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From local improvement to operational excellence: integrating lean six sigma, process management, and performance measurement systems.

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From local improvement to operational excellence: integrating lean six sigma systems, process management and performance measurement

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SUMMARY

This article analyzes, through narrative review and conceptual integration, how organizations can combine Lean principles, the structured logic of Six Sigma, process management, and performance measurement systems to transform isolated improvement initiatives into a system of operational excellence. It discusses the transition from AS IS diagnosis to TO BE design, the use of Value Stream Mapping, DMAIC, PDCA, and Kaizen, the selection of indicators capable of connecting quality, flow, capacity, reliability, cost, and safety, as well as the governance mechanisms necessary to sustain gains over time. The analysis emphasizes that operational efficiency should not be confused with indiscriminate cost reduction: it is about increasing the capacity to deliver value with less variability, waste, and risk, while preserving regulatory and strategic requirements. Finally, it proposes an integrated architecture for continuous improvement based on evidence, management cadence, and organizational learning.

Keywords: operational excellence; Lean Six Sigma; process management; performance indicators; continuous improvement; operational governance.

ABSTRACT

This article examines, through a narrative review and conceptual integration, how organizations can combine Lean principles, the structured logic of Six Sigma, process management, and performance measurement systems to transform isolated improvement initiatives into an operational excellence system. It discusses the transition from AS IS diagnosis to TO BE design, the use of Value Stream Mapping, DMAIC, PDCA, and Kaizen, the selection of indicators linking quality, flow, capacity, reliability, cost, and safety, and the governance mechanisms required to sustain gains over time. The analysis stresses that operational efficiency should not be confused with indiscriminate cost cutting; rather, it involves increasing the ability to deliver value with lower variability, waste, and risk while preserving regulatory and strategic requirements. An integrated architecture for evidence-based continuous improvement, management cadence, and organizational learning is proposed.

Keywords: operational excellence; Lean Six Sigma; process management; performance indicators; continuous improvement; operational governance.

INTRODUCTION

The pursuit of operational excellence is no longer an agenda restricted to the factory floor and has become...

to occupy a central position in the strategy of industrial, service, and regulated organizations.

Pressures for productivity, quality, traceability, speed, and predictability necessitate...

companies need to understand their processes as interdependent systems, in which local decisions

They can produce adverse effects at other stages of the chain. Operations literature shows that

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Metrics form an essential link between strategy, execution, and value creation, which requires...
deliberate design of measurement systems, and not just the accumulation of available indicators.
(MELNYK et al., 2004).

In the field of continuous improvement, Lean thinking guides the identification of value from a perspective...
From the client's perspective, visualizing the workflow and eliminating resource-consuming activities that do not contribute to the overall experience are key.
for the expected result. Value Stream Mapping allows for the joint representation of flows of
materials and information, offering a systemic view of the current state and the future state. This
This perspective reduces the risk of one-off optimizations that improve a single step while shifting queues.
inventory, rework, or variability for another part of the process (WOMACK; JONES, 2003).

Six Sigma, in turn, adds analytical discipline to improvement, especially through DMAIC.
; define, measure, analyze, improve and control ; a structure that organizes complex problems into
Verifiable steps. The integration between Lean and Six Sigma makes it possible to address them simultaneously.
Waste, flow, defects, and variability. However, tools alone do not guarantee results.
Same: lasting gains depend on governance, defining responsibilities, and standards.
operational mechanisms, control systems, and indicators that quickly reveal deviations and trends.
(ASQ, 2025).

This article aims to systematize an integrated approach to operational excellence.
articulating process management, Lean Six Sigma, AS IS/TO BE design, key indicators of
Performance and governance. The focus is didactic and conceptual and incorporates, as an application resource,
Illustrative and anonymized examples derived from the author's professional work in improvement.
Continuous management of indicators and economic-operational evaluation. These examples do not constitute
Primary data and identifiable case studies are not used; they serve to demonstrate how the concepts...
They can support decisions in different organizational contexts.

2. METHODOLOGY

The study adopts a narrative literature review and integrative conceptual analysis. Works were prioritized.
Classic articles on operations management and continuous improvement, articles on measurement systems.
Performance and recognized institutional sources, including the American Society for Quality, Lean
Enterprise Institute, National Institute of Standards and Technology and International Organization for
Standardization. The review was limited to references published up to 2025.

The analysis strategy was organized into four axes: process design and visualization; solution
Structured problem-solving; performance measurement; and governance to sustain results.
In each axis, recurring concepts, complementary relationships, and risks were identified.

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Fragmented application. The purpose was not to perform meta-analysis, estimate causal effect, or compare.
statistically improved methods.

For the construction of the synthesis, concepts from Lean, DMAIC, PDCA, Kaizen, and management by indicators were used.
They were examined according to their function in the improvement cycle. Tools were treated as
components of a system and not ends in themselves. Thus, the central criterion of integration
It was the ability of each component to contribute to diagnosis, prioritization, intervention, and control.
and learning.

As a limitation, the narrative nature of the study does not allow for statistical generalizations nor does it replace statistical methods.
Empirical validations in specific sectors. The proposed architecture should be understood as
A reference for managerial design. Its application requires adaptation to the context, risks, and constraints.
regulatory requirements, data maturity, and the strategic objectives of each organization.

3. Operational Excellence, Processes, and Performance Governance

Operational excellence presupposes a management architecture capable of articulating processes and methods.
problem-solving, measurement systems, and governance mechanisms. The literature on
Performance demonstrates that isolated measures have limited utility when they are not related to...
strategy, operational environment, and the decisions they are intended to guide. For this reason, the
Performance should be understood as a system of relationships between flow, quality, capacity,
cost, reliability and risk, and not as the sum of independent indicators (NEELY; GREGORY;
PLATTS, 1995; MELNYK; STEWART; SWINK, 2004).

From a Lean perspective, this integration begins with understanding the value stream and...
Systematic identification of activities that consume resources without increasing the value delivered.
Womack and Jones (2003) associate Lean maturity with the ability to see the end-to-end flow.
to promote continuous improvement with a value-oriented approach. In parallel, the logic of DMAIC
It adds analytical discipline to the identification of causes and the control of results, while
KPI systems make the effects of interventions observable and comparable over time.
(ASQ, 2025; LEAN ENTERPRISE INSTITUTE, 2025).

Governance completes this system by establishing responsibilities, decision criteria, and standards.
of data and monitoring routines. Operational excellence, therefore, is not limited to the application
of tools. It depends on the institutional capacity to transform diagnosis into intervention.
Intervention with measurable results and results in learning embedded in the processes. This
This reading guides the following subsections and allows for an integrated examination of processes and methods.

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improvement, indicators, capacity, financial effects, standardization and risk management (ISO, 2018; NIST, 2013).

3.1 Processes as Value Creation Systems

Organizational processes are sequences of activities that transform inputs into outputs for Internal or external clients. Performance analysis should transcend departmental boundaries. Because value is produced along flows that traverse functions, systems, decisions, and interfaces. When management remains overly functional, each area tends to optimize its own... objectives, creating conflicts of priority, waiting times and unnecessary transfers. Lean thinking contributes by shifting attention from isolated resources to the value stream. Womack and Jones (2003) structure Lean around value, value stream, continuous flow, Pull production and the pursuit of perfection. This logic does not mean eliminating inventory or personnel. indiscriminate approach; it means understanding which activities are necessary and which add value. and which represent waste that can be reduced without compromising quality and safety. or conformity.

Value Stream Mapping is particularly useful because it represents material and information in a same vision. The current state map documents how the process actually works, while the The future state explicitly outlines a desired design. The Lean Enterprise Institute highlights that VSM helps to... To visualize the entire flow and identify sources of waste, as well as create a common language. for improvement decisions (LEAN ENTERPRISE INSTITUTE, 2025).

The quality of the diagnosis depends on observing the actual work and the reliability of the data. Formal procedures may differ from how tasks are actually performed. Therefore, Interviews, direct observation, record analysis, cycle times, queues, rework, and error rates. They should be triangulated. An overly idealized map produces a future state based on weak premises.

The TO BE design should be guided by explicit principles and constraints. It is necessary to define which... Problems will be solved, what requirements are non-negotiable, and what indicators will prove the... Improvement. Process transformation becomes more robust when the new design reduces complexity clarifies responsibilities, brings decisions closer to the point of occurrence of the problem and It establishes mechanisms for the rapid detection of deviations.

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3.2 DMAIC, PDCA, AND KAIZEN AS COMPLEMENTARY LOGICS

DMAIC offers a disciplined sequence for addressing problems in existing processes that do not
They meet performance standards or expectations. In the Define phase, the problem, the scope, the clients
and the objectives are defined. Measure establishes the baseline and the quality of the measurement. Analyze
Investigates causes. Improve selects and tests solutions. Control creates conditions so that the gain does not...
loss after project closure (ASQ, 2025).

PDCA presents a similar logic of iterative learning: plan the change, execute it in
controlled scale, verify results and act on learning. Its value lies less in the acronym and
more in the discipline of transforming hypotheses into verifiable cycles. In mature organizations, the
PDCA can be used in daily management routines, while DMAIC is reserved for more complex problems.
complex, higher-risk, or requiring more structured statistical analysis.

Kaizen adds the cultural dimension of continuous improvement. Small, frequent improvements can...
produce relevant effects when inserted into a system that captures problems and prioritizes
It creates opportunities and disseminates standards. This logic is consistent with the tradition of the Toyota Production System.
Production, in which continuous improvement and waste elimination are treated as key components.
of the management system (OHNO, 1988). The risk arises when Kaizen events are used as actions
episodic, disconnected from strategic objectives, or without subsequent follow-up. In this
In this situation, the organization accumulates initiatives, but not necessarily the capacity for improvement.

The choice of methodology should follow the nature of the problem. Simple and well-defined questions
Problems with multiple issues can be resolved through visual management and a short PDCA cycle; problems with multiple issues can also be solved.
Causes, significant variability, or high risk may require DMAIC. Flow changes
Cross-functional approaches may require VSM (Visual Market Sense) before selecting solutions. This differentiation avoids both...
The bureaucratization of simple problems, as well as the superficial treatment of complex problems, can all contribute to their inefficiency.

Methodological integration also reduces so-called solution jumping, that is, the tendency to
Implementing a solution before properly understanding the problem. The analysis phase should
Separate symptoms from causes, test plausible relationships, and verify the reliability of the measurement system.
Without this discipline, apparent improvements may only shift costs, delays, or risks elsewhere.
point in the process.

3.3 Indicators, KPIs and the Measurement Architecture

A KPI is not just a relevant number; it's a metric associated with a goal, a definition.
operational, a data source, a frequency, a responsible party, and a decision-making mechanism. Neely,

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Gregory and Platts (1995) demonstrate that the design of measurement systems needs to consider
Individual measures, the set of measures, and the relationship of this system to the organizational environment.
The proliferation of indicators without hierarchy can increase noise instead of knowledge.
Kaplan and Norton (1992) drew attention to the limitations of exclusively centered systems.
in financial measures. Financial indicators remain indispensable, but are
mostly accumulated results. Operational management also requires measures.
background factors, such as source quality, adherence to plan, lead time, availability, rework,
Safety and reliability. The balance between outcome and process indicators increases...
The ability to intervene before losses materialize.
NIST recommends that measures be relevant, comprehensive, accurate, timely, and useful for decision-making.
These characteristics offer a practical criterion for auditing dashboards: if an indicator does not
influences a decision, has no one responsible, or arrives too late to allow action, its
The presence of information should be questioned. The quality of the information is as important as the aesthetics of the presentation.
visualization (NIST, 2013).
Indicators also need to avoid perverse incentives. Measuring only volume produced can...
To stimulate overproduction; measuring only machine utilization may increase inventory; measuring only
Unit cost can mask deterioration in quality or lead time. Balanced systems make
explicit trade-offs prevent a single indicator from being maximized at the expense of performance.
global. The need for consistency between individual measurements and the measurement system is discussed by
Neely, Gregory, and Platts (1995).
KPI governance should include a metrics dictionary, calculation rules, official source, and control of...
Version control and exception handling. In environments with multiple systems, conceptual divergences arise.
This can lead to meetings dedicated to discussing which number is correct, instead of discussing what to do.
Semantic standardization is therefore part of operational excellence.
Considering the professional experience reported by the author, it is possible to formulate, for didactic purposes...
and without identifying specific organizations or outcomes, an example involving governance
of indicators in an operation in which different areas used different definitions for a
same performance measure. The review of the KPI dictionary, official sources and the
Responsibility for each indicator reduced discussions about which number should prevail and
The management meeting shifted towards analyzing root causes and developing action plans. The lesson learned is that...
Indicator governance is not an ancillary activity: it determines whether the organization can...
Transforming data into comparable decisions over time.

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3.4 CAPACITY, FLOW AND VARIABILITY

Operations are systems subject to capacity and variability constraints. Nominal capacity
It rarely corresponds to the effective capacity, due to downtime, setups, product mix, absenteeism,
Quality and availability of materials reduce truly productive time. Robust planning
It should work based on demonstrated capacity and demand scenarios, avoiding compromises.
based on averages that do not represent peaks and dispersions.
Lead time is a systemic measure because it incorporates processing and waiting times. In many workflows, the
The effective transformation time represents a small fraction of the total time. Reducing queues,
Transfers and batch processing can generate more speed than simply speeding up an activity.
VSM makes this difference visible and allows for prioritizing interventions where time does not add value.
Variability affects predictability and service level. Processes with an acceptable average may
This results in a dispersion incompatible with SLAs. Six Sigma emphasizes precisely the reduction of variation.
and defects through data and root cause analysis. However, the application of statistical tools
It requires reliable data, a consistent definition of defects, and an understanding of process conditions.
Production planning and control must connect demand, capacity, inventory, and priorities.
In highly variety-rich environments, simple sequencing rules can fail when not...
They consider critical constraints. Visual load versus capacity management, combined with review.
Periodic bottleneck assessments provide a more transparent basis for deadline commitments.
The improvement in flow should be evaluated by systemic effects. A reduction in time in a given area...
This step may not change the total lead time if the bottleneck is elsewhere. The logic of improvement
Continuous monitoring requires before-and-after measurements, observing system behavior, and updating the diagnosis.
when the constraint changes. This guidance is consistent with the value stream view presented by
Womack and Jones (2003).

3.5 Continuous Improvement and Conversion of Operational Gain into FINANCIAL RESULT

Operational improvement only translates into economic benefit when the organization identifies the
The mechanism by which technical gain alters costs, revenue, assets, working capital, or risk. Reduce
Cycle time, rework, or movement can free up capacity and improve performance without
to automatically produce an equivalent reduction in expenditure during the period. The financial reading
You need to distinguish between efficiency created and cash flow actually realized.

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This distinction is especially important in Lean projects. Eliminating waste can create...
Available capacity previously occupied by waiting, rework, or non-value-added activities. If this
capacity is absorbed by growth, reduction of overtime, postponement of hiring,
Whether it's the divestment of assets or another economic decision, the benefit tends to become more apparent.
Clear. If it remains idle without a change in cost or revenue, the operating gain exists, but its
The financial conversion has not yet occurred.

The literature on Lean Management Accounting draws attention to this difference between improvement and...
Financial process and recognition. The Lean Enterprise Institute highlights that accounting
Management must produce information capable of linking continuous improvement to customer value.
Growth, profitability, and cash flow, preventing traditional systems from influencing decisions.
incompatible with Lean logic (LEAN ENTERPRISE INSTITUTE, 2026).

An illustrative example, anonymized and derived from the author's professional experience, is that of a
An initiative that reduces processing time and frees up team hours. Address all hours freed up.
The analysis suggests that immediate economics would overestimate the impact if the payroll remained unchanged.
Correctly identifies the destination of the capacity: absorption of additional demand, reduction of overtime,
Postponement of new hires or effective elimination of expenses.

The same logic applies to inventory and working capital. An improvement that reduces batches, queues, or materials.
The process can free up cash without necessarily immediately altering the accounting margin. On the other hand
On the other hand, an initiative presented as a cost reduction may simply transfer the expense to another [situation/purpose].
center, increase inventory, or deteriorate service level. Financial validation should consider the effect.
liquid and systemic.

Thus, the governance of improvement projects can include an explicit link between indicators.
Operational and financial indicator. Before implementation, the baseline and the mechanism are defined.
value generation, the person responsible for capturing it, and the expected timeframe; then, the
results obtained with the original hypothesis. This discipline reduces the practice of accounting as
Savings values that represent only potential capacity or benefits not yet converted into...
result.

3.6 Standardization, Control and Sustainability of Profits

Improvements that are not incorporated into the standard work process tend to regress. The Control phase of
DMAIC emphasizes control plans, procedures, monitoring, and response mechanisms.
The standard should record the best known way to perform the activity at that moment, without being...
Treated as an immutable document. Standardization creates a basis for training, auditing, and new developments.

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Improvement. The Control phase of DMAIC formalizes this concern with sustaining the results.
(ASQ, 2025).

Effective controls must be proportionate to the risk. Critical processes may require segregation of
Functions, validations, traceability, and double-checking; low-risk processes can operate with
Lighter controls. Excessive manual controls increase costs and can create new sources of...
Error. Automation should be considered when it reduces variability and improves traceability, since
that the underlying process is sufficiently understood.

Visual management and short performance meetings help bring information closer to action. A whiteboard
Daily management should highlight goals, results, deviations, responsible parties, and deadlines, avoiding...
Lengthy presentations without decisions. The cadence creates working memory and allows for scaling.
problems that exceed the team's autonomy.

Process audits should verify adherence and effectiveness, not just the existence of documentation.
A procedure may be formally up-to-date and yet still be impractical. A mature audit
It seeks to understand why deviations occur, distinguishing between design flaws, training, resources,
Incentives and supervision.

Sustainability also depends on leadership. When managers treat improvement as a project...
Temporary, teams realize that the priority will disappear over time. Excellence
Operational work requires constancy of purpose, willingness to remove barriers, and discipline to...
Review results even when there is no apparent crisis.

3.7 GOVERNANCE, RISK AND ORGANIZATIONAL LEARNING

Operational excellence and risk management are complementary agendas. ISO 31000 establishes
principles for integrating risk into governance, strategy, planning, and processes. This means that
An efficiency initiative should consider not only cost or speed gains, but also...
exposure to failures, compliance, safety, continuity and reputation (ISO, 2018).

Prioritizing improvements can combine economic impact, customer impact, risk, effort, and
dependencies. Explicit criteria reduce the influence of political urgencies or perceptions.
Individual initiatives. A balanced portfolio should contain quick actions, structuring projects, and initiatives.
prevention, avoiding exclusive focus on problems that have already materialized.

Organizational learning occurs when project outcomes are converted into standards.
Training, decision-making rules, and reusable knowledge. Without this mechanism, teams repeat mistakes.
Diagnostics and errors. A3 repositories, lessons learned, root cause analysis, and patterns can support this.
this memory, provided that they are easy to consult and linked to real routines.

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Data governance is part of this learning process. Indicators need to be traceable from the very beginning.
From the source to the dashboard, and rule changes must be documented. Inconsistent data
They weaken trust and can lead to misguided decisions. In digitized operations, quality
Data quality should be treated as process quality.

Finally, the maturity of operational excellence can be observed in the transition from a logic...
A shift from a reactive to a preventative approach. Less mature organizations only act when goals are missed;
More mature organizations detect early signs, learn from small anomalies, and...
They adjust processes before the problem escalates. This capability results from the integration between
Methodology, data, governance, and culture.

Sectoral data helps to demonstrate why operational excellence cannot be represented by
artificially uniform indicators. In 2025, the Bureau of Labor Statistics recorded an increase of
Productivity increased in 41 out of 85 manufacturing and mining industries, while production fell in 66 and
Working hours decreased by 52. Only seven industries saw simultaneous increases.
Production and hours. The heterogeneity highlights that operational performance should be interpreted
by multiple signals and in context, and not by standardized indices without empirical basis. (US
BUREAU OF LABOR STATISTICS, 2026).

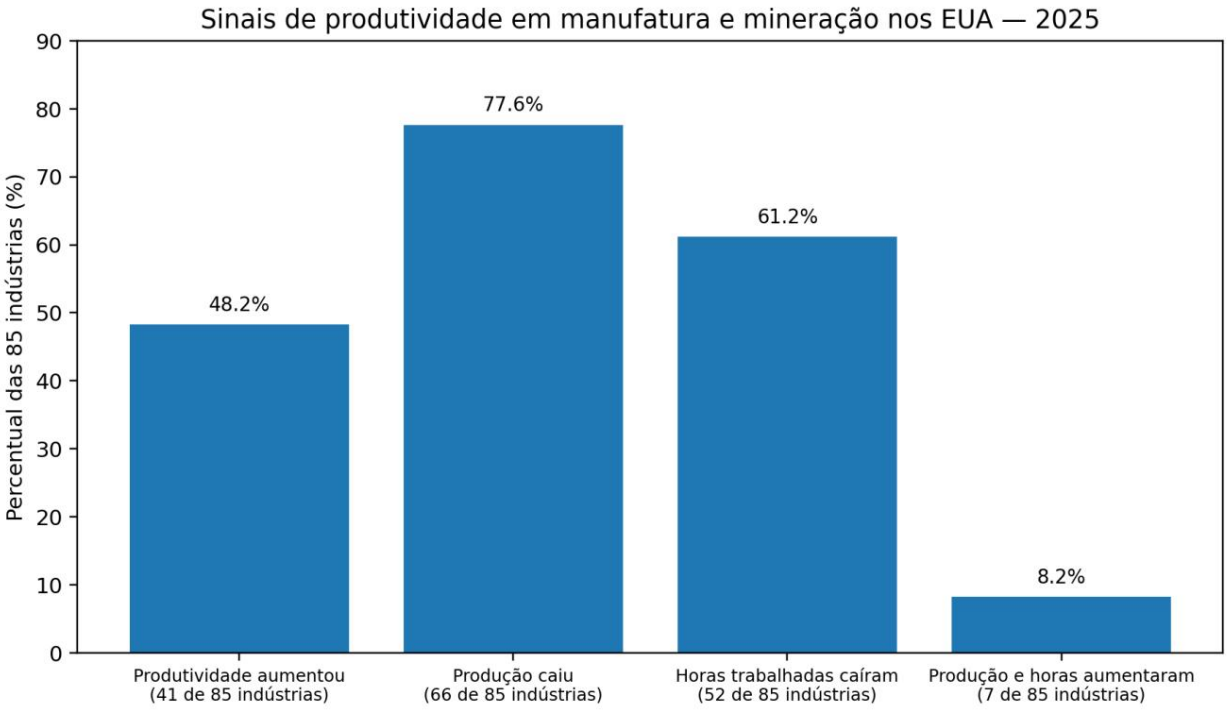

Figure 1 - Selected productivity indicators in 85 manufacturing and mining industries
of the United States in 2025. Source: US Bureau of Labor Statistics (2026). Percentages calculated.
based on counts published by the BLS.

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CONCLUSION

Operational excellence should be understood as a management system, not a collection of attributes.
tools. Lean, Six Sigma, PDCA, Kaizen, process mapping and KPIs generate greater
value when connected by a common logic of diagnosis, prioritization, intervention, control and
learning.
The starting point is understanding the actual flow. AS IS maps and Value Stream Mapping make this possible.
visible interfaces, waiting times, rework, decisions, and information flows that frequently
They remain hidden within functional structures. The TO BE design must address these problems.
demonstrated and respecting quality, safety and compliance requirements.
DMAIC offers a particularly useful discipline for complex and higher-risk problems.
While PDCA and Kaizen can support faster learning cycles. Maturity
The managerial aspect lies in selecting the approach that is proportionate to the problem, avoiding both excess and...
Method as much as improvisation.
Measurement systems are central elements because they connect strategy and execution. Indicators
They should be few enough to guide focus and comprehensive enough to reveal trade-offs.
Quality, deadlines, productivity, reliability, cost, and safety need to be analyzed in a way that...
integrated.
The reliability of the data determines the reliability of the decision. Metrics dictionaries, sources
Officials, calculation rules, and designated accountees reduce semantic disputes and strengthen governance.
Dashboards should function as decision-making tools, not as information showcases.
Sustaining gains depends on incorporating improvements into the work standard, to
Training, controls, and management cadence. Without this institutionalization, results tend to...
It depends on individuals and deteriorates when managerial attention shifts.
Integration with risk management enhances the quality of the transformation. Efficiency that weakens
Controls, safety, or continuity do not constitute operational excellence. ISO 31000 reinforces that...
The need to consider risks in the context of strategy and governance.
It can be concluded that organizations capable of combining systemic vision, improvement methods, and data...
Reliable resources and governance create superior conditions for sustainable productivity. This proposal
This article is conceptual and should be adapted to each context, but it offers a basis for transformation.
Continuous improvement in ongoing organizational capacity.

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