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# WELL, RESERVOIR AND FACILITY MANAGEMENT: AS STRATEGY FOR PRODUCTION OPTIMIZATION



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*This study presents the implementation of a Well, Reservoir, and Facility Management (WRFM) strategy in the mature oil field Field X, located in western Kazakhstan. The main objective of the pilot project was to improve the performance of five representative wells through a structured cycle of surveillance, diagnostics, opportunity identification, execution, and performance review. All interventions were carried out using existing field resources, without capital-intensive operations.*

*The application of WRFM led to a 5–10% increase in oil production relative to baseline, achieved through low-cost measures such as choke adjustments, gas-lift tuning, and reactivation of a previously shut-in well. A key enabler of these results was exception-based surveillance (EBS) and the consistent use of well operating envelopes, which enabled early detection of anomalies and prevented inefficient operation.*

*The project also demonstrated significant organizational improvements: reduced response time from diagnostics to action, enhanced collaboration between engineering and operations, and the development of a continuous improvement culture. The WRFM implementation in Field X confirmed the viability of this approach under the constraints of aging infrastructure and limited investment.*

*The positive results provide a foundation for expanding the WRFM program to additional wells and fields. This study shows that a structured WRFM approach can deliver sustainable production optimization and operational reliability by integrating technical rigor with cross-disciplinary coordination.*

***KEY WORDS:*** *field management; WRFM; production optimization; well diagnostics; gas lift; reservoir pressure; operational efficiency.*

# УПРАВЛЕНИЕ СКВАЖИНАМИ, ПЛАСТОМ И ИНФРАСТРУКТУРОЙ: СТРАТЕГИЯ ОПТИМИЗАЦИИ ДОБЫЧИ

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*В данной работе представлена реализация стратегии управления скважинами, пластами и инфраструктурой (УСПИ) в зрелом нефтяном месторождении X в Западном Казахстане. Основной целью пилотного проекта было повышение эффективности эксплуатации пяти характерных скважин за счёт внедрения циклического процесса: наблюдение, диагностика, идентификация возможностей, выполнение мероприятий и оценка результатов. Все мероприятия были выполнены с использованием имеющихся ресурсов, без капиталоёмких вмешательств.*

*Применение УСПИ позволило достичь прироста добычи нефти на 5–10% от базового уровня за счёт низкозатратных вмешательств, таких как регулировка штуцеров, настройка газлифта и перезапуск скважины, ранее считавшейся нерентабельной. Исключительно важную роль сыграли инструменты мониторинга, включая исключающее наблюдение и использование рабочих эксплуатационных диапазонов скважин, что обеспечило своевременное выявление отклонений и предотвращение неэффективного режима работы.*

*Проект также продемонстрировал значительные организационные улучшения: сокращение времени от диагностики до вмешательства, повышение взаимодействия между инженерными и производственными службами, а также формирование культуры непрерывного совершенствования. Внедрение УСПИ в месторождение X подтвердило применимость этой стратегии в условиях зрелых месторождений с ограниченными ресурсами и устаревшей инфраструктурой.*

*Полученные результаты служат основой для масштабирования подхода на другие скважины и месторождения. Исследование показывает, что структурированный подход УСПИ способен обеспечить устойчивую оптимизацию добычи и надёжность эксплуатации за счёт системного управления и междисциплинарной координации.*

***КЛЮЧЕВЫЕ СЛОВА:*** *менеджмент месторождения; УСПИ; оптимизация добычи; диагностика скважин; газлифт; пластовое давление; операционная эффективность.*

# ҰҢҒЫМАЛАРДЫ, ҚАБАТТЫ ЖӘНЕ ИНФРАҚҰРЫЛЫМДЫ БАСҚАРУ: ӨНДІРУДІ ОҢТАЙЛАНДЫРУ СТРАТЕГИЯСЫ РЕТІНДЕ ҚОЛДАНУ

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*Бұл зерттеуде Батыс Қазақстандағы жетілген X мұнай кен орнында Скважина, Коллектор және Қондырғыны Басқару (ҰҚИБ) стратегиясын енгізу нәтижелері сипатталған. Пилоттық жобаның негізгі мақсаты - бес типтік ұңғыманың жұмысын құрылымдық цикл бойынша жақсарту: бақылау, диагностика, мүмкіндіктерді анықтау, орындау және нәтижелерді бағалау. Барлық іс-шаралар қолда бар ресурстармен, күрделі капитал шығындарынсыз жүзеге асырылды.*

*ҰҚИБ қолдану нәтижесінде мұнай өндіру деңгейі бастапқы көрсеткішпен салыстырғанда 5–10% артты. Бұл нәтижеге төмен шығынды шаралар - штуцерді реттеу, газлифтті теңшеу және бұрын тоқтатылған ұңғыманы іске қосу арқылы қол жеткізілді. Негізгі табыс факторларының бірі - ерекше жағдайларды автоматты түрде анықтайтын бақылау және ұңғыма жұмыс диапазондарын тұрақты пайдалану болды. Бұл тәсілдер жұмыс тиімділігін жоғалтуға жол бермей, ауытқуларды ерте анықтауға мүмкіндік берді.*

*Жоба барысында ұйымдық деңгейде де айтарлықтай нәтижелер байқалды: диагностикадан араласуға дейінгі уақыт қысқарып, инженерлік және өндірістік бөлімдер арасындағы үйлестіру артты, сонымен қатар үздіксіз жетілдіру мәдениеті қалыптасты. ҰҚИБ стратегиясының X кен орнында сәтті енгізілуі шектеулі ресурстар жағдайында да тиімділігін дәлелдеді.*

*Жоба нәтижелері бұл тәсілді басқа ұңғымалар мен кен орындарына кеңейтуге негіз бола алады. ҰҚИБ - техникалық негізділікті пәнаралық үйлестірумен біріктіре отырып, өндіру тиімділігі мен сенімділігін арттыруға мүмкіндік беретін тұрақты стратегия*

***ТҮЙІН СӨЗДЕР:*** *кен орнын басқару; ҰҚИБ; өндіруді оңтайландыру; ұңғыма диагностикасы; газлифтілік жүйе; қабат қысымы; операциялық тиімділік.*

**Introduction.** The modern oil and gas industry faces significant challenges in sustaining production and profitability as fields reach late-life stages. As reservoirs approach maturity, issues such as reservoir pressure depletion, increasing water production, and aging surface infrastructure are pervasive. These challenges, compounded by financial constraints, have underscored the need for efficient and integrated asset management strategies in brownfields [1]. In this context, Well, Reservoir, and Facility Management (WRFM) has emerged as a leading framework to maximize hydrocarbon recovery, reduce production deferment, and prolong field value delivery.

WRFM is not a single technology, but a disciplined management process built on routine surveillance, data-driven diagnostics, and continuous performance optimization [2]. It integrates multiple technical domains-including subsurface engineering, production operations, and surface facilities-into a coordinated cycle of action and review. The overarching aim is to ensure that every well, reservoir segment, and facility performs to its full potential by maximizing hydrocarbon recovery and optimizing production within operational and budgetary constraints. Accordingly, WRFM programs encompass proactive well integrity management, systematic surveillance, timely restoration of underperforming wells, and continuous optimization of the production system [3]. A core principle of WRFM is that improvement opportunities should be continuously identified, ranked, and executed as part of a perpetual “value loop” of review and action [4].

The importance of WRFM becomes particularly pronounced in complex, late-life fields where fragmented operations and inconsistent data have historically hindered performance management [5-6]. In such environments, conventional field management practices-often reactive, siloed, and reliant on manual workflows-have proven insufficient to unlock remaining potential. Instead, a holistic and systematized WRFM approach is

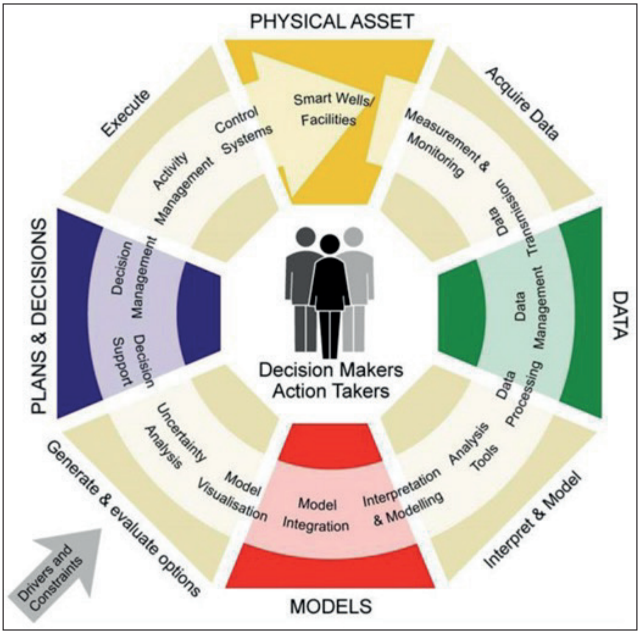


*Figure 1* - **Schematic representation of the WRFM continuous improvement cycle, integrating surveillance, diagnostics, opportunity identification, execution, and review**

required to enable real-time decision-making, align multidisciplinary teams, and drive disciplined execution across the asset [7-9].

Field X, a mature carbonate oil field in western Kazakhstan, provides a compelling case for WRFM implementation in a brownfield setting. With over four decades of production history, the field exhibits all the classic symptoms of maturity observed in other aging fields [10-11]: declining reservoir energy, uneven pressure support, rising water cut, and flow assurance challenges caused by aging artificial lift systems and surface bottlenecks. Historically developed under a gas-oil gravity drainage (GOGD) strategy, Field X has a heterogeneous reservoir profile of variable quality across different compartments, and a well inventory comprising active producers, intermittently shut-in wells, and candidates for recompletion or sidetracking.

Despite the field's complexity and operational difficulties, production analysis indicated that significant optimization potential remained untapped. Surveillance data showed many wells underperforming relative to expectations, indicating artificial lift inefficiencies and underutilized system capacity. Many wells were operating outside their ideal performance envelopes, and numerous low-cost opportunities for production improvement had not been pursued due to organizational misalignment and poor data integration. Against this backdrop, a WRFM pilot was launched to demonstrate the potential impact of applying structured field management workflows.

The WRFM implementation detailed here focused on five wells chosen to represent a cross-section of Field X's technical and operational challenges. These wells included a mix of high water-cut producers, gas-lifted wells with declining performance, and one long-term shut-in well with suspected restoration potential. The goal was to apply the full WRFM cycle-surveillance, diagnostics, opportunity identification, execution, and review-using a consistent methodology supported by digital surveillance tools and cross-functional planning processes.

What distinguishes this initiative from earlier optimization efforts in Field X is the emphasis on integration and repeatability. Rather than treating each well as an isolated problem, the WRFM process established a regular rhythm of collaborative engagement, including weekly reviews to evaluate data trends, validate diagnostics, prioritize actions, and coordinate field execution. The interventions themselves were deliberately designed to be low-cost and operationally simple, focusing on short-cycle optimization activities such as choke adjustments, drawdown management, and artificial lift tuning.

The decision to start with a small, focused set of wells was intentional. It allowed the team to test and refine workflows, assess the quality and availability of field data, and build alignment between technical and operational stakeholders. The campaign also served as a training ground for engineers and operators new to the WRFM concept, cultivating internal champions who could support broader rollout across the asset.

The results of the initial implementation-detailed in the following sections-demonstrated not only technical gains in production rates and system stability but also organizational benefits such as improved collaboration, data visibility, and execution discipline. Moreover, the campaign confirmed that many of the challenges encountered in Field X were not unique, but common to mature fields globally. As such, this experience offers valuable lessons for operators seeking to improve field performance under similar constraints.

This paper presents the full context of the WRFM implementation in Field X-from field selection and workflow development to diagnostic methodology, intervention execution, and performance review. The findings highlight the efficacy of structured management practices in revitalizing mature assets and lay the groundwork for scaling this approach across other fields. In doing so, the study contributes to the growing body of technical literature that supports WRFM as a high-impact, low-cost strategy for unlocking value in late-life fields.

**Materials and methods.** The implementation of the WRFM strategy in Field X was guided by both technical requirements and on-the-ground operational constraints. Emphasis was placed on a practical, repeatable workflow rather than an overly complex or capital-intensive program. In particular, priority was given to *workflow standardization*, *data accessibility*, and *cross-functional collaboration* to ensure any optimization could be executed with existing resources and gradually scaled up. This pragmatic approach aligns with WRFM best practices reported in other mature fields. For example, operators in Oman and Nigeria have documented that structured, low-cost WRFM programs can yield substantial production improvements without major capital projects. These and other case studies highlight similar success factors, notably rigorous surveillance, disciplined diagnostics, and close collaboration between subsurface and operations teams [6]. These insights from Oman, Nigeria, and Caspian field applications reinforced the design choices for Field X's WRFM implementation.

The WRFM workflow for Field X was structured into five core phases – Surveillance, Diagnostics, Opportunity Identification, Execution, and Review – arranged in a continuous feedback loop. Each phase feeds into the next, creating an iterative cycle aimed at systematic performance improvement. Figure 1 illustrates this cyclic WRFM workflow, showing how continuous surveillance drives diagnostics, which in turn generate optimization opportunities that are executed and then reviewed for performance gains. The initial WRFM campaign focused on a pilot set of five production wells chosen to represent a cross-section of Field X's challenges. These wells included high water-cut producers, a gas-lifted well with erratic performance, an unstable flowing well, and one long-term shut-in well with suspected remaining potential. Concentrating on a small, representative well set allowed the methodology to be tested and refined in a controlled scope while ensuring that learnings would be applicable across the wider field.

The WRFM cycle began with intensive well surveillance to establish a data-driven basis for decisions. Daily production rates, tubing and casing pressures, artificial lift parameters, and periodic well test results were collected from each pilot well. A combination of real-time SCADA feeds and manual field measurements was used, ensuring that even wells with minimal instrumentation were monitored. Where modern sensors were lacking, proxy diagnostics were drawn from observed trends in pressures, production decline rates, and responses to past interventions. An exception-based surveillance (EBS) approach was employed to automatically flag wells operating outside expected envelopes of pressure, rate, water cut, or lift settings. This method of "managing by exception" helped focus engineering attention on the wells most likely to benefit from intervention. Notably, early anomaly detection through EBS is one of the most cost-effective ways to boost production, as it enables problems to be addressed before they escalate [9]. To support the surveillance effort, a dedicated WRFM dashboard was developed on a field-wide data visualization platform. The dashboard displayed live well data alongside key performance indicators and diagnostic alerts. A simple traffic-light coding (green for normal, yellow for marginal, red for out-of-envelope) was used to visualize well status at a glance. This visual tool structured the weekly WRFM review meetings and ensured that emerging issues were promptly communicated across reservoir, production, and operations teams.

Diagnostics. Following surveillance, each of the five candidate wells underwent detailed diagnostic analysis to identify the root causes of suboptimal performance. Inflow–outflow modeling and well operating envelopes (WOEs) were applied to evaluate each well's production behavior relative to its theoretical capacity and reservoir support. By plotting flowing pressure versus rate within a defined envelope, it was determined whether a well was being over-drawn (risking issues like water coning or elevated gas–oil ratio) or under-drawn (indicating untapped potential), or if it operated within an optimal range. This systematic envelope analysis revealed several mismatch conditions in the pilot wells – for instance, some wells had been pulled below their ideal drawdown, while others were operating at unnecessarily constrained rates. In parallel, artificial lift performance was scrutinized for the wells on lift. For the gas-lifted wells, injection gas rates were cross-checked against the wells' inflow performance and surface constraints to assess efficiency. In one case, diagnostics showed that an excessive volume of lift gas was being injected with minimal gain in oil rate, pointing to wasted energy that could be reallocated. The single beam-pumped well in the group was evaluated via pump dynagraph (card) analysis and surface stroke monitoring to determine pump fillage and identify any mechanical bottlenecks. These diagnostic findings guided *targeted tuning measures* – such as adjusting gas lift injection parameters and modifying pump stroke settings – aimed at restoring each well to a more optimal operating condition.

Opportunity Identification. Identified optimization actions from the diagnostics phase were then formalized and ranked through a structured opportunity management process. Cross-functional review sessions were held with reservoir engineers, production technologists, and field operations supervisors to discuss each well's case using a standardized WRFM opportunity template. This template captured the well's surveillance trends, key diagnostic insights, the estimated production gain if an opportunity was realized, the operational requirements or downtime needed, and alignment with available field resources. To ensure objective decision-making, a ranking matrix was applied to score each opportunity on several criteria – expected impact (production or performance gain), implementation complexity, cost, and readiness (availability of equipment/personnel). Using this prioritization matrix, the team avoided ad-hoc or intuition-driven choices and instead pursued those interventions that offered the highest benefit-to-effort ratio. Opportunities scoring highest in the matrix (typically those with substantial upside and relatively straight forward execution) were slated for immediate action, whereas lower-scoring ideas were deferred or slated for later consideration. This transparent ranking approach is in line with recommendations for WRFM process standardization, ensuring that resources are directed to the most value-adding tasks first [7].

Execution. For each high-priority opportunity selected, a detailed execution plan was prepared in coordination with field operations and maintenance teams. Given the focus on short-cycle, low-cost interventions, the implementation was designed to use existing field infrastructure and routine operational crew wherever possible. Common execution activities included surface choke adjustments to modify well drawdown, gas-lift valve tuning or controller set-point changes, lowering of surface backpressure, and a controlled well restart procedure for the long inactive well. All jobs were scheduled to minimize production deferral and were carried out under standard workover-free operations (no rig required). Each action was documented in the WRFM dashboard and action-tracking log, with clear assignment of responsible personnel and expected timelines. By using in-house capabilities and avoiding any major equipment deployments, the project ensured that the optimization actions remained cost-efficient and could be repeated across other wells. Field personnel were briefed in advance for each intervention to align on objectives and safety considerations, reflecting the collaborative ethos of the WRFM approach.

Review. Post-intervention performance evaluation was an integral final phase of the cycle. After each optimization job, the affected well's production and pressure trends were closely monitored over a defined period (generally 1–4 weeks, depending on the type of change) to gauge the effect of the intervention. Key metrics (oil rate, water cut, gas–oil ratio, flowing pressure, etc.) were compared against the pre-intervention baseline and the expected outcome predicted during diagnostics. Any deviation between expected and actual results was analyzed to extract lessons. For example, if a choke change did not yield the anticipated oil rate increase, the team would investigate whether reservoir constraints or unforeseen facility bottlenecks were limiting the gain. These findings were fed back into the next cycle of surveillance and diagnostics – in subsequent WRFM meetings the team revisited such wells to update the operating envelope or adjust the opportunity ranking criteria based on real results. In this way, the WRFM process was iterative and learning-oriented. Even when certain interventions delivered only marginal improvements, they provided valuable insight into Field X's reservoir behavior and system response. The continuous feedback loop refined the team's understanding and improved the accuracy of future diagnostics and opportunity evaluations.

By keeping the methodology practical and the workflow transparent, the WRFM initiative in Field X was executed without the need for new infrastructure, specialized software, or large capital expenditures. All tools and techniques were chosen to fit the maturity and constraints of this brownfield asset, making the approach readily transferable to similar mature fields facing aging equipment, declining pressure, and high water cut challenges. The overall WRFM strategy thus created a framework for sustainable optimization that not only achieved immediate production gains, but also built up the organizational capability (skills, data utilization, and teamwork culture) required for continuous field management improvement. This materials and methods framework provides a template for how a focused WRFM program can be implemented in practice, offering a balance between technical rigor and operational pragmatism that is applicable to many late-life oil fields.

**Results and discussion**. The pilot implementation of WRFM in Field X yielded clear improvements in well performance and efficiency. Pre- and post-intervention comparisons on the five target wells showed several positive trends:

Increased oil production rates: All five wells experienced a rise in oil output after low-cost WRFM interventions, contributing an estimated 5–10% addition to the field's total production (relative to the pre-WRFM baseline). This gain was achieved without drilling new wells and falls within the uplift range reported in similar WRFM case studies in Oman and Nigeria [11-12].

Controlled gas-oil ratio (GOR): Wells that had been overstimulated (exceeding optimal drawdown) showed stabilized GOR and steadier flow after choke adjustments and lift gas tuning brought operating conditions back within efficient envelopes. This prevented the elevated GOR and flow instability seen before intervention, in line with other WRFM applications that used well operating envelopes to optimize drawdown [8].

Managed water cut: In high water-cut producers, the WRFM approach avoided further water influx by curbing excessive drawdown. Post-intervention data indicated that water cut levels were maintained at or below prior values instead of rising, an outcome of operating each well within its ideal range to prevent coning. This aligns with "fix-the-basics" WRFM practices reported to improve water management in mature fields [12].

Improved well uptime: Exception-based surveillance and proactive maintenance reduced unplanned downtime. No prolonged production stoppages occurred in the post-WRFM monitoring period, whereas previously some wells suffered frequent deferred production. The use of real-time alerts allowed field teams to address issues (e.g. pressure anomalies or flow restrictions) before they escalated, helping to minimize deferment. Other operators have likewise noted that disciplined WRFM surveillance cuts unscheduled deferments and boosts uptime [11].

Restored dormant well output: One long-term shut-in well was successfully returned to production following WRFM diagnostic review and a simple restart execution. This well, previously considered uneconomic, began producing a sustained oil rate with manageable pressure-adding new barrels that were zero before. Such restorations underscore WRFM's value in re-evaluating "dead" assets, as similarly demonstrated by a Nigerian field campaign that revived idle wells through structured WRFM efforts [13].

The combined oil-rate uplift from the five wells provided a meaningful increment to Field X's daily output. Notably, none of the interventions required rig operations or major capital expense; all gains were achieved through short-cycle actions (choke changes, gas-lift tuning, artificial lift tweaks, and a well restart) using existing field infrastructure. This outcome highlights the cost-efficiency of a WRFM approach focusing on quick wins – a similar strategy in a brownfield onshore cluster realized significant gains with minimal investment [12]. By concentrating on low-cost opportunities, the team delivered production improvements at a fraction of the cost of traditional workovers, echoing results from Oman where optimization jobs under WRFM cost only a few dollars per barrel for a 4–12% boost in output [11].

Among the technical enablers of these successes was the consistent use of well operating envelopes to guide production limits. Prior to WRFM, many wells were operated on historical settings with little real-time optimization. Diagnostic review revealed several wells had been producing outside their optimal drawdown window – either overdrawing (leading to gas breakout and rising GOR) or underdrawing (leaving potential oil untapped). Implementing WRFM brought a shift to envelope-based operating set-points for each well. Engineers plotted inflow-performance against the well's operating envelope and identified needed adjustments (e.g. reducing choke size on an over-pulled well to drop its GOR back to an efficient range or opening a choke on an underutilized well to raise its output). As a result, each well was repositioned into its ideal operating range, improving overall stability. This envelope-centric approach has been reported to be critical for WRFM optimization – for example, PDO's heavy-oil fields employed live operating envelopes to keep wells within desired pressure-rate limits, thereby arresting production decline and gas/oil imbalances [8]. In Field X, the envelope method allowed the team to visualize and correct deviations quickly, translating into tangible gains in oil rate and reduced undesirable production (gas and water).

Another key element was the deployment of exception-based surveillance (EBS) to enhance real-time monitoring. A WRFM digital dashboard flagged wells breaching set thresholds for pressure, rate, water cut or other parameters. These EBS alerts directed engineers' attention to anomalies in a timely manner. For instance, a sudden drop in tubing pressure on one well triggered an immediate investigation: whereas operators initially suspected a gas-lift system failure, the WRFM team's cross-domain analysis (correlating pressure trends, flowline status, and prior interventions) discovered a partially obstructed flowline causing back-pressure. Quickly removing this bottleneck restored the well's flow before it suffered prolonged downtime. Figure 2 illustrates the surveillance logic, where real-time exceptions initiate diagnostic workflows. This proactive surveillance culture marked a shift from past reactive approaches and is consistent with industry experience – successful WRFM implementations often credit EBS tools for early detection of issues and production optimization opportunities [9]. By integrating live data and automated alerts, Field X's team improved their diagnostic confidence despite some gaps in instrumentation.

Notably, the pilot revealed data quality challenges common in mature assets: several wells had missing or unreliable sensor data (e.g. intermittent downhole pressure readings), forcing engineers to infer behavior from incomplete datasets. While the team mitigated this by using pattern recognition and analog well comparisons, the experience highlighted the need for targeted data gathering and selective instrument upgrades to support future WRFM cycles. Effective data management has been identified as an enabler for WRFM value creation [5], and Field X's results reaffirm that robust, high-frequency data underpins accurate diagnostics.

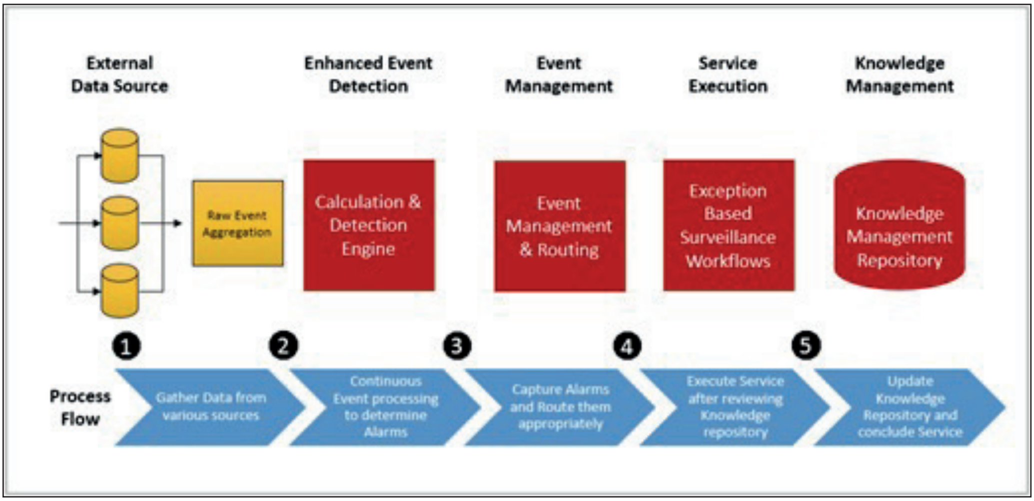


*Figure 2 – EBM Process*

Operational integration and collaboration were also pivotal to the campaign's success. The WRFM team – comprising reservoir engineers, production technologists, field supervisors, and maintenance staff – worked from a unified opportunity register and held weekly WRFM meetings to review progress. This cross-functional setup ensured that every recommended action (such as a gas-lift valve adjustment or pump parameter change) was vetted from multiple angles (subsurface, production, operations) and scheduled with full alignment. The high level of transparency and teamwork reduced delays and implementation gaps. Field crews were engaged early in planning, so interventions were embedded in routine operations with minimal disruption. The benefit of this approach was evident: the average time from identifying an opportunity to executing it dropped by ~30% over the course of the pilot, as bottlenecks in decision-making and handoffs were eliminated. Such cross-functional collaboration is frequently cited as a critical success factor in WRFM programs [6]. In the Karachaganak field (Caspian region), for example, a unified WRFM action team significantly improved execution speed and knowledge sharing among disciplines [6]. Field X's experience mirrored this – junior and senior staff jointly analyzed results and learned from each intervention, creating a continuous improvement loop. The culture shift from siloed, reactive troubleshooting to integrated, proactive field management was one of the most important outcomes of the pilot. Over the campaign, teams increasingly used shared dashboards and common performance metrics, which fostered accountability and a problem-solving mindset at the front line. This organizational benefit, while less quantifiable than production gains, laid the groundwork for sustainable WRFM practice in Field X.

Despite the positive outcomes, the WRFM trial also encountered practical challenges and limitations. Data quality emerged as a recurring issue: aging wells lacked modern sensors, and historical data gaps sometimes hindered rigorous analysis. The team addressed this by instituting a "surveillance audit" – systematically identifying data deficiencies and assigning actions (such as gauge recalibration or extra well tests) to improve the dataset. Going forward, only wells meeting a minimum data quality standard would be admitted into the WRFM cycle, ensuring time is spent where diagnostics can be trusted. This emphasis on data stewardship is echoed in other WRFM implementations; for instance, Shell's Nigeria assets reported that improving data consistency was vital to unlocking WRFM value loops [5]. Another challenge was variability in artificial lift response. Some gas-lifted wells responded immediately to optimization (e.g. cutting excess lift gas reduced backpressure and boosted oil), while others showed delayed or negligible response due to downhole constraints. These differences underline that each well's system has unique characteristics; more advanced modeling (network simulation or nodal analysis) might be required to predict outcomes in complex cases. In fact, studies have begun incorporating data-driven models to enhance WRFM opportunity identification in multilayered fields [10-14]. In the Field X pilot, however, the decision was made to defer advanced tools and stick to fundamental techniques first. This kept the process simple and accessible for the team's first cycle, avoiding over-complication. It was acknowledged that some potential opportunities (especially in wells with scant data or unclear inflow behavior) were left on the table for now. These will be revisited in future WRFM cycles once additional data is gathered or if more sophisticated analysis tools are introduced.

When benchmarked against external cases, the Field X results are broadly in line with global WRFM trends. Production uplifts in the range of 5–15% from structured WRFM programs have been documented in mature fields across the Middle East, West Africa, and Central Asia [11-12]. Field X's ~5–10% improvement falls squarely within this range. These international case histories also stress the same ingredients for success observed in Field X: rigorous surveillance, disciplined opportunity ranking and execution, and strong cross-functional teamwork [1-7]. One study from Petroleum Development Oman reported a sustained 12% production gain over two years after instituting a WRFM excellence process in a large carbonate asset [11], while a Nigerian "back-to-basics" WRFM campaign similarly arrested decline and added thousands of barrels of oil per day through systematic optimizations [12]. Conducted research demonstrate adaptability of WRFM strategy: even under Field X's localized constraints (aging infrastructure, limited budget, etc.), the core WRFM principles proved broadly applicable.

Finally, the pilot provided insight into the scalability and sustainability of WRFM. With encouraging results from five wells, Field X's operators are planning to expand the WRFM program to a larger set of wells. The team recognizes that scaling up will introduce new challenges – more data to process, greater variability in well conditions, and the need for consistent execution across multiple crews. To manage this, a "WRFM Fieldbook" of standardized templates and checklists is being developed to ensure that best practices are maintained as the scope grows. This approach reflects the importance of process standardization found in top-quartile WRFM organizations [7]. Importantly, the success in Field X was driven not by cutting-edge technology, but by disciplined application of basic engineering and management practices. Every opportunity was grounded in data, every action tracked, and every result reviewed. This focus on process over glamour technology turned individual well tweaks into a repeatable system. It confirms that sustainable optimization in mature fields hinges on consistency and rigor more than on any single tool or software [15]. That said, the team remains realistic: not every WRFM intervention will yield large gains, and some will underperform expectations. The key is the continuous learning loop – even modest results or occasional failures provide lessons to refine the models and assumptions in the next cycle. In essence, the Field X pilot has demonstrated that a WRFM strategy can revive brownfield performance and instill a proactive operating culture. It serves as a practical blueprint for similar fields: by leveraging existing data, staff, and low-cost measures, meaningful production and reliability improvements can be attained. The broader implication is that WRFM is a strategically essential practice for aging assets – one that can defer major expenditures and extract remaining value through systematic surveillance and optimized execution, as also concluded by numerous SPE case studies worldwide [6-11].

**Conclusion.** The implementation of a structured WRFM strategy in Field X yielded both technical and organizational benefits. Over the course of the five-well pilot in a mature carbonate reservoir, oil production was increased by approximately 5–10% relative to baseline rates, consistent with incremental gains reported in similar WRFM deployments in aging [1]. Notably, the WRFM framework enabled the successful reactivation of a previously shut-in well, and operating wells within defined performance envelopes helped stabilize production and reduce operational variability. These outcomes underscore the capability of a disciplined WRFM approach to unlock additional value even in late-stage field operations.

The introduction of exception-based surveillance and systematic opportunity ranking significantly improved the efficiency of performance diagnostics and intervention planning. By focusing attention on wells and facilities that deviated from expected operating conditions, this process enabled rapid identification of issues and prioritization of low-cost remedial actions. This approach accelerated the cycle from anomaly detection to resolution, contributing to sustained production gains throughout the pilot. Importantly, the use of predefined operating envelopes in conjunction with real-time exception-based surveillance ensured that optimization efforts remained within safe operating limits, in line with best practices for maintaining well integrity while maximizing output [9].

Crucially, the pilot results demonstrate that technical optimization must be supported by organizational alignment and a culture of continuous improvement. Cross-functional collaboration under the WRFM framework, together with management support, was instrumental in translating identified opportunities into executed field actions. Emphasizing low-cost interventions not only delivered quick wins but also facilitated stakeholder buy-in for the WRFM process, indicating that even modest operational changes can gain traction if backed by clear value and team consensus. This synergy between technical measures and organizational readiness was central to the success observed in Field X, highlighting that sustained WRFM benefits depend on both engineering solutions and effective change management.

For all its benefits, the pilot's limited scope – five wells over a short period – presents a key limitation regarding broader generalization. Longer-term monitoring is required to verify that the observed gains are sustainable, and future work should assess the strategy's performance as it scales to full-field implementation. Nevertheless, the positive outcomes suggest that expanding the WRFM strategy to additional wells or fields is feasible, provided that the supporting surveillance infrastructure and multidisciplinary workflows are maintained. In summary, the Field X case demonstrates that an integrated WRFM approach can rejuvenate mature assets by bridging technical enhancements with organizational best practices, achieving notable production improvements in a cost-effective and sustainable manner.

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