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Strategic Integration of AI and Smart Facility Management for Operational Excellence in the Healthcare Sector

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مقدمة:

As healthcare institutions continue to encounter rising pressures on both operational efficiency and financial sustainability, the demand for intelligent management solutions has become more especially in facility operations. Strategic decisions in maintenance and operations are key urgent, to sustaining high service standards, optimizing asset performance, and minimizing costs.

The rapid evolution of Artificial Intelligence (AI) and the rise of technologies like CAFM, CMMS, and predictive analytics have opened new possibilities for transforming administrative decision-making in facility management through data-driven insights and automation.

This study aims to explore the impact of strategically integrating AI and smart facility management applications on improving operational efficiency, enhancing decision-making, and achieving sustainable operational excellence in the healthcare sector.

مشكلة الدراسة:

Although AI technologies and advanced facility management systems are accessible, their implementation remains underutilized across a significant number of healthcare settings.

Frequently, facility management departments are excluded from core strategic and operational discussions, resulting in maintenance delays, increased expenditure, suboptimal use of resources, and premature asset deterioration.

This study investigates to what extent the strategic integration of AI and smart facility management technologies can help overcome these challenges by enabling more accurate, timely, and sustainable decisions that contribute to operational excellence in the healthcare sector.

أهمية الدراسة:

This research is important as it connects emerging technological innovations with core administrative processes within the highly sensitive healthcare environment. It offers both theoretical insights and practical applications by proposing a model that leverages AI and smart facility management to strengthen decision-making, streamline operations, and advance data-informed improvements.

On a practical level, the research provides healthcare administrators with insights on how to integrate AI-based tools to improve maintenance response times, optimize asset usage, reduce costs, and extend the life cycle of key equipment. Strategically, it highlights how this integration supports long-term planning, resource sustainability, and the overall growth and resilience of healthcare organizations.

أهداف الدراسة:

- To analyze the role of smart facility management applications in supporting operational decision-making in healthcare settings.
- To assess the impact of integrating AI technologies on maintenance efficiency and cost control.
- To explore the relationship between facility management performance and asset sustainability.
- To develop a practical framework that combines AI and FM systems to enhance decision accuracy and operational excellence.
- To support strategic planning and long-term growth in healthcare organizations through data-driven facility decisions.

تساؤلات الدراسة

What is the current state of smart facility management applications in the healthcare sector?

How does integrating artificial intelligence impact maintenance efficiency and operational decisions?

What is the relationship between facility management performance and asset sustainability in healthcare institutions?

To what extent does the integration of AI and FM systems contribute to operational excellence and cost optimization?

How can this integration support long-term strategic planning and resource sustainability?

فروض الدراسة:

There is a statistically significant relationship between the efficiency of facility management and operating costs in healthcare institutions.

The integration of artificial intelligence into facility management systems improves the accuracy and timeliness of operational decisions.

AI-enabled smart facility management contributes to reducing downtime and enhancing maintenance efficiency.

The strategic use of AI and FM technologies supports asset sustainability and facilitates long-term planning in healthcare organizations.

الدراسات السابقة:

While numerous studies have individually examined the effectiveness of facility management and the application of AI in healthcare, limited attention has been paid to the intersection of both areas. This gap is particularly significant given that operational choices in healthcare settings directly affect patient safety, asset availability, and cost-efficiency.

This research aims to bridge this gap by integrating technical innovation with an administrative strategy to assess how AI-enhanced facility management systems can strengthen decision-making, boost maintenance practices, and support sustainability efforts. The analysis also underscores the critical nature of healthcare environments, where even minor inefficiencies can result in serious repercussions, highlighting the urgent need for intelligent, data-driven management systems.

المنطلقات النظرية للدراسة:

This research builds upon several theoretical underpinnings:

Decision Theory: to understand how data-driven systems enhance accuracy and reduce uncertainty in operational decision-making.

Operational Efficiency Principles: to evaluate how AI and FM integration improves resource utilization and service delivery.

Asset Lifecycle Theory: to explore how smart facility systems contribute to extending asset lifespan and ensuring sustainability.

Digital Transformation Theory: to examine how the integration of advanced technologies reshapes administrative and facility operations.

Artificial Intelligence Frameworks: particularly machine learning and predictive analytics, which are central to modern facility management innovation.

المنهجية وطرق البحث:

Methodology: The study adopts a descriptive and analytical approach to examine the impact of AI and smart facility management integration on decision-making and operational performance in the healthcare sector.

Data Collection Methods:

Structured surveys will be distributed to facility and maintenance teams to capture their practices, challenges, and views on current systems.

Semi-structured interviews will be conducted with decision-makers (e.g., operations directors, facility managers) to collect qualitative insights.

An analysis of internal reports (maintenance costs, downtime, asset performance) will be conducted to support the findings with actual operational data.

Sample and Population: The study will use purposive sampling to select participants from healthcare institutions across different regions in Saudi Arabia. Participants include professionals with direct involvement in facility management and operational decisions.

Data Analysis: Both quantitative (e.g., correlation and regression) and qualitative (e.g., thematic analysis) methods will be applied using tools such as SPSS and Excel.

أدوات الدراسة:

Structured Questionnaire: Designed to gather quantitative data from facility and maintenance teams about existing practices, system usage, response times, and challenges.

Semi-Structured Interviews: Conducted with operations managers and administrators to collect qualitative insights about decision-making processes, system integration, and strategic planning.

Operational Data Analysis: Review and analysis of internal documents such as maintenance logs, downtime reports, and cost breakdowns to support findings with real-world evidence.

Statistical Tools: Tools such as SPSS and Microsoft Excel will be used for data coding, statistical analysis, and generating performance charts or models.

حدود الدراسة:

Time Limitation: The study will be conducted during the academic year 2025, which may limit the observation of long-term operational outcomes.

Geographical Limitation: The research is limited to healthcare institutions within the Kingdom of Saudi Arabia.

Subject Limitation: The study focuses specifically on the integration of AI with smart facility management systems in relation to maintenance, operational efficiency, and decision-making.

Access Limitation: Some operational or financial data may be partially restricted due to institutional confidentiality policies, which may affect the depth of data analysis in some cases.

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