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Capital Planning in Imaging:

A Dashboard Approach for Strategic Decision-Making

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Abstract—Capital planning for medical imaging devices presents unique challenges due to their complex lifecycles, varying funding sources, and critical operational dependencies. Despite the abundance of data collected on these assets, the lack of clear, real-time, and automated insights has limited its utility for stakeholders in understanding current and future needs. To address these challenges, we propose an integrated dashboard solution powered by Microsoft Power BI. This approach combines real-time data visualization, advanced scenario modeling, and actionable insights aligned with institutional priorities. By leveraging this solution, healthcare organizations can make data-driven decisions that enhance fiscal sustainability and operational efficiency.

Keywords—**Capital Planning, Power BI, Medical Imaging**

INTRODUCTION

Capital planning for medical imaging devices presents significant challenges due to their complex lifecycles and funding requirements. While imaging equipment can remain operational for years with minimal investment, they often require substantial funding at the end of their lifecycle, creating sudden financial strain. Compounding this issue, synchronized purchasing cycles—driven by multi-level approval processes—often result in clusters of devices reaching end-of-life at the same time, further straining budgets and operational resources.

Adding to the complexity, the lifecycle of imaging equipment is not fixed. Devices may outlast or fall short of their expected lifespan due to factors such as technological obsolescence, clinical demand, or maintenance regime. This variability provides opportunities for strategic decision-making to prioritize replacements based on the specific needs and performance of each device. However, these decisions often lack transparency due to the absence of clear data metrics that can be used to communicate need to multiple stakeholders.

Healthcare organizations often rely on external funding sources, such as Canadian Foundation for Innovation (CFI) grants or hospital foundation donations, to acquire new imaging equipment [1]. While these sources can address short-term needs, they are inherently variable and subject to economic cycles [2]. Furthermore, transitioning devices acquired through these means into clinical operations introduces operational costs that must be accommodated year-after-year to ensure viability.

The extended lifecycle of imaging devices also highlights an organizational risk: these devices frequently outlast the tenure of key staff members. Relying on individual advocates for replacement planning is insufficient as organizations grow and evolve rapidly. A coordinated, data-driven approach is essential to ensure continuity and alignment with institutional priorities.

To address these challenges, we propose a dashboard-based approach to capital planning. This tool would provide stakeholders with real-time, actionable insights into the state of imaging equipment, enabling data-driven decisions about prioritization and replacement. By consolidating and visualizing key metrics, the dashboard will empower organizations to strategically deploy capital funds, enhance operational efficiency, and maintain safety and reliability in medical imaging services.

PROPOSED SOLUTION

Computerized Maintenance Management Systems (CMMS) are essential tools for managing the lifecycle of medical devices by storing critical asset data such as network information and work order history. Biomedical Engineering at University Health Network (UHN) utilizes Accruent TMS, which excels in supporting technologists with tracking corrective and preventive maintenance tasks. However, its capabilities for analyzing aggregate data and identifying trends to guide capital planning are limited.

To address this gap, we propose enhancing CMMS functionality by integrating Microsoft Power BI. Power BI enables advanced data analysis and visualization through its ability to connect directly to SQL databases, allowing real-time access to CMMS data. By programming custom functions, stakeholders can filter data dynamically and perform tailored calculations directly within an interactive dashboard interface. This eliminates the need to export data into Excel or CSV files for manual processing, significantly reducing the time and effort required to create actionable reports.

Key Features of Power BI for CMMS Integration:

- Real-Time Data Analysis: Power BI enables seamless integration with CMMS databases, allowing dynamic, up-to-date insights.Cost-Effective Implementation: For organizations with Microsoft enterprise accounts, Power BI is often included as part of existing licenses.
- Customizable Dashboards: Publishers can design tailored reports and dashboards, offering detailed insights specific to organizational needs. Administrators can manage permissions and ensure data integrity, while viewers interact dynamically with reports without altering underlying data.
- Enhanced Accessibility: URL-based dashboards provide secure remote access, removing the need for distributing large static files. Stakeholders can navigate multi-page reports with ease, exploring various metrics and areas of interest in detail.
- Shareable Insights: Users can download formatted PDF reports directly from the dashboard, ensuring that critical information is readily accessible for stakeholder discussions and decision-making.

Implementation – Case Study

Figure 1 illustrates the challenges of managing synchronized equipment lifecycles. This example highlights a bolus of medical imaging equipment nearing the end of its operational life, representing a scenario where a number of high-cost devices require replacement within a single fiscal year.

While this visualization effectively demonstrates the scale of the issue, it does not provide granular insights into the specific devices that need to be replaced. Critical details—such as equipment type, clinical importance, utilization rates, or current condition—are missing, which limits the ability to prioritize replacements or allocate resources effectively.

Figure 2 showcases the proposed capital planning dashboard. By breaking down complex challenges into manageable components, the dashboard supports effective resource allocation, ensures financial stability, and promotes seamless clinical operations.

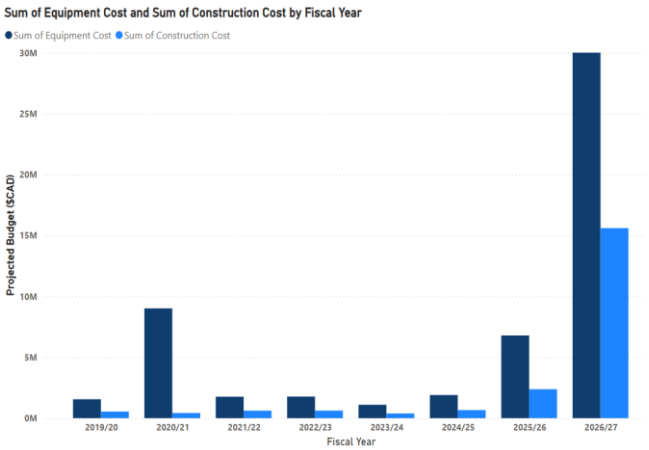

Figure 1: Projected capital expenditures (CAD) over fiscal years 2019/20 to 2026/27, highlighting a significant financial burden in 2026/27 driven by adherence to CAR lifecycle guidelines. The bolus in 2026/27 includes equipment and construction spending, the latter which can be highly variable, illustrating the need for financial smoothing strategies to mitigate the impact.

Focusing on the fiscal year 2026/27, the dashboard offers a detailed analysis of replacement requirements across key modalities, including MRI, CT, Ultrasound, and X-ray, as well as across different hospital sites. The visualization highlights critical data points, such as the number of units due for replacement and the associated costs. It also provides an overview of average replacement costs and a summary of expenditure by site, offering a high-level perspective on the financial implications for each year.

This granular yet holistic breakdown enables stakeholders to pinpoint the greatest areas of need, both by modality and by site. With this data-driven approach, decision-makers can prioritize resources effectively, addressing the most pressing needs while balancing long-term fiscal and operational goals.

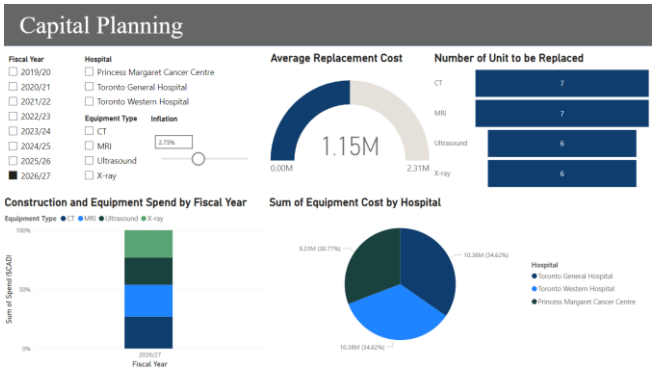

Figure 2: A snapshot of the capital planning dashboard, showing key metrics such as average replacement cost, units to replace, and spending distribution across sites and modalities.

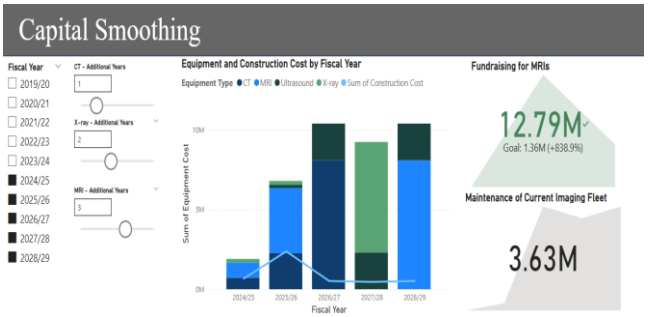

Figure 3: Projected Equipment and Construction Costs Smoothing for Fiscal Years 2024/25–2028/29, illustrating the impact of staggered replacements and additional years on CT, MRI, X-ray, and Ultrasound allocations. This includes fundraising progress and current maintenance cost visualization to support strategic resource planning and fiscal balance to show just a few of Power BI capabilities.

In contrast, Figure 3 illustrates how the projected financial burden for 2026/27 can be redistributed across three fiscal years. By rearranging expected spend according to clinical priorities—for example, addressing X-ray replacements early, followed by CT and MRI replacements in subsequent years, and evenly distributing Ultrasound replacements across all three years—the dashboard demonstrates a straightforward strategy for leveling capital expenditures.

The dashboard integrates adjustable parameters for factors such as inflation rates, replacement schedules, and maintenance costs. This functionality allows stakeholders to explore various financial scenarios. Features like End-of-Life notifications and trends in escalating maintenance costs further enhance the ability to develop flexible and responsive replacement strategies.

By presenting the immediate needs for 2026/27 and a smoothed multi-year approach, the dashboard becomes a valuable tool for high-level scenario planning and resource allocation. While this provides a robust foundation for proactive planning, it will require ongoing refinement to address the specific requirements and complexities of individual assets and sites, ensuring adaptability to evolving priorities.

LIMITATIONS

Power BI is an effective tool for high-level visualization and quick data analysis, but its utility is limited by the quality of the data fed into its models. Preparing data often requires programming to make it suitable for analysis, especially when exploring future scenarios. While it is excellent for providing broad overviews, Power BI may be best utilized by pre-programming specific situations, allowing users to customize high-level insights while integrating details such as construction timelines and asset-specific factors. This approach ensures insights are both actionable and aligned with operational needs.

Tools like Power BI and similar dashboards have limitations when applied to complex scenarios like imaging equipment planning. They often allow oversimplification of vital dependencies such as construction timelines, infrastructure modifications, and clinical capacity during disruptions, which extend beyond basic equipment lifecycles. To address these limitations, dashboards should include features to track delays from regulatory approvals or contractor availability, model phased construction scenarios, and integrate long-term financial and operational data. These enhancements would transform dashboards from simple visualization tools into comprehensive systems, enabling institutions to navigate unpredictability and make informed, strategic decisions.

CONCLUSION

Effective capital planning for medical imaging equipment requires tools that go beyond high-level visualizations to address the complexities of synchronized lifecycles, funding variability, and construction dependencies. By integrating Power BI with CMMS systems, we can create dashboards that dynamically analyze real-time data and provide detailed, actionable insights. This approach enables healthcare organizations to prioritize replacements strategically, balance operational and financial goals, and adapt to evolving needs. With features such as phased construction scenarios, cost distribution modeling, and customizable parameters, these dashboards bridge the gap between planning and execution, fostering transparency and alignment with institutional objectives. This strategy not only mitigates financial and operational risks but also ensures continuity and sustainability in delivering critical medical imaging services.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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