

Importance of Information Systems adaptation focusing on healthcare information systems sensitizing to healthcare 4.0 & Society 5.0.

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Abstract

Introduction

Global healthcare is likely to reach a magnitude of US\$ 1,211.14 billion by 2034 with a C.A.G.R. of 22.5% from 2024 to 2034 indicating the enormous magnitude. Due to the technological advent, IoT in Healthcare (IoHT), Healthcare 4.0, Society 5.0 and remote patient management altogether dynamically change the perception of the healthcare sector thereby transforming healthcare into a new technological 'realm' where healthcare information systems (H.I.S) is the backbone of healthcare delivery. HIS needs to be adapted internally for external sustainability of the healthcare delivery platform. This mentioned HIS adaptation needs to be done at constant intervals of time, thus the accurate method of Information Systems adaptation needs to be formulated.

Objectives

This research paper aims to endorse the new method of Information Systems efficiency management called the Co-efficient of Progressive Adaptation which states that, *"the rate of change of progressive adaptation of the concerned Information Systems is directly proportional to the efficiency of the same. Vice-versa"*. This method indicates prominence because, the H.I.S as mentioned need to be adapted internally in order to adapt to the dynamically changing external environment providing maximum efficiency, sustainability and the competitive advantage. For this, just technology alone will not be adequate. The accurate combination of technology and change management together will be required to devise the optimum strategy for Information systems adaptation which in this case is the Healthcare Information Systems.

Methods

This research work uses a mixed methodology by primarily focusing on conceptual research endorsed by epistemology and empirical research endorsed by phenomenology.

The conceptual research uses literature review by reviewing more than 100 articles on the topic of Information Systems efficiency management published on and after 2020. These articles were analyzed based on the theme of Information Systems efficiency management and thereby shortlisted. The aggregate findings were endorsed by epistemology and thus the consolidated aggregate was ontologically linked by the Co-efficient of Progressive Adaptation to the aggregate seminal findings from the empirical research that was endorsed by the implementation of phenomenology thereby indicating the result.

Results

Having focus on information systems adaptation on an accurate and timely basis for the optimum efficiency, accurate combination of change management and technology, eradication of steps no longer required, automation and adaptation, direct proportionality to the adaptation and H.I.S. and the inverse proportion between H.I.S. efficiency and the eradicated steps no longer required thereby covering gaps of the existing methods of information systems efficiency management as discovered in the gap analysis and seminal findings

holistically blended using ontologically thereby indicating the importance of I.S. adaptation using the Coefficient of Progressive Adaptation.

Conclusion

In the contemporary healthcare ecosystem, with Remote Patient Management inverting the perception of the healthcare sector and eradicating geographical barriers thus increasing patient information multi-fold, the accurate implementation of Knowledge Management Systems, AI, Cloud and Big Data into the Healthcare Information Systems that form the backbone of delivery for the healthcare delivery platform's external sustainability is highly crucial. This can be done using the Co-efficient of Progressive Adaptation.

Key words : Information Systems (I.S.), I.S. Adaptation, Gap Analysis, Healthcare 4.0, Society 5.0, Change Management and Strategic Implementation

1. Introduction

Global healthcare is likely to reach a magnitude of US\$ 1,211.14 billion by 2034 with a C.A.G.R. of 22.5% from 2024 to 2034 with a CAGR of 22.55% indicating the enormous magnitude of financial value thereby acting as an endorsement of this statement as the need for research in the domain of this massively expanding sector that is highly enhanced by the advent of technology (Presedence research, 2025). The advent of technology impacts the healthcare sector through the domain of remote patient management (RPM) as RPM part of the 'new normal' of healthcare delivery 'inverts' the perception of the healthcare sector by making the healthcare facility come to the patient rather than the patient going to the healthcare facility and even eradicates geographical barriers to a very noteworthy extent given these rapid technological advances in healthcare. Added to this, the healthcare sector's IoT also called the IoHT (Internet of Health Things) combined accurately with rapid advancements such as healthcare 4.0 and society 5.0 in aggregate further enhance the healthcare sector resulting the entire healthcare sector to the next dimension that is highly advanced and dependent on adaptation to the new healthcare technologies that includes digitization of healthcare (Burgess, 2018; Ranger, 2020) along with increasing use of wearable healthcare devices used for RPM, smart devices and electronic health records (EHR) all part of this mentioned IOHT that also enables remote health monitoring in remote geographical location (Rodrigues, 2023; Jain, 2022). With all these technological advancements, the healthcare sector still has Information Systems (IS) as the backbone of delivery called Healthcare Information Systems (HIS) i.e. all healthcare delivery platforms

have HIS as the backbone of delivery and connects all the various healthcare specific devices part of the IoHT that is used for RPM thus needing the HIS to be crucially focused upon particularly in terms of HIS adaptation (Reid, 2005; World Health Organization, 2008; Verma, 2023; Shahid, 2022). This mentioned HIS adaptation does include automation of the HIS, implementing AI and robotics along with Real Time Health Systems (RTHS) into the HIS platform, adapting the HIS adapt/sensitize with to cloud and big data and specifically optimise the knowledge management principle i.e. to provide the right information to the right person at the right time which in this case is the information about the concerned patient to the concerned doctor during the time of the consultation thereby optimizing the efficiency of the healthcare delivery platform (MARKETSANDMARKETS, 2023; Ahmad, 2011; Harrinson, 2021; Dias, 2014; Buchnowska, 2011; Burgess, 2018; Al-Jaroodi & al, 2020; Haleem, 2022). Thus the adapted HIS that forms the backbone of delivery to the healthcare delivery platform optimizes the efficiency output of the healthcare delivery platform that include accurate remote patient management and optimization of the treatment process in terms of optimal coordination, reduced human errors and human interventions, waste minimization, streamlined digitization, healthcare reimaging, greater diagnostic precision, maximally enhanced patient experience, better quality throughput through along with data driven insights (Dias, 2014; Technologies, 2023; Khang, 2024; Kaledio, 2024; Kaluvakuri, 2022; HELYXON, 2020; MIRALY.V, 2021).

Adaptation

Thus the endorsed adaptation of the HIS and RTHS (Real Time Health Systems) that are likely to become the key to the IoHT need to be accurately adapted constantly on a timely basis. This adaptation of the concerned HIS needs to be done internally in order to adapt externally to the dynamic and constantly changing environment effected by several factors (PESTEL factors). Thus , the CPA a.k.a Co-efficient of Progressive Adaptation is endorsed for this very purpose. The CPA states that , : *“the rate of change of progressive adaptation of the concerned Information Systems is directly proportional to the efficiency of the same. Vice-versa”* thereby indicating to be used in this scenario for HIS adaptation and the adaptation of RTHS as well by adaptation in various forms such as implementation of A.I., robotics, Cloud, Big Data, chatbots, A.R.,V.R. and K.M.S. (Knowledge Management Systems) given the large amount of increasing data in healthcare needing knowledge management principle to be implemented . The capacity of the concerned Information Systems which in this case is the Healthcare Information Systems to adapt to the dynamic and constantly changing environment is widely acknowledged to serve as the competitive advantage enabler Mirlay, Importance of Constant adaptation in the field of Management INformation systems in the banking Industry, 2019; Mirlay, Prominent role of IoT in the field of telemedicine, 2021; Covetus, 2020; Raphael David Schilling, 2017; Abdisalam Issa-Salwe, March 2010). Thereby : systematic planning along with adaptation of the Information System’s architecture that in this case is the architecture of the HIS is the point of focus to internally adapt the HIS by accurately combining change management and technology to device the optimum strategy for HIS adaptation/ healthcare technology’s architecture resulting in the healthcare delivery platform for

Literature review

which the HIS forms the backbone of delivery to produce maximum efficiency output and obtain the competitive advantage (Covetus, 2020; Raphael David Schilling, 2017; Merali, 2006; Ngelechei, 2016; PILARCZYK, 2016). Therefore the Architecture of the concerned HIS, RTHS and healthcare technology needs to be adapted at constant time intervals by accurately combining change management and technology for the optimum HIS adaptation strategy that includes the integration of A.R., V.R., A.I., RTHS and KMS by optimum strategic management resulting in the competitive advantage from the strategic perspective (Amiri, 2024; Phan, 2022; Alhashmi, 2025; Islam, 2025; Bizalwan, 2025).

Therefore the importance of constantly adapting the HIS for accurate and optimally efficient RPM on a global scale, the accurate and efficient IS adaptation method needs to be implemented. Current methods used in the process of Information Systems efficiency management are useful but appear to have gaps in very crucial areas that need to be addressed failing which the efficiency of the concerned Information Systems which in this case is Healthcare Information Systems are at the risk of declining efficiency due to crucial and substantial gaps that have not been addressed thereby endorsing the main objective of this study that is to endorse the need for accurate and timely adaptation of information systems by the optimum IS adaptation strategy that accurately combines change management and technology.

Thus, the literature review has examined current methods of Information Systems efficiency management in terms of current presence, current gap and the indicated direction for this research study to progress ahead .

Specific model	Title	Current Presence	Current Gap	Scope forward
T.P.M. and T.Q.M.	Integrating TQM and TPM into a management information system	Total Productive Maintenance (T.P.M.) of the concerned IS which in this case is HIS and Total Quality Management of the concerned Healthcare Information systems .	Adaptation/automation required and eradicated steps as core focal points.	New method of Healthcare Information systems’ efficiency being

				managed and measured.
T.P.M. and T.Q.M.	Prioritizing success factors for implementing total productive maintenance (TPM)	Total Productive Maintenance (T.P.M.) of the concerned Information systems, specifically in he Analytical Hierarchy Process.	Information systems focus which in this particular case is Healthcare Information Systems as a specific point of focus	Healthcare Information System's efficiency to be managed in this new method that covers the existing gaps present in T.P.M. and T.Q.M.
T.P.M. and T.Q.M.	Assessment of critical success factors, barriers and initiatives of total productive maintenance (TPM) in selected Ethiopian manufacturing industries.	T.P.M success factors in the field of IS efficiency management and Overall Equipment Efficiency (O.E.E.) in the filed of Information Systems which in this case is Healthcare Information Systems	Accurate and timely adaptation of the concerned Information Systems which in this case is H.I.S.	Efficiency of the healthcare information systems to be managed by the C.P.A.
O.E.E.	A Case Study to Determine OEE - A KPI Representing the Overall Productivity of a Machine.	T.P.M success factors in the field of Information Systems efficiency management along with Overall Equipment Efficiency (O.E.E.) in the domain of IS efficiency management .	Adaptation of the IS accurately on a timely basis.	The CPA to be implemented to manage the efficiency of the concerned Information Systems which in this case are the Healthcare Information Systems.
O.E.E.	Improvement of Operational Efficiency by Optimizing the OEE Score.: A Case Study of a Large Manufacturer.	Overall Equipment Effectiveness score for operational efficiency of the concerned Information Systems that well include IS efficiency improvement and sustainability.	Steps of the I.S. process to be automated and steps no longer required to be eradicated by adaptation of the Information Systems by the accurate and timely strategy.	The CPA to be implemented to manage the efficiency of the concerned Information Systems which in this case are

				the Healthcare Information Systems.
O.E.E.	INCREASING OEE THROUGH SIX BIG LOSSES ANALYSIS IN THE MACHINING PROCESS OF AUTOMOTIVE COMPANY	OEE in the machine process similar to the process in the Information Systems which in this case is the HIS. Noted gaps causing Production failures, machine downtime ,long preparation time and product defects. Preventive maintenance of machines , skill enhancement, and improving production process.	Timely adaptation the includes automation and eradication of steps that are no longer required.	The CPA to be implemented to manage the efficiency of the concerned Information Systems which in this case are the Healthcare Information Systems.
T.P.M.	Remote Audit Scheme of Embedded Device Software Based on TPM	TPM-based remote auditing scheme focused on security and malware prevention. Integration to enhance security.	Not focusing on efficiency.	To increase manage and measure the efficiency of the concerned Information systems using the CPA.
T.P.M.	Assessment of the modernized production system through selected TPM method indicators	Substantial similarity not noted in this study,	No specific Information Systems efficiency management and measurement focus.	Co-efficient of Progressive Adaptation to measure IS efficiency.
O.E.E.	OEE approach applied to additive manufacturing systems in distributed manufacturing network	OEEE used for decision-making approach in distributed manufacturing networks based on additive manufacturing, exploring technologies from industry 4.0. that may have some similarity to the Information systems being used in the healthcare domain.	Reduction of steps that are no longer required along with adaptation and automation not specified in this particular paper reviewed.	Co-efficient of Progressive Adaptation to measure IS efficiency.
O.E.E.E.	Measurement Using the OEE Method and Design Using the Single Minute Exchange of Dies	Requirement for increased productivity. THE OEEE figure showed 81% effected by machine setup, and machine downtime. Internal environment to face the	Specifics on how Information Systems efficiency can be maximized by	Increased efficiency measurement and management by the

	Method to increase Productivity in the Manufacturing Industry	external environment. Reduction in time and increase performance in the manufacturing industry.	accurate and timely IS adaptation.	implementation of the Co-efficient of Progressive Adaptation.
O.E.E.E.	A rule-based machine learning methodology for the proactive improvement of OEE: a real case study.	O.E.E. machine learning framework for OEE which includes A.I. Performance and quality investigation.	Accurate and timely IS adaptation to maximize the IS efficiency through automation and eradication of redundant steps.	How to implement the CPA to measure information system efficiency and increase the efficiency of the concerned information system after adaptation and eradication of steps in the IS process that are redundant, time consuming and have room for errors.
Lean Healthcare	Lean Healthcare Tools for Processes Evaluation: An Integrative Review	Continuous improvement and change. Define, measure, analyze , improve and control thereby process management. Process reduction time including waste reduction. Lean Six Sigma healthcare (Lean Healthcare - LH)approach. Operational performance improvement. Value Stream map.	Accurate and timely adaptation of the concerned Information Systems which in this case is the Healthcare Information Systems.	Lean healthcare gap to be covered by the Co-efficient of Progressive Adaptation.
Ishikawa Diagram	A study on Ishikawa's original basic tools of quality control in healthcare	7QC tools in the healthcare sector.	Accurate and timely Information Systems adaptation.	How to relate 7QC to the CPA and further compare and contrast.

Ishikawa Diagram	Analysis of root causes of problems affecting the quality of hospital administrative data: A systematic review and Ishikawa diagram	Hospital database and healthcare systems. Root cause analysis systemized using Ishikawa framework. Reusing data to point actions aiming at improving quality. Errors in data and data quality problems.	Accurate and timely Information Systems adaptation.	The CPA to manage and measure information system efficiency to efficiently manage the data using A.I. and automation by following the knowledge management principle.
Improvement measures	APPLYING QUALITY IMPROVEMENT APPROACHES FOR THE CONTROL OF CRITICAL MEDICAL PROCESSES IN A HEALTHCARE FACILITY	Requirement of continuous improvement of healthcare by quality management systems for hospital related information.	Accurate and timely Information Systems adaptation.	Continuous improvements by applying the CPA.
Lean in Healthcare	A Model for the Implementation of Lean Improvements in Healthcare Environments as Applied in a Primary Care Center.	Lean in the healthcare environment -adoption of lean for sustainability. Adaptation to rapid market changes leading to improvement post adaptation to environmental changes.	The new method to measure the efficiency of healthcare information systems.	Measurement of efficiency in healthcare information systems using the CPA.
Big Data in healthcare	Digital Disruption and Big Data in Healthcare - Opportunities and Challenges	Innovation and productivity to close the healthcare gap. Digital disruption by Big Data , A.I., Blockchain, IoT, Robotics, Cloud computing, drones, Edge computing, A.R./V.R. Data analysis. Changes in the healthcare sector. E.M.R.-information management. Time reduction in data analysis using disruptive	Neural networks and fraud detection along with operational problem being the challenge in big data analytics.	CPA to be implemented in the information systems that connect the various IoT devices to enhance digital disruption and solve

		innovation. Automation integration into the systems.		challenges such as the long learning curve .Remote Patient Monitoring focus.
O.E.E.	Online Overall Equipment Effectiveness (OEE) Improvement Using Data Analytics Techniques for CNC Machines	Improving quality, saving time and waste elimination . Industry 4.0 and big data. Productivity , quality and efficiency. Data analytics and Machine Learning with regard to adaptation.	CNC Machine production	Measuring HIS efficiency post waste reduction using the CPA.
O.E.E.	Analysis and directions of OEE and its integration with different strategic tools.	The five principles of OEE: identify equipment availability, identify value losses, improve process accuracy, improve quality precision, improve effectiveness-perfection.	Downtime loss, speed loss, quality loss, quantity loss, setup loss, and yield loss. Lot of focus on losses. Barriers of implementing O.E.E.. And Upgrading O.E.E.	Compare and contrast analysis to the new method of efficiency management and measurement being developed in this study. Unique integration of OEE with Lean manufacturing.
O.E.E.	Analysis of Medical Equipment Utilization and Management in Hospital	$O.E.E.=Availability*Performance* Quality$. Loss analysis.	More into radiology and invasive diagnosis. Root cause analysis may be another gap.	Efficiency of healthcare information systems in tele radiology.
O.E.E.	A Literature Review on the Contribution of Industry 4.0 Technologies in OEE Improvement	Industry 4.0 which in this case refers to the IoHT(Internet of Health Things). Remote patient management. Big Data ,A.I. Minimizing errors and losses and better decision making.	Simulation and digital twins to test product scenarios.	The new method of efficiency measurement and management to test the scenarios in order to

				determine the accurate strategy.
Lean	Operating room effectiveness: a lean health-care performance indicator	Adaptations of performance indicators. Waste identification.	More into the O.R. related and not loHT/Remote Patient Management.	CPA can be used as a reference.
Lean	Adoption of Industry 4.0 and lean concepts in hospitals for healthcare operational performance improvement	Adoption of Industry 4.0 in healthcare.	Vague information about how the healthcare sector improved.	How Big Data, IoT, Cloud computing with value streaming and 5S in the process of adopting healthcare technologies can optimize efficiency by the accurate strategy implemented using the Co-efficient of Progressive adaptation.
Lean	How to use lean manufacturing for improving a Healthcare logistics performance.	Increase supply chain management using lean thus adapting the process used in Industry 4.0.	Healthcare logistics 4.0 and tracking medicines.	How the Co-efficient of Progressive Adaptation can be used to maximize the efficiency of the information systems used in the supply chain of the Healthcare 4.0. by adapting the HIS forming the backbone of delivery at constant time intervals.

Lean	Measuring the effect of Healthcare 4.0 implementation on hospitals' performance	Healthcare 4.0 and implementation barriers with practical implementation leading to significant improvement.	Analysis of barriers to the implementation of healthcare 4.0 where the CPA might add value	CPA to determine the accurate strategy in the Healthcare 4.0 that includes eradication of barriers.
Lean	Effects of Lean Interventions Supported by Digital Technologies on Healthcare Services: A Systematic Review	Lean combined with six sigma for adaptation purpose. Reduction in Turn Around Time. Healthcare 4.0. Tele medicine and automation. Exponential growth of healthcare data being a major challenge in healthcare information systems. Data transmission.AR and VR.	Virtual modeling along with deep learning and simulation.	How the CPA to solve the major challenges caused by exponential growth of data by using automation and accurately combining Change management and technology that includes cloud and big data.
Lean	Increasing Competitiveness through the Implementation of Lean Management in Healthcare	New management innovations.	Lean implementation in healthcare. Compare and contrast analysis with models such as Kaizen and 5S. Process, Personnel and KPIs.	Optimum HIS adaptation strategy by accurately combining change management and technology at constant time intervals.
Lean	The Revolution Lean Six Sigma 4.0	Disruptive technology and IoT such as wearable devices making change management highly required. Data Storage and analysis .Reducing wastes. Synchronization of intelligent and self optimizing machines in the production line with the entire	The three pillars of the industrial revolution -People ,Process and Technologies. Data collection and predictive analysis. Emergency triaging .	Accurate strategy including the three pillars and emergency triaging using the Co-efficient of Progressive

		end-to-end (E2E) process, from suppliers to delivery of goods to customers. Methods to reduce turn around time.		Adaptation by combining change management and technology. Predictive analysis using A.I. algorithms. Value chain process is to adapted precisely.
Lean	Lean Manufacturing Practices and Integration of IR 4.0 Technologies for Sustainability in the Healthcare Manufacturing Industry.	Revolution 4.0 technologies on sustainability. Smart tools and data collection for strategic implementation in the healthcare sector.	Joint effect of LPM and IR 4.0 technologies on sustainability.	How the CPA may be used to format the accurate strategy combining the loHT, LPM and IR 4.0.
Lean	Revolutionizing healthcare organizations with Operational Excellence and Healthcare 4.0: a systematic review of the state-of-the-art literature	Healthcare delivery and Healthcare interface.	Relationship between Operational Excellence and Healthcare 4.0 by HIS adaptation.	How to maximize operational excellence with the Healthcare 4.0 by implementing the accurate strategy using the CPA.
DMAIC	Application of DMAIC Cycle and Modeling as Tools for Health Technology Assessment in a University Hospital.	Adaptation in the form of Six Sigma in Health Technology Assessment.	More into length of stay and technicalities.	Define, Measure, Analyze, Improve and Control to be used in the Co-efficient of Progressive Adaptation in H.I.S.
DMAIC	DMAIC for process digitalization: a	Adaptation in the form of Six Sigma in healthcare	More into the ambulatory systems rather than in the	The DMAIC indicates to be a relevant

	hospital case study.	operations. Improvement by 23%.	IoHT and Healthcare 4.0. that have HIS as the backbone of delivery.	problem-solving structure to measure the success and support the digitalization of business processes used in the CPA to increase efficiency and find solutions for current challenges in the domain of RPM.
DMAIC	Motivators to Application of DMAIC in Patient Care Processes.	Adaptation by using Six Sigma which comprises of DMAIC in the field of healthcare. Reduction in process time and improving patient quality.	Hospitals and emergency units.	How to implement the DMAIC and Six Sigma accurately in healthcare information systems by referring to the CPA
DMAIC	LEAN HEALTHCARE AND DMAIC TO IMPROVE THE OR SUPPLY PROCESS IN A PUBLIC HOSPITAL	Increase efficiency and reduce wastes. Lean Healthcare . Six Sigma in increasing efficiency. Identifying errors and mistakes in the Business Process. With regard to DMAIC, some similarities are there such as suppliers, input, output, process and customers.	Hospital and clinical practice such as surgical procedures. More into production. Improvements with 5S, VSM and so on.	CPA focus on the HIS adaptation.
DMAIC	Reducing the Healthcare-Associated Infections in a Rehabilitation Hospital under the Guidance of Lean Six Sigma and DMAIC.	Adaptation in the for of Lean and Six Sigma in healthcare.	More focus on rehabilitation and length of stay in hospitals rather than RPM and IoHT.	Adds strength to the Co-efficient of Progressive Adaptation to be implemented in the

				adaptation of the HIS.
Six Sigma	Six Sigma to reduce claims processing errors in a healthcare payer firm.	Continuous improvement by adapting using Six Sigma as an example. Non clinical setup. Reduction of errors-error free delivery.	No substantial gap noted in this particular study.	Immense scope for Six Sigma in healthcare thereby clearly indicating that the Co-efficient of Progressive Adaptation can be used to accurately device the strategy to optimize the results once the Six Sigma is implemented in healthcare.
Six Sigma	Quality improvement in healthcare: Six Sigma systematic review	Improve efficiency and reduce defects. Reduction of inefficient resources.		How the Co-efficient of Progressive Adaptation can be used in comparison to Six Sigma to increase efficiency and measure efficiency of the concerned healthcare information system.

The above table compares and contrasts how the current methods of IS efficiency management add value and also endorses certain gaps that are crucial for the management of Information Systems efficiency which in this case is the efficiency of Healthcare Information Systems. The conducted literature review therefore endorses the indication for the new method of IS efficiency management in

the mentioned Co-efficient of Progressive Adaptation as the CPA covers gaps in the present methods of IS efficiency management. The noted gaps in IS efficiency management are as follows :

- Adaptation of the concerned HIS accurately on a timely basis.
- Constant adaptation of HIS at regular time intervals.

- HIS having the focus on the implementation of automation.
- Elimination of steps that are no longer required, time consuming have a room for errors and eventually lead to the steady decline of IS efficiency.
- Barriers to implement the required adaptation.
- Accurate combination of change management and technology to devise the optimum strategy for IS adaptation.
- Lack of the dynamic component of adaptation accounting for real-time technological advancements and environmental shifts of an external nature. The **structured and cyclical framework for continuous, real-time adaptation** focusing on leveraging **AI, automation, and robotics** to optimize processes dynamically. Evolved responses to technological disruptions resulting in assured **agility and resilience**.
- Lack of systems adaptability shift in an environment like Healthcare 4.0 and society 5.0 that are dynamic and constantly changing.
- Real time alignments for sensitization with constant and dynamic technological changes and evolution in the healthcare domain that include implementation of A.I. and robotics in the HIS that form the backbone of delivery of the HIS.
- Adaptation that includes emphasis on timelines and precision assuring changes at regular time intervals assuring maximum IS efficiency.
- Lack in real time adaptation of Information Systems which in this case is Healthcare Information Systems.
- Fragmented characteristic features of the various methods used for IS efficiency management.
- Lack of efficiency and capacity to handle complexity i.e. complex situations such as evolved technological advancements in healthcare that require the accurate combination of change management and technology.
- Strategic adaptation.
- The two main hypothesis of this study that are :
 - Direct proportionality between the Information Systems adaptation and the Information systems' efficiency.

- Inverse proportionality between the Information systems efficiency and the number of redundant steps in the Information Systems process that are to be eradicated.

(Sharp, 2004) (Singh R. K., 2022) (Gelaw M. T., 2023) (Pierre., 2023) (Li, 2022) (Michlowicz, 2022) (Mendonça, 2022) (Lucantoni, 2023) (Sahroni, 2023) (de Barros, 2021) (McDermott O. A., 2023) (Carvalho, 2021) (Moldovan, 2021) (Khatib, 2022) (Yuan, 2021) (Singh S. K., 2021) (Souza, 2020) (Ilangakoon, 2022) (Paul-Eric, 2020) (Tortorella G. L., 2020) (Prado-Prado, 2020) (Pieroni) (Akanmu, 2022) (Detwal, 2024) (Ponsiglione, 2021)(Ramires., 2020) (Reis, 2021) (Cesarelli, 2021) (Kunnath, 2019) (Niñerola, 2020) (Pai, 2023) (Alim, 2023) (Blaga, 2021) (Oscar, 2021) (McDermott O. A., 2023) (Yuan A. Z., 2021) (Singh K. a., 2020) (Masmoudi, 2023) (Ilangakoon W. S., 2021).

2. Objectives

The objectives of this research work aim at endorsing the indication of the new method of Information Systems efficiency management called the Co-efficient of Progressive Adaptation which states that: “ *the rate of change of progressive adaptation of the concerned Information Systems is directly proportional to the efficiency of the same. Vice-versa.*” . This mentioned new method is endorsed by the competitive advantage over contemporary methods of Information Systems efficiency management such as T.P.M., T.Q.M., O.E.E. and D.M.A.I.C. as these methods have gaps covered by the new method that can be dangerous to the Information Systems if not addressed in terms of the efficiency of the concerned Information Systems declining steadily over a period of time eventually leading to the platform that it forms the backbone of delivery for becoming obsolete. Particularly in this case, the Information Systems used by Remote Patient Management – the ‘New Normal’ of medical practice, Healthcare Information Systems need to function with maximum efficiency output for the sustainability of the healthcare delivery platform.

3. Methodology

Based on past aggregate empirical research that reaped seminal findings and aggregate findings from rigorous conceptual research that were

ontologically linked using the CPA, the literature review in this study was done by analysing peer reviewed articles of Healthcare IT, computer science, information management, and AI applications (2020–2025) from journals and databases that included leading publications from Scopus, PubMed, and IEEE Xplore. The key phrases used for the search are elaborated below :

Search Keywords for Healthcare Information Systems

- Efficiency AND "healthcare information systems" AND "artificial intelligence".
- "Measuring efficiency" AND "AI in healthcare" AND "information systems".
- "Adaptation strategies" AND "automation" AND "healthcare systems".
- "Methods for efficiency maximization" AND "healthcare IT".

Search Keywords for Information Systems in General

- "Information systems" AND "artificial intelligence" AND "efficiency management".
- "Maximizing efficiency" AND "automation" AND "information systems".
- "Adaptation strategies" AND "AI systems" AND "efficiency metrics".

The gap analysis used to examine the literature review endorsed a fragmented outlook for the sustainability of maximum Information Systems efficiency in specific areas such as continuous improvement by constant IS adaptation at regular time intervals, elimination of steps in the IS process that are redundant , time consuming have a lot of room for errors and eventually decline the IS efficiency therefore need to be eradicated along with accurately combining change management and technology for the optimum IS adaptation strategy to be implemented by using the CPA.

4. Results

This gap analysis is further endorsed by the findings that suggested the CPA adds value by contributing a cyclical framework for managing and measuring

Information Systems efficiency by implementation of the optimum IS adaptation strategy that accurately combines change management and technology for the IS adaptation at constant time intervals to ensure maximum IS efficiency output of the healthcare delivery platform that has HIS as the backbone of delivery thereby enabling sustainability of the concerned healthcare delivery platform that eventually leads to the competitive advantage. This is because the CPA also emphasizes the synergy between AI, robotics, automation, and knowledge management systems to optimize processes dynamically, adhering to the Knowledge Management principle of delivering the right information to the right person at the right time which in this case is the information about the concerned patient to the concerned doctor at the time of the consultation.

5. Discussion

This mentioned competitive advantage obtained by the healthcare delivery platform by the maximum efficiency of the HIS by the implementation of the CPA is endorsed in the adaptation of Information Systems as well as the efficiency management of Information Systems in specific terms of :

- IS efficiency measurement.
- IS efficiency management.
- Relevant problem-solving structure to measure the success and support the IS.
- Gap analysis in comparison to the 7QCs.
- Integration of HIS with lean and Six Sigma.
- Accurate and timely IS adaptation that includes automation, integration of AI, robotics, cloud, Big Data , and KMS.
- KMS integration into HIS to sensitize the process with big Data and cloud using the KM principle.
- Reduction of steps in the HIS process increasing HIS efficiency thereby efficiency of the healthcare delivery platform.

The CPA equation is elaborated as follows :

Optimum efficiency (Oe)=Pm (Present methods * θ – Es(Eradicated steps).

Variables of the CPA such as Oe (Optimum efficiency) method, adaptation, Pm(Present method), and Er (Eradicated steps). In this : the Oe

and Adaptation are the dependent variables where as the Pm and Er happen to be the dependent variables. The clear hypothesis observed here are :

- A. Direct proportionality between the Oe and adaptation of the HIS.
- B. Inverse proportionality between the Oe and the Er.

The empirical findings that endorse and support these findings are :

- A. Implementation of the CPA in the banking sector increasing IS efficiency by a magnitude of more than 410 man hours per anum.
- B. CPA implementation in the HIS used in the healthcare platform increased efficiency by 50 % in the main step of the process i.e. the doctor consultation sue to template automation.

6. Conclusion

Therefore with this advent of technology that includes IoHT, Healthcare 4.0 and Society 5.0 all having Information Systems known as Healthcare Information Systems as the backbone of delivery and the backbone of delivery for the healthcare delivery platform , the Information Systems need to be adapted regularly at constant time intervals by accurately combining change management and technology to devise the optimum strategy for IS adaptation. The HIS needs to be adapted internally in order for the healthcare delivery platform to adapt externally and produced maximum efficiency output for sustainability given the dynamically changing and evolving healthcare technological ecosystem that requires the accurate combination of change management and technology also leading to sustainability by environmental sensitization and enablement of the competitive advantage. This can be done by the implementation of the Co-efficient of Progressive Adaptation in the concerned Information Systems , and this also includes implementation of robotics, A.I., chat bots, cloud, big data, RTHS (Real Time Health Systems) and KMS (Knowledge Management Systems).

References :

1. Ahmad. (2011, June). *mobisoftinfotech.com*. Retrieved March 10, 2021, from <https://mobisoftinfotech.com/resources/blog/iot-in-telemedicine/#:~:text=Trending%20Use%20C>

ases%20of%20IoT,improved%20network%20and%20internet%20connectivity.

2. Akanmu, M. D. (2022). Lean Manufacturing Practices and Integration of IR 4.0 Technologies for Sustainability in the Healthcare Manufacturing Industry. *International Journal of Service Management and Sustainability (IJSMS)*, 7(1), 21-48.
3. Alhashmi, S. M. (2025). Knowledge management, health data, and advanced data analytics to expedite solutions in the healthcare industry. *Academic Press : Digital Healthcare, Digital Transformation and Citizen Empowerment in Asia-Pacific and Europe for a Healthier Society* , 231-247.
4. Alim, K. a. (2023). INCREASING OEE THROUGH SIX BIG LOSSES ANALYSIS IN THE MACHINING PROCESS OF AUTOMOTIVE COMPANY. *Jurnal Ilmiah Global Education*.
5. Al-Jaroodi, & al, r. M. (2020). Health 4.0: On the Way to Realizing the Healthcare of the Future. *IEEE*, 211189 - 211210.
6. Amiri, Z. (2024). Leveraging AI-enabled information systems for healthcare management. *Journal of Computer Information Systems*, 1-28.
7. Bizalwan, D. S. (2025). Enhancing Healthcare with Artificial Intelligence: A Configurational Integration of Complementary Technologies and Stakeholder Needs. *Communications of the Association for Information Systems*, 57(1), 17.
8. Blaga, M. a. (2021). APPLYING QUALITY IMPROVEMENT APPROACHESFOR THE CONTROL OF CRITICAL MEDICALPROCESSES IN A HEALTHCARE FACILITY. *Sciendo*.
9. Buchnowska. (2011). Customer Knowledge Management Models: Assessment and Proposal. *SPRINGER NATURE Link*, 25-38.
10. Burgess. (2018, February 16). Retrieved from www.wired.co.uk: <https://www.wired.co.uk/article/internet-of-things-what-is-explained-iot>
11. Burgess, M. (2018, February 16). Retrieved April 24, 2020, from www.wired.co.uk:

- <https://www.wired.co.uk/article/internet-of-things-what-is-explained-iot>
12. Carvalho, L. O. (2021). Analysis of root causes of problems affecting the quality of hospital administrative data: A systematic review and Ishikawa diagram. *International Journal of Medical Informatics*.
 13. Carvalho, R. L. (2021). Analysis of root causes of problems affecting the quality of hospital administrative data: A systematic review and Ishikawa diagram. *International journal of medical informatics*, 156, 104584.
 14. Cesarelli, G. P. (2021). Reducing the Healthcare-Associated Infections in a Rehabilitation Hospital under the Guidance of Lean Six Sigma and DMAIC. *MDPI : Healthcare (Vol. 9, No. 12)*, 1667.
 15. Covetus. (2020, October 24). Retrieved January 23, 2021, from www.covetus.com: <https://www.covetus.com/blog/the-impact-of-the-internet-of-hospital-things-ioht-on-the-healthcare-it-industry>
 16. de Barros, L. B. (2021). Lean Healthcare Tools for Processes Evaluation: An Integrative Review. *International journal of environmental research and public health*, 18(14), 7389.
 17. Detwal, P. K.-R. (2024). Revolutionizing healthcare organizations with Operational Excellence and Healthcare 4.0: a systematic review of the state-of-the-art literature. *International Journal of Lean Six Sigma*, 15(1), 80-102.
 18. Dias. (2014, July 21). Retrieved January 23, 2021, from hitconsultant.net: <https://hitconsultant.net/2014/07/21/6-big-benefits-of-applying-automation-to-healthcare/>
 19. Gelaw, A. a. (2023). Assessment of critical success factors, barriers and initiatives of total productive maintenance (TPM) in selected Ethiopian manufacturing industries. *Emerald Insight*.
 20. Gelaw, M. T. (2023). Assessment of critical success factors, barriers and initiatives of total productive maintenance (TPM) in selected Ethiopian manufacturing industries. *Journal of Quality in Maintenance Engineering*, 30(1), 51-80.
 21. Gurtu., S. a. (2022). Prioritizing success factors for implementing total productive maintenance (TPM). *Emerald Insight*.
 22. Haleem, J. ., (2022). Medical 4.0 technologies for healthcare: Features, capabilities, and applications. *Internet of Things and Cyber-Physical Systems; Volume 2* , Pages 12-30.
 23. Harrinson, E. (2021, May 30). Retrieved from www.kminstitute.org: <https://www.kminstitute.org/blog/getting-right-knowledge-right-person-right-time>
 24. HELYXON. (2020). <https://www.linkedin.com/company/helyxon-healthcare-solutions-private-limited>. Retrieved from <https://www.linkedin.com/company/helyxon-healthcare-solutions-private-limited>: https://www.linkedin.com/company/helyxon-healthcare-solutions-private-limited/?lipi=urn%3Ali%3Apage%3Ad_flagship3_search_srp_all%3ByVsF0gVJR06y74JLUdE3Nw%3D%3D
 25. Hospital, A. o. (2022). Marion, Kumar, Boaz, and Nair. *Tuijin Jishu/Journal of Propulsion Technology*.
 26. Ilangakoon, T. S. (2022). Adoption of Industry 4.0 and lean concepts in hospitals for healthcare operational performance improvement. *International Journal of Productivity and Performance Management*, 71(6), 2188-2213.
 27. Ilangakoon, W. S. (2021). Adoption of Industry 4.0 and lean concepts in hospitals for healthcare operational performance improvement. *International Journal of Productivity and Performance*.
 28. Islam, M. Z. (2025). Artificial Intelligence in Strategic Healthcare Business Decisions: Engineering Competitive Advantage Across Health Systems. *Pacific Journal of Business Innovation and Strategy*, 2(2), 29-40.

29. Jain, J. a. (2022). Applications of AI, IoT, and Robotics in Healthcare Service Based on Several Aspects. *Blockchain Technology and Healthcare Applications*.
30. Kaledio, D. a. (2024). www.researchgate.net. Retrieved from https://www.researchgate.net/profile/Kaledio-Potter/publication/379783724_Optimizing_Hospital_Workflows_with_AI_and_Robotics/links/661a520b39e7641c0bbb1894/Optimizing-Hospital-Workflows-with-AI-and-Robotics.pdf
31. Kaluvakuri. (2022). Revolutionizing Healthcare: The Impact of Robotics on Health Services . *ISSN 2313-0008 (Print); ISSN 2313-0016 (Online)*, 1-10.
32. Khang, B. a. (2024). Machine Learning Advancements in E-Health: Transforming Digital Healthcare. *Medical Diagnostics and AI-Assisted Diagnostics for a Hi-Tech Healthcare Industry*, 21.
33. Khatib, H. A. (2022). Digital Disruption and Big Data in Healthcare - Opportunities and Challenges. *Taylor and Francis*, 563-574.
34. Khatib, H. A. (2022). Digital Disruption and Big Data in Healthcare - Opportunities and Challenges. *Taylor and Francis Online*, 563-574.
35. Kunnath, S. a. (2019). Six Sigma to reduce claims processing errors in a healthcare payer firm. *Taylor & Francis Online*, 496-511.
36. Li, Z. C. (2022). Remote Audit Scheme of Embedded Device Software Based on TPM. *IEEE*, 61-66.
37. Lucantoni, L. A. (2023). A rule-based machine learning methodology for the proactive improvement of OEE: a real case study. *International Journal of Quality & Reliability Management*, 1356-1376.
38. MARKETSANDMARKETS. (2023, December). www.precedenceresearch.com. Retrieved from www.precedenceresearch.com/telehealth-market#:~:text=The%20global%20telehealth%20market%20size,22.5%25%20from%202024%20to%202034.
39. Masmoudi, P. a. (2023). A Literature Review on the Contribution of Industry 4.0 Technologies in OEE Improvement. *Springer Link* .
40. McDermott, O. A. (2023). A study on Ishikawa's original basic tools of quality control in healthcare. *The TQM Journal, 35(7) :Emerald Journal*, 1686-1705.
41. McDermott, S. R. (2023). A study on Ishikawa's original basic tools of quality control in healthcare. *Emerald Journal* .
42. Mendonça, P. A. (2022). OEE approach applied to additive manufacturing systems in distributed manufacturing networks. *Computers & Industrial Engineering.*, 171.
43. Merali. (2006). Complexity and Information Systems: The Emergent Domain. *Journal of Information Technology*.
44. Michlowicz, E. (2022). Assessment of the modernized production system through selected TPM method indicators. *Eksploracja i Niezawodność, 24(4)*, 677-686.
45. Michlowicz, E. (2022). Assessment of the modernized production system through selected TPM method indicators. *Library of Science*.
46. MIRALY.V. (2021). Prominent role of IoT in the field of telemedicine; the case for technology adaptation. *MANAGEMENT MATTERS*, 76-93.
47. Moldovan, F. &. (2021). APPLYING QUALITY IMPROVEMENT APPROACHESFOR THE CONTROL OF CRITICAL MEDICALPROCESSES IN A HEALTHCARE FACILITY. *Acta Marisiensis. Seria Technologica.*, 18(2).
48. Ngelechei, P. C. (2016). MANAGEMENT INFORMATION SYSTEMS AND ACHIEVEMENT OF SUSTAINABLE COMPETITIVE ADVANTAGE IN THE KENYAN BANKING SECTOR: CASE OF KENYA COMMERCIAL BANK LTD. *Strategic Journal of Business & Change Management*.
49. Niñerola, A. S.-R.-L. (2020). Quality improvement in healthcare: Six Sigma

- systematic review. *Six Sigma systematic review. Health Policy*, 124(4), 438-445.
50. Oscar, C. a. (2021). A Model for the Implementation of Lean Improvements in Healthcare Environments as Applied in a Primary Care Center. *MDPI*.
 51. Pai, R. ,. (2023). A Case Study to Determine OEE - A KPI Representing the Overall Productivity of a Machine. *Journal of Mines, Metals & Fuels* .
 52. Paul-Eric, R. C. (2020). How to use lean manufacturing for improving a Healthcare logistics performance. *Procedia Manufacturing.*, 1657-1664.
 53. Phan, A. C. (2022). A systematic approach to healthcare knowledge management systems in the era of big data and artificial intelligence. *Applied Sciences*, 12(9).
 54. Pieroni, A. a. (n.d.). The Revolution Lean Six Sigma 4.0. *International Journal of Advanced Science Engineering Information Technology*, 141-149.
 55. Pierre, R. a. (2023). Improvement of Operational Efficiency by Optimising the OEE Score.: A Case Study of a Large Manufacturer. *Digitala Vetenskapliga Arkivet*.
 56. Pierre., R. a. (2023). Improvement of Operational Efficiency by Optimising the OEE Score.: A Case Study of a Large Manufacturer. *Digitala Vetenskapliga Arkivet*.
 57. PILARCZYK, K. (2016). Importance of Management Information System in Banking Sector. *MARIAE CURIE-SKŁODOWSKA*.
 58. Ponsiglione, A. M. (2021). Application of DMAIC Cycle and Modeling as Tools for Health Technology Assessment in a University Hospital. *Journal of Healthcare Engineering*, 8826048.
 59. Prado-Prado, J. C.-A.-G.-A. (2020). Increasing Competitiveness through the Implementation of Lean Management in Healthcare. *MDPI : International Journal of Environmental Research and Public Health*, 17(14), 4981.
 60. Presedence research . (2025, October 15). Retrieved from [www.precedenceresearch.com: https://www.precedenceresearch.com/telehealth-market](https://www.precedenceresearch.com/telehealth-market)
 61. Rabelo, P. a. (2022). OEE approach applied to additive manufacturing systems in distributed manufacturing networks. *Computers & Industrial Engineering*.
 62. Ramires., P. &. (2020). DMAIC for process digitalization: a hospital case study. *International Conference on Quality Engineering and Management* .
 63. Ranger, S. (2020, February 03). Retrieved April 24, 2020, from What is the IoT? Everything you need to know about the ...: <https://www.zdnet.com/article/what-is-the-internet-of-things-everything-you-need-to-know-about-the-iot-right-now/>
 64. Raphael David Schilling, J. B. (2017). Revisiting the Impact of Information Systems Architecture Complexity: A Complex Adaptive Systems Perspective. *Thirty Eighth International Conference on Information Systems, South Korea*. South Korea.
 65. Reid, P. P. (2005). Information and communications systems: The backbone of the health care delivery system. *National Academies Press (US) : Building a better delivery system: a new engineering/health care partnership*.
 66. Reis, M. V. (2021). Motivators to Application of DMAIC in Patient Care Processes. *IFIP International Conference on Advances in Production Management Systems : Springer International Publications*, 269-279.
 67. Rodrigues, R. C. (2023). Digital health in smart cities: Rethinking the remote health monitoring architecture on combining edge, fog, and cloud. *Springer Nature Link* , 449–472.
 68. Sahroni, Z. P. (2023, May 17). *Measurement Using the OEE Method and Design Using the Single Minute Exchange of Dies Method to increase Productivity in the Manufacturing Industry*. Retrieved January 2024, 09, from [www.e3s-conferences.org: https://www.e3s-](https://www.e3s-conferences.org)

- conferences.org/articles/e3sconf/abs/2023/25/e3sconf_icobar2023_01024/e3sconf_icobar2023_01024.html
69. Sahroni, Z. P. (2023). Measurement Using the OEE Method and Design Using the Single Minute Exchange of Dies Method to increase Productivity in the Manufacturing Industry. *E3S Web of Conferences*.
70. Shahid, A. K. (2022). Data Protection and Privacy of the Internet of Healthcare Things (IoHTs). *MDPI*.
71. Sharp, I. a. (2004). Integrating TQM and TPM into a management information system. *International Journal of Information Technology and Management*. , 242-255.
72. Sharp, I. a. (2004). Integrating TQM and TPM into a management information system. *International Journal of Information Technology and Management*., 242-255.
73. Singh, K. a. (2020). Analysis and directions of OEE and its integration with different strategic tools. *Sage Journals*.
74. Singh, R. K. (2022). Prioritizing success factors for implementing total productive maintenance (TPM). *Journal of Quality in Maintenance Engineering*, 28(4), 810-830.
75. Singh, S. K. (2021). Analysis and directions of OEE and its integration with different strategic tools. *Proceedings of the Institution of Mechanical Engineers, Part E: Journal of Process Mechanical Engineering*, 235(2), 594-605.
76. Souza, T. A. (2020). Operating room effectiveness: a lean health-care performance indicator. *Emerald Insight : International Journal of Lean Six Sigma*, 11(5), 973-988.
77. Technologies, S. o. (2023). Survey on Electronic Health Record Management Using Amalgamation of Artificial Intelligence and Blockchain Technologies. *ACTA INFORMATICA PRAGENSIA*, 179-199.
78. Tortorella, G. L. (2020). Measuring the effect of Healthcare 4.0 implementation on hospitals' performance. *Taylor and Francis online : Production Planning & Control*, 33(4), 386-401.
79. TPM, R. A. (2022). IEEE. *Li, Zhang, Cui, Liu, Sun, Guan, and Wan*.
80. Verma, C. a. (2023). A Comprehensive review of 'Internet of Healthcare Things': Networking aspects, technologies, services, applications, challenges, and security concerns. *Computer Science Review*.
81. World Health Organization. (2008). Toolkit on monitoring health systems strengthening HEALTH INFORMATION SYSTEMS. *World Health Organization* .
82. Yuan, A. Z. (2021). Online Overall Equipment Effectiveness (OEE) Improvement Using Data Analytics Techniques for CNC Machines. *Springer link*.
83. Yuan, M. A. (2021). Online Overall Equipment Effectiveness (OEE) Improvement Using Data Analytics Techniques for CNC Machines. *Implementing Industry 4.0: The Model Factory as the Key Enabler for the Future of Manufacturing*, 201-228.