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Real-Time KPI Monitoring in Pharma Using Qlik Sense with Advanced Set Analysis

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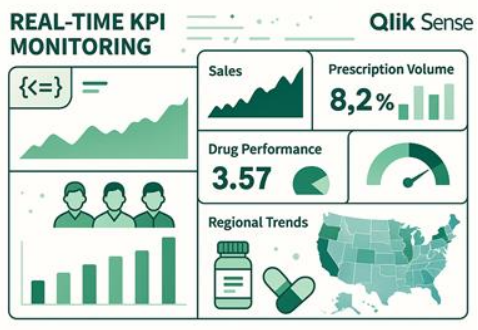
Abstract – In the pharmaceutical industry, where data accuracy, regulatory compliance, and operational responsiveness are critical, real-time monitoring of Key Performance Indicators (KPIs) has become a strategic necessity. This article explores how Qlik Sense, combined with advanced Set Analysis, can empower pharma organizations to gain immediate insights into essential metrics such as batch performance, regulatory adherence, and manufacturing efficiency. We discuss the unique challenges of real-time data integration from multiple systems like ERP, MES, and LIMS, and demonstrate how Qlik Sense's data engine supports high-frequency updates without compromising performance. A deep dive into Set Analysis showcases its power in filtering data contextually for specific products, time frames, and production sites—enabling dynamic, user-driven analysis. Through real-world design principles and a case study of a global pharma firm, the article illustrates how intuitive dashboards and automated alerts drive faster, data-informed decision-making.

Keywords – Qlik Sense, KPI Monitoring, Pharmaceutical BI, Pharma Dashboards, Qlik Alerting.

I. INTRODUCTION



The pharmaceutical KPIs

The pharmaceutical industry is highly data-driven, where real-time insights can make the difference between operational efficiency and costly delays. From manufacturing to quality assurance, and from R&D to regulatory compliance, decisions in pharma rely on up-to-date, accurate Key Performance Indicators (KPIs). Traditional business intelligence (BI) approaches, however, often rely on batch-processed reports or weekly snapshots, which lag behind the rapid pace of events in labs, plants, and markets. This time lag limits responsiveness and can lead to missed opportunities or compliance risks.

Modern BI platforms like Qlik Sense are transforming how pharma companies monitor their operations by offering real-time, interactive, and user-centric dashboards. Qlik Sense stands out for its associative data model, fast in-memory analytics engine, and strong capabilities in Set Analysis, which allow analysts to filter and segment data dynamically without writing complex SQL.

In this article, we explore how Qlik Sense enables real-time KPI monitoring in the pharmaceutical context. We start by identifying key KPIs specific to pharma workflows, followed by a technical breakdown of how to integrate real-time data sources into Qlik's ecosystem. We then focus on Set Analysis as a core technique for advanced filtering and comparative analysis—essential in a sector that operates across multiple geographies, product lines, and regulatory regimes.

The article also includes design guidance for building intuitive, actionable dashboards tailored to pharma users, along with alerting strategies to notify stakeholders when KPIs deviate from target. A real-world case study further grounds the discussion, showing how one global pharma firm implemented real-time KPI dashboards to enhance visibility and reduce reporting latency. Finally, we close with challenges, lessons learned, and future directions, including predictive monitoring and AI integration.
By embracing real-time BI strategies powered by Qlik Sense, pharmaceutical companies can improve decision-making, ensure compliance, and achieve a level of operational agility that is essential in today's complex and fast-paced landscape.

II. UNDERSTANDING PHARMA-SPECIFIC KPI REQUIREMENTS

Pharma KPIs are uniquely complex and critical due to the highly regulated, scientifically driven, and globally distributed nature of the industry. Unlike standard business metrics such as revenue or conversion rates, pharma KPIs must account for compliance, quality, safety, traceability, and production efficiency—often all at once.

Key metrics can vary widely depending on the functional domain. In manufacturing, KPIs like batch yield, downtime, OEE (Overall Equipment Effectiveness), and deviation rates are monitored to ensure that production is efficient and within compliance limits. In R&D, KPIs may

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include cycle time per study phase, protocol deviations, and screen failure rates. Regulatory teams monitor audit readiness, CAPA (Corrective and Preventive Actions) closure times, and SOP (Standard Operating Procedure) compliance.

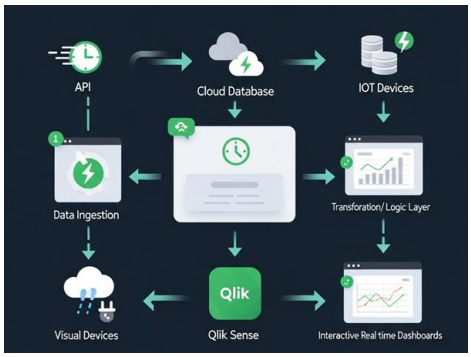
Because pharma companies must comply with stringent regulations from authorities like the FDA, EMA, and WHO, many KPIs are tied directly to audit trails and must be presented in a timely and traceable manner. Furthermore, these metrics often require cross-functional data integration from ERP (e.g., SAP), MES (Manufacturing Execution Systems), LIMS (Laboratory Information Management Systems), CRM, and third-party tools—making real-time visibility even more critical and technically challenging.

Another layer of complexity is granularity. A quality dashboard may need to drill down from a corporate-level KPI to specific manufacturing sites, production lines, or even individual batch numbers. Regulatory dashboards must segment performance by region, product, and submission type.

Therefore, real-time KPI monitoring in pharma isn't just about speed—it's about precision, context, and compliance. The KPI infrastructure must allow teams to compare today's numbers with historical trends, detect outliers, and isolate patterns—all without sacrificing data quality or security.

Understanding these unique KPI requirements sets the foundation for designing Qlik Sense solutions that are not only technically sound but also aligned with business priorities in pharmaceutical operations.

III. REAL-TIME DATA INTEGRATION WITH QLIK SENSE



The real-time data integration with Qlik Sense

Real-time KPI monitoring hinges on the ability to ingest, process, and visualize data with minimal latency. In Qlik Sense, this is enabled through a combination of native connectors, scheduled reloads, and direct query techniques. For pharmaceutical applications, this means pulling data from core systems such as SAP ERP, Oracle, OSIsoft PI, LabWare LIMS, and TrackWise QMS, among others.

Qlik's Data Load Editor allows developers to script efficient ETL pipelines that extract data incrementally or in near-real-time. For real-time or streaming use cases, Qlik Data Gateway, Qlik Replicate, and Qlik Streaming Services can be leveraged to sync transactional data as it changes. These tools support Change Data Capture (CDC) and push updates into the Qlik engine at high frequency.

For example, a pharma manufacturer may need to monitor batch-level temperature data from an IoT system in real time to ensure product stability. Using MQTT or OPC-UA protocols and connecting to a time-series database like InfluxDB, Qlik Sense can be configured to refresh relevant KPI visuals every few minutes—flagging anomalies as they happen.

Equally important is data quality. Real-time pipelines must include validation layers that check for missing values, schema mismatches, or out-of-range entries before exposing metrics to business users. This can be managed within Qlik scripting using IF/THEN logic, custom error tables, or even external validation layers connected through APIs.

Another challenge is performance at scale. Large pharma datasets can strain the Qlik engine if not modeled efficiently. Best practices such as data reduction, incremental loading, and the use of optimized QVD files are essential to keep dashboards responsive while maintaining real-time freshness.

Finally, data governance must be tightly integrated. Role-based access control ensures that only authorized users can see sensitive clinical, manufacturing, or financial KPIs. Integration with Active Directory or Azure AD allows Qlik to inherit user roles and secure metadata access accordingly.

IV. LEVERAGING ADVANCED SET ANALYSIS IN QLIK SENSE

Set Analysis in Qlik Sense is a powerful feature that allows users to define complex filtering logic within measures—enabling calculations across specific contexts without altering the user's current selection. In the pharmaceutical domain, where KPIs often need to be segmented by product, facility, batch, regulatory category, or time period, Set Analysis becomes essential for enabling precision and flexibility in dashboard design.

At its core, Set Analysis lets you isolate subsets of data based on static or dynamic conditions. For example, calculating the average batch yield only for a specific drug type, during a certain manufacturing campaign, and within

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a specified quality range is easily achievable using a Set Expression.

Common functions like P(), E(), AGGR(), and wildcards enhance these capabilities even further. For instance, identifying exceptions (batches not conforming to standard operating ranges) can be performed using exclusion sets or nested aggregation logic.

Set Analysis also enables period-over-period comparisons—vital for identifying performance improvements or regressions. An example would be tracking CAPA resolution times this quarter versus the previous one.

By mastering Set Analysis, Qlik developers can ensure their KPI dashboards are not only accurate and real-time, but also deeply contextual, enabling pharma users to make informed, segmented, and compliance-ready decisions at a glance.

V. DESIGNING INTUITIVE KPI DASHBOARDS FOR PHARMA USERS

Creating an effective KPI dashboard in the pharma industry goes beyond clean visuals—it must translate complex, regulated data into actionable insights for a variety of stakeholders, including scientists, quality officers, regulatory managers, and executives. Each audience segment has unique needs, and dashboards must be carefully tailored to align with their workflows, decision-making patterns, and regulatory obligations.

Design simplicity and data clarity are paramount. Dashboards should begin with high-level KPI indicators such as batch pass rates, CAPA closures, or on-time submission percentages, using visual cues like traffic-light colors, KPI tiles, and trend lines. Users should be able to quickly identify issues—such as production delays or temperature breaches—without interpreting raw tables.

Drill-down functionality is critical. Users may start at the global level and then explore KPIs by manufacturing site, product line, or time range. For example, a quality analyst may view a spike in deviation rates, click on the metric, and drill into the batch number, deviation type, and root cause within seconds.

Interactivity enhances user engagement. Filters should be dynamic and context-aware, updating visualizations in real time as users change selections. Variable inputs—like date pickers, threshold sliders, or toggle switches—allow users to adjust views based on scenario planning or audit needs.
Mobile optimization is another priority, particularly for plant managers or lab technicians who need real-time access via tablets on the shop floor. Dashboards should use responsive design, limit heavy visuals, and rely on icons and concise text.

In terms of layout, KPI dashboards should follow a top-down structure: starting with strategic indicators, then moving into operational KPIs, followed by detailed tables or visualizations. Grouping visuals by business function—such as Manufacturing, Quality, Regulatory—helps users focus on what matters most to them.

Accessibility and compliance are also vital. Dashboards should accommodate color-blind users, support export-to-PDF for audit documentation, and ensure consistent terminology using a centralized data dictionary.

By combining design best practices with the powerful analytics of Qlik Sense, pharma dashboards become not just data displays—but decision-support tools that drive productivity, compliance, and patient-centric outcomes.

VI. ALERTS, TRIGGERS, AND EXCEPTION REPORTING

In a real-time pharma environment, monitoring KPIs is only half the battle. The true value comes from the ability to act on anomalies immediately, whether it's a temperature deviation in cold storage or a sudden drop in yield from a critical production line. This is where alerts, triggers, and exception reporting come into play—enabling stakeholders to intervene proactively and prevent downstream issues.

Qlik Sense supports alerting capabilities through Qlik Alerting—an enterprise-grade add-on that integrates with the Qlik platform to deliver data-driven notifications via email, SMS, or mobile apps. These alerts are highly configurable, allowing for both static thresholds (e.g., "Notify when yield < 95%") and dynamic conditions (e.g., "Alert when this week's CAPA closure rate is 20% lower than last week's").
In the pharma use case, common alert scenarios include:

- Environmental excursions: Real-time detection of out-of-range values for humidity, pressure, or temperature
- Manufacturing downtimes: Alerting plant engineers when OEE drops below acceptable limits
- Regulatory SLA breaches: Notifying compliance teams when submission timelines are at risk
- Inventory shortages: Flagging low raw material levels for critical APIs

Advanced triggers can also incorporate Set Analysis logic, where alerts are issued only when specific filters apply. For instance, an alert may trigger only for batches of a particular product category manufactured at a specific site.
Qlik's exception reporting tools go beyond alerting by compiling pre-filtered views of outliers. These can be embedded in dashboards or scheduled as email reports. For example, a daily exception report might list all open deviations older than 30 days, sorted by risk level.

Automation is key. Alerts should not only inform but also initiate workflows, such as creating a Jira ticket, updating a

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SharePoint log, or pinging a compliance officer on Microsoft Teams. Integration with RPA (Robotic Process Automation) tools enhances this further.

Overall, Qlik's alerting and exception-handling capabilities transform KPI dashboards from passive monitors into active governance systems, helping pharma teams remain compliant, efficient, and patient-safe in real time.

VII. CASE STUDY: REAL-TIME KPI DEPLOYMENT IN A GLOBAL PHARMA FIRM

To illustrate the tangible impact of real-time KPI monitoring using Qlik Sense, consider the case of a multinational pharmaceutical manufacturer with operations across North America, Europe, and Asia. The company faced persistent challenges in tracking manufacturing KPIs across sites, including delays in detecting production deviations, inconsistent reporting practices, and limited insight into facility-level performance.

The previous BI environment was reliant on monthly and weekly reports extracted from SAP and MES systems, which were compiled manually into spreadsheets and static dashboards. By the time leadership received the reports, many critical events—such as process deviations, quality rejections, or capacity bottlenecks—had already escalated, resulting in operational inefficiencies and regulatory concerns.

The organization partnered with a Qlik implementation team to modernize its KPI monitoring infrastructure. The solution was centered around Qlik Sense, chosen for its associative engine, ease of integration, and robust data modeling capabilities. Key steps in the implementation included:

- Real-time data integration from SAP, OSIsoft PI (for process data), and TrackWise (for quality events) using Qlik Replicate and custom APIs.
- Creation of unified KPI models with QVD layers to standardize definitions across global manufacturing sites.
- Use of Set Analysis to enable dynamic KPI breakdowns by region, site, batch, and product category.
- Design of interactive dashboards with drill-downs, heat maps, deviation timelines, and batch traceability features.
- Deployment of Qlik Alerting to notify production managers and quality leaders of exceptions in real time.

As a result, leadership could monitor metrics such as yield variances, batch cycle times, and deviation response rates on a daily basis—down from a two-week delay. Exception reporting helped quality teams focus on high-risk issues, reducing CAPA backlog by 35% in six months. Moreover, the new platform improved audit readiness by ensuring KPI traceability and consistent documentation.

This case study highlights the strategic value of combining Qlik Sense with real-time pipelines and advanced analytics. It demonstrates that with the right architecture and user-centered design, pharma firms can gain actionable insight from complex data environments—and achieve measurable business outcomes.

VIII. CHALLENGES AND LESSONS LEARNED

While real-time KPI monitoring with Qlik Sense offers significant value, the journey to full implementation is not without challenges. Pharmaceutical environments, with their legacy systems, strict regulatory requirements, and siloed data sources, present unique obstacles that must be addressed through planning and iterative development.
One of the first technical hurdles is data latency. Not all source systems are designed for high-frequency querying or API access. For instance, ERP systems like SAP may limit real-time extract frequency due to performance concerns. This requires careful load balancing, caching strategies using QVD layers, or selective field extraction to reduce system strain.

Another key issue is data standardization. In global pharma organizations, KPI definitions often vary between plants or business units. For example, "OEE" or "Deviation Rate" may be calculated differently depending on regional practices. Establishing a governed data dictionary and aligning stakeholders around shared metrics is crucial to ensure consistency in dashboard interpretation.

User adoption can also be a challenge. Not all stakeholders are comfortable with self-service analytics or interpreting complex visuals. Investing in training sessions, interactive help guides, and role-specific dashboards goes a long way in encouraging active use. Some teams may prefer mobile alerts, while others rely on printouts for regulatory binders—requiring flexible deployment strategies.

Security and compliance remain central. Dashboards must respect GxP standards, with full audit trails for data refreshes and user access. Sensitive data—such as patient information or product formulations—must be restricted based on role and region, enforced through section access and row-level security models in Qlik.

Finally, scalability becomes critical as real-time systems grow. As more metrics and users are onboarded, performance tuning, load balancing, and usage monitoring must be incorporated into the platform strategy. Automated testing for data freshness and error detection should also be included in the maintenance plan.

Despite these challenges, the benefits outweigh the obstacles when approached strategically. Lessons learned include the importance of agile delivery cycles, cross-functional stakeholder involvement, and governance frameworks that support long-term sustainability. When done right, real-time KPI systems become embedded in the decision-making culture of the organization.

IX. CONCLUSION AND FUTURE OUTLOOK

Real-time KPI monitoring is no longer a luxury in the pharmaceutical industry—it is a necessity. The ability to visualize, interpret, and act on key metrics as they unfold provides pharma leaders with a competitive edge in regulatory compliance, production efficiency, and operational agility. Qlik Sense, with its dynamic Set Analysis, powerful data engine, and interactive design features, offers a robust platform to achieve this goal.

Through real-time dashboards, pharma companies can monitor temperature excursions before they compromise product quality, detect trends in deviations before they lead to recalls, and maintain regulatory compliance with auditable, automated reports. These insights lead to faster decision-making, better risk management, and improved alignment across teams and sites.

Looking ahead, the future of real-time KPI monitoring is poised to integrate even more intelligence. The incorporation of AI and machine learning models into Qlik Sense applications could allow for predictive KPI alerts—such as forecasting potential batch failures or resource bottlenecks based on historical patterns. Natural language interfaces may enable executives to query KPIs conversationally. Augmented analytics will help users explore anomalies and trends automatically, without requiring deep technical skills.

Further, tighter integration with RPA tools and workflow engines will create self-healing dashboards, where triggers not only inform users but also initiate actions—like reassigning tasks, logging events, or triggering investigations. Cloud-native deployments will also enhance scalability, flexibility, and security across global operations.

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