-Through Rate	$CTR = \frac{N_{clicks}}{N_{impressions}} * 100\%$	%
Business	Conversion Rate	$CR = \frac{N_{conversions}}{N_{visitors}} * 100\%$	%
Business	Average Revenue Per User	$ARPU = \frac{R}{N_{users}}$	USD
Business	Lifetime Value	$LTV = ARPU * \bar{t}$	USD
Business	Customer Acquisition Cost	$CAC = \frac{C_{marketing}}{N_{new\ users}}$	USD

Each metric plays a distinct role, but their true value is revealed through their interaction. For example, a low Conversion Rate (CR) combined with high traffic might be caused by an elevated Bounce Rate or a short session duration — both of which indicate issues with content or usability. Similarly, poor uptime and a high error rate may explain a low Average Revenue Per User (ARPU) or a decline in Customer Lifetime Value (LTV), as service instability directly affects user trust and long-term engagement.

The relationship between LTV and CAC is one of the key financial balances: excessive spending on user acquisition makes little sense if those users do not generate corresponding value. In this context, ARPU serves as an intermediate metric — it helps assess how well the company monetizes its audience before calculating LTV. Meanwhile, average session duration and bounce rate can act as early indicators of content or navigation issues that may not yet be reflected in financial metrics but already impact user behavior.

Thus, correctly interpreting the interdependencies between KPIs helps understand not only *what* happened but also *why* it happened, significantly improving the quality of decision-making.

Key performance indicators become an effective tool for regular monitoring, development planning, and achieving both short-term and long-term business goals. They help set objectives, prioritize improvements, justify business decisions, and enhance both the technical quality and financial performance of the product.

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