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**CRITERIA AND KEY PARAMETERS
OF CONSTRUCTION WORK PLANS PRODUCTIVITY**

Abstract. *The importance of data-driven criteria and key performance indicators for the success of civil construction projects has been established. The construction industry thrives on executing projects on time, within budget, and to stringent quality standards. But how do you measure success in such a complex field? This is where criteria and key performance indicators come into play. By tracking the right data points, construction companies can gain insights into their work plans, identify areas for improvement, and ultimately achieve better project outcomes. In the dynamic world of construction, success depends not only on completing projects on time and within budget but also on continuously improving processes and results. To achieve this, construction organizations rely on robust metrics and key performance indicators to effectively measure and track progress. In this article, we will take a closer look at the key criteria and key performance indicators that are crucial for assessing the success of a construction project. Measuring construction project success requires a multifaceted approach that goes beyond traditional measurements of time and cost. By utilizing a variety of criteria and key performance indicators, construction organizations can gain a comprehensive understanding of project performance, resource utilization, client satisfaction, and sustainability. The aim of the article is to help construction companies effectively use key performance indicators: to describe the benefits of key performance indicators, including improved decision-making processes and enhanced efficiency. By effectively using these tools, construction professionals can achieve operational excellence, deliver successful projects, and attain long-term business success. By implementing a robust key performance indicator system, construction companies can gain clear insights into how their work plans are performing. This data-driven approach allows for proactive adaptation, improved project outcomes, and long-term success.*

Keywords: *performance parameters; construction organization; optimization; control; efficiency; monitoring; key indicators*

Introduction

In the realm of dynamic construction, success is measured not only by the completion of projects on time and within budget, but also by the improvement of processes and results. To accomplish this, organizations that construct things rely on metrics and indicators that are effective and meaningful to measure and assess progress. Construction productivity is influenced by various criteria encompassing labor, materials, equipment, site conditions, and management practices. Key parameters such as labor productivity rates, material usage efficiency, equipment utilization, site layout optimization, and scheduling techniques play a vital role in determining the overall productivity of a construction project. By carefully considering and optimizing these parameters during the planning phase, construction firms can enhance their competitiveness, improve project performance, and deliver high-quality results within the specified timeframe and budget constraints. In this article, we explore the fundamental metrics and

indicators of performance essential to the evaluation of construction programs success. The appropriate metrics and primary performance indicators allow construction teams to assess critical aspects like schedule, cost, safety, quality, and productivity.

The purpose of the article

Overall, the article attempts to provide professionals in the construction industry with the knowledge and tools necessary to measure and improve the performance of their projects, this will ultimately lead to a more successful and effective outcome.

**Analysis of recent research
and publications**

Scientific and practical problems related to the formation of criteria and basic performance parameters of construction work plans are reflected in the works of domestic authors such as O. V. Ivanilov, Y. V. Maksymenko, O. M. Shevchenko, I. M. Verba,

N. O. Honcharenko. In foreign works by such authors as John Smithson, Dr. Jane Roberts, Michael Collins, Maria Ramirez, Phoenix, Arizona. Concepts such as the use of indicators to measure the effectiveness of construction programs, the development and implementation of best practices that are used by many firms, etc. are considered.

Main material

While metrics provide important data, key performance indicators provide a more focused and strategic approach to measuring performance. Key performance indicators correspond to organizational goals and serve as metrics for success. This article shows a list of the most important performance indicators for building projects that are important to a construction company:

1. General Equipment Efficiency. GEE calculates the effectiveness of equipment by taking into account factors like accessibility, performance, and quality. Maximizing GEE maximizes the efficiency of resources and minimizes the amount of downtime.

In the rushed world of construction, time is of the essence. Projects should be finished in a timely manner and with a high degree of efficiency in order to avoid costly late fees. One of the most popular metrics used by construction companies to maximize efficiency is General Equipment Efficiency. This metric was originally developed in the manufacturing industry, but has now become more popular in the construction industry.

What is the definition of General Equipment Efficiency? GEE provides a comprehensive evaluation of the effectiveness of a piece of equipment or production process in comparison to its full potential. It considers three critical factors:

- Availability: Is the equipment expected to be running when it's supposed to be? This explains the time needed for downtime caused by breakdowns, setups, and adjustments.
- Performance – Is the equipment functioning at its maximum capacity? This calculates the loss of revenue due to idle time, minor stops, and decreased speed.
- Quality – Is the equipment producing a significant amount of output that is acceptable? These documents the loss of quality due to defects and malfunction that do not meet the standards of quality.

GEE takes these three components into consideration and combines them into a single measurement, which is calculated as:

$$\text{GEE} = \text{Availability} \times \text{Performance} \times \text{Quality}$$

A GEE score of 100% represents the highest degree of production perfection with no downtime, maximum speed, and no quality issues. In reality, the GEE score of 85% is considered exceptional, and the typical worth is 60%.

While GEE originated in factories, the principles are also applicable to construction sites that rely on equipment like cranes, excavators, concrete pumps, and more. By tracing GEE, contractors can recognize inefficiencies, simplify processes, and increase the utilization of expensive machinery and labor.

Some examples of the worth of GEE on building projects include:

- Scheduling preventive maintenance during periods of planned absence to maximize availability.
- Investigating the causes of minor pauses and standstills in order to enhance performance.
- Measuring the quality of the product via rework and defects.
- Comparing the OEE score of projects and processes in terms of benchmarks.
- Identifying the limitations and bottlenecks of the workflow.

Leading companies in construction are already taking part in GEE as a part of their lean construction strategies and initiatives to increase productivity and profitability. While GEE shouldn't be the sole metric employed, it provides an invaluable insight into equipment-based processes. As with any other manufacturing process, increasing GEE is a pursuit of continual improvement. However, in an industry characterized by wastefulness and overruns in the schedule, overall equipment effectiveness may be of paramount importance to contractors in maximizing the return on their capital investments in equipment.

2. Earned Worth Control. EWC combines cost, schedule, and scope in order to assess the performance of projects and predict future results. It facilitates the identification of differences early on and ensures that you stay on course.

Construction projects are complex endeavors involving many moving pieces, deliverables, and stakeholders. It's all too easy for projects to drift over budgets and behind schedule without careful monitoring and course correction. This is where Earned Worth Control comes in – a methodology to objectively measure project performance and forecast future progress.

What is Earned Worth Control? Earned Worth Control is a project management methodology that integrates scope, schedule, and resource management into a unified system. It enables project managers to quantify the "earned worth" of work accomplished at any given point during the project timeline. This earned worth is then compared against the planned worth for that work as well as the actual costs incurred. The power of EWC lies in the analysis of three critical variables:

- Planned Worth (PW) – The budgeted cost for the scheduled work that should have been completed.
- Earned Worth (EW) – The measure of work that has actually been accomplished, expressed as the budgeted cost for that work.

- Actual Cost (AC) – The real costs incurred for the work that has been completed.

By comparing this worth using straightforward calculations, EWC generates key performance indicators such as schedule variance (SV) and cost variance (CV). From these components, several key performance indicators can be derived:

- Schedule Variance (SV): $EW - PW$. Indicates whether the project is ahead or behind schedule.
- Cost Variance (CV): $EW - AC$. Indicates whether the project is under or over budget.
- Schedule Performance Index (SPI): EW / PW . A ratio indicating schedule efficiency.
- Cost Performance Index (CPI): EW / AC . A ratio indicating cost efficiency.

These indicators enable project managers to identify potential issues early on and swiftly determine if the project is progressing ahead of schedule, behind schedule, over budget or under budget.

Originally developed for manufacturing and government projects, Earned Worth Control has increasingly proven its worth in the construction industry. Some key applications of this methodology include:

- Project Monitoring and Forecasting: EWC provides an objective, quantitative perspective on a project's current status. Performance indices enable forecasting of future project costs and estimated completion dates.
- Risk Mitigation: Variances identified through EWC highlight potential risks to the budget and schedule. Root causes can be analyzed, and corrective actions taken proactively before issues escalate.
- Progress Reporting: Standardized EWC metrics facilitate reliable, auditable progress reports for all stakeholders, eliminating subjective percentage completion estimates.
- Resource Optimization: EWC reveals which areas of a project are performing well or poorly, allowing project managers to reallocate resources for maximum influence.

EWC is fully scalable and can be applied to construction projects of any size. It mitigates "surprise" factors by providing early insights into performance trends and issues. While EWC requires some initial setup and baseline establishment, the benefits of objective progress tracking quickly outweigh the costs on complex projects.

In today's fast-paced construction environments, reactive management can be disastrous. Companies that embrace Earned Worth Control gain powerful foresight, enabling them to keep projects on track and deliver maximum worth to clients and shareholders.

3. Customer Contentment Index. Construction companies measure customer contentment through various means, including surveys, feedback forms, and

project evaluations. High customer satisfaction scores indicate successful project delivery and increase the likelihood of repeat business and referrals from satisfied customers.

In the highly competitive construction industry, delivering an exceptional final product is the minimum requirement. Top firms must surpass customer expectations throughout the entire project lifecycle – from the initial bidding and pre-construction phases to execution and commissioning. One powerful metric that construction companies are utilizing is the Customer Contentment Index to continuously enhance customer relationships and improve service delivery.

The Customer Contentment Index is an industry-standard, survey-based measurement tool used to quantify a customer's satisfaction with a company's products, services, and overall working relationship. CCI scores are typically tracked annually, allowing companies to benchmark their performance over time and compare themselves to industry averages. While the specific questions may vary across different surveys, CCI generally covers key dimensions such as:

- Quality of work and deliverables;
- Effectiveness of project management;
- Responsiveness and communication;
- Adherence to health and safety standards;
- Adherence to schedules and budgets;
- Overall worth for money spent;
- Likelihood of using the vendor again.

Customers anonymously rate their satisfaction level on a numeric scale, often from 1 to 10. Scores above 8 are generally considered "excellent," while anything below 6 or 7 raises concerns about systemic customer service issues.

In an industry where multi-million-dollar projects hinge on one-off bids, maintaining strong customer relationships is crucial for securing repeat business and referrals. Monitoring the Customer Contentment Index provides construction firms with invaluable feedback to enhance their operations and keep clients satisfied throughout every phase of a project. Some specific benefits of tracking CCI include:

- Identifying service strengths and weaknesses.
- Benchmarking performance against competitors.
- Improving responsiveness to customer needs.
- Fostering greater collaboration and transparency.
- Increasing chances of negotiated or repeat work.
- Enhancing the company's reputation and referrals.

Leading construction companies in client experience are placing greater emphasis on CCI programs. By meticulously collecting and responding to customer feedback, they ensure that rigorous quality, safety, and service standards are upheld on every job site.

Monitoring CCI allows issues to be resolved before they escalate.

Average the index score for each parameter and then combine them to get an overall contentment index. The formula may look like this:

$$CCI = \Sigma(\text{Dimension Scores})/\text{Number of Dimensions}$$

The Customer Contentment Index is a crucial metric in the construction industry, offering important insights into customer perceptions and experiences. By systematically measuring and analyzing customer contentment, construction companies can improve their performance, strengthen customer relationships, and achieve greater success in their projects. Despite the challenges, the advantages of implementing a robust Customer Contentment Index program significantly outweigh the costs, making it an essential element of contemporary construction management. In the fiercely competitive construction landscape, merely meeting specifications is insufficient. Firms that truly understand their customers' needs and prioritize satisfaction will be well-positioned for long-term success and growth.

4. Change Order Periodicity and Influence. Monitoring the periodicity and influence of change orders is crucial for assessing project complexity, scope creep, and contract management effectiveness in the construction industry. Minimizing change orders enhances project profitability and client satisfaction.

Changes are inevitable in the world of construction. Projects evolve due to client requests, unforeseen site conditions, design modifications, and various other factors. While some changes are unavoidable, an excessive number of change orders can disrupt schedules, inflate budgets, and negatively influence profitability. This is why tracking the periodicity and influence of change orders has become essential for construction firms.

A change order is a formal amendment to the original construction contract that modifies the scope, schedule, and/or pricing. Changes are priced, reviewed, and approved by all stakeholders before implementation. Typical drivers for change orders include:

- owner-requested changes;
- design errors or omissions;
- differing site conditions;
- substitutions or worth engineering;
- changes to regulatory or code requirements.

Change order frequency refers to how often these revisions occur throughout the project's duration. Influence measures the cumulative effect of changes on the overall cost, schedule, and performance.

While an occasional minor change order may seem harmless, as they accumulate, the collective influence can significantly erode productivity and profits. Some key consequences of excessive change orders include:

- schedule delays due to rework and additional tasks;

- increased costs for labor, materials, and equipment;
- disrupted workflow and lost efficiency;
- degraded quality from constant revisions;
- strained client/vendor relationships;
- diminished employee morale and turnover.

Studies suggest that ideal change order rates should be under 2–3% of the original contract worth for successful projects. Rates exceeding 10% tend to correlate with severely influenced outcomes, such as contractor losses and claims or disputes.

While some changes are inevitable, construction firms can employ strategies to mitigate excessive change orders, such as thorough pre-construction planning and reviews, rigorous site inspections and surveys, detailed and coordinated drawings and documents, clear roles, communication protocols, and approvals, proactive issue tracking and resolution, and comprehensive workforce training.

By continuously tracking and analyzing change order metrics, firms gain insights into operational issues driving changes. This enables targeted process improvements and more effective risk management.

In the construction industry, where profit margins are often thin, firms that prioritize change order prevention and rapidly adapt when adjustments are needed will consistently deliver more successful outcomes for clients and better financial results.

5. Indicators of Ecological Sustainability. Crucial performance pointers affiliated to energy consumption, waste generation, and carbon emigrations reflect a construction association's commitment to sustainability. Achieving sustainability targets contributes to environmental stewardship and enhances brand character. The construction assiduity faces a growing challenge structure structures while minimizing environmental influence. To achieve this, a shift towards sustainable construction practices is essential. Then is where environmental sustainability criteria come into play.

Why Measure Sustainability? Ecological sustainability in construction goes beyond just using recycled accoutrements. It's a holistic approach that considers the entire lifecycle of a structure, from material sourcing and construction to operation and eventual obliteration.

Effectively enforcing criteria and crucial performance pointers requires careful planning, stakeholder alignment, and robust data operation systems. Then are some stylish practices for using these tools:

- Define clear objects and performance targets aligned with organizational pretensions.
- Select applicable criteria and crucial performance pointers acclimatized to the unique requirements and precedence of each construction design.

- Establish birth measures to track progress over time and identify areas for enhancement.
- use technology results, similar as construction operation software and data analytics platforms, to streamline data collection, analysis, and reporting.
- Foster a culture of responsibility and nonstop enhancement by regularly reviewing performance criteria and crucial performance pointers with design brigades and stakeholders.

Ecological sustainability criteria equip construction companies with precious data to make informed opinions that minimize environmental influence. By embracing these criteria and enforcing sustainable practices, the construction assiduity can make a greener future, one design at a time. Key Indicators of Ecological Sustainability:

- Carbon Footprint: This metric quantifies the total greenhouse gas emissions generated directly and indirectly by construction activities, encompassing emissions from material production and transportation, on-site energy usage, and waste management.
- Energy Consumption: Monitoring energy usage in construction identifies opportunities for enhancing energy efficiency, covering both the energy consumed during the construction process and the operational energy use of completed buildings.
- Water Usage: Tracking water consumption in construction projects is essential, particularly in areas experiencing water scarcity. This metric includes water used in construction activities, such as dust suppression and concrete mixing, as well as water usage throughout the building's lifecycle.
- Waste Management: This involves tracking the types and quantities of waste produced on-site and the methods for disposal or recycling. Effective waste management minimizes landfill use and encourages the recycling and reuse of materials.

- Site Biodiversity Influence: This metric assesses the effects of construction activities on local ecosystems and biodiversity, evaluating habitat disruption, species displacement, and efforts to restore or enhance biodiversity.

- Sustainable Site Development: This includes metrics related to site selection, development density, and the conservation of natural features. Sustainable site development aims to minimize environmental influence and promote green spaces.

Ecological sustainability metrics are essential for steering the construction industry towards more sustainable practices. By systematically measuring and managing the environmental influences of construction activities, companies can reduce their carbon footprint, conserve resources, and contribute to a healthier planet. Implementing these metrics requires dedication, collaboration, and continuous improvement, but the benefits – from regulatory compliance to enhanced reputation and long-term viability – make it a valuable investment.

Conclusions

Defining and monitoring performance criteria and parameters is a key aspect of effective planning and delivery of construction projects. It optimizes cost, time, quality, safety and productivity to ensure projects are completed on time and within budget. Measuring the success of construction projects requires a holistic approach that goes beyond traditional measures such as time and cost. Using a range of metrics and key performance indicators, construction companies can gain insight into project performance, resource utilization, customer satisfaction and sustainability. Skilled use of these tools enables construction professionals to drive operational excellence, successfully complete projects and achieve ongoing business prosperity.

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КРИТЕРІЇ ТА ОСНОВНІ ПАРАМЕТРИ ПРОДУКТИВНОСТІ ПЛАНІВ БУДІВЕЛЬНИХ РОБІТ

Анотація. Визначено важливість критеріїв та ключових показників ефективності, що керуються даними, для успіху проєктів цивільного будівництва. Будівельна галузь процвітає завдяки виконанню проєктів вчасно, в рамках бюджету та суворих стандартів якості. Але як виміряти успіх у такій складній сфері? Тут задіяні критерії та ключові показники ефективності. Відстежуючи правильні точки даних, будівельні компанії можуть отримати уявлення про свої робочі плани, визначити сфери для вдосконалення, а отже, досягти кращих результатів проєкту. У динамічному світі будівництва успіх залежить не лише від виконання проєктів вчасно та в межах бюджету, а й від постійного вдосконалення процесів та результатів. Щоб досягти цього, будівельні організації покладаються на потужні метрики та ключові показники ефективності для якісного вимірювання і відстеження процесу. У цій статті розглянуто ключові критерії та ключові показники ефективності, які мають вирішальне значення для оцінки успіху будівельного проєкту. Вимірювання успіху будівельного проєкту потребує багатогранного підходу, який виходить за рамки традиційних вимірювань часу і витрат. Використовуючи різноманітні критерії та ключові показники ефективності, будівельні організації можуть отримати всебічне уявлення про продуктивність проєкту, використання ресурсів, задоволеність клієнтів і стійкість. Мета статті – допомогти будівельним компаніям ефективно використовувати ключові показники ефективності: описати переваги ключових показників ефективності, зокрема покращення процесу прийняття рішень і підвищення ефективності. Ефективно використовуючи ці інструменти, професіонали з будівництва можуть досягти операційної досконалості, реалізувати успішні проєкти та досягти довгострокового успіху в бізнесі. Запровадивши надійну систему ключових показників ефективності, будівельні компанії можуть отримати чітке уявлення про те, як виконуються їхні робочі плани. Цей підхід на основі даних дає змогу активно адаптуватися, покращувати результати проєкту та досягти довгострокового успіху.

Ключові слова: параметри продуктивності; будівельна організація; оптимізація; контроль; ефективність; моніторинг; ключові показники

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