AI BASED TRANSFORMATION PROJECTS-LANGUAGE PROCESSING ENVIRONMENTS FOR AUDIT AND GOVERNANCE (LPE_AG)-THE PROOF OF CONCEPT

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ABSTRACT

This article presents Artificial Intelligence (AI) role in complex Transformation Initiatives and Projects, in which Language Processing Environments (LPE) like Machine Learning (ML) and Natural Language (NL) Processing (NLP) and other are applied to integrate, and implement enterprise's Audit, and Governance (LPE_AG) Framework (LPE_AGF). Where the author privileges an Authentic Local Implementation (ALI) approach for such a holistic framework. Taking into-account various domains related to audit, governance-analytics, and where the application of AI and LPE, is apriority. The proposed approach was analysed and the related basics were hammered [1] and, in this article, an adapted implementation is presented to support the mentioned basics and fundaments. Such an implementation supports auditors to get precise insights from stored data and experiences, to be used by dedicated frameworks, like the LPE_AGF. The LPE_AGF relied on AI Subdomains (AIS) to achieve various AACG tasks, and especially to automate AACG procedures by applying LPE. The main AIS that is applied is ML which learns from patterns and to mitigate important risks. Project risks cause transformation projects' eXtremely High Failure Rates (XHFR) at about 95%. This article implementation uses standard Enterprise Architecture (EA), audit methodologies-frameworks, decision-making system, interfaces for existing AG frameworks like the Control Objectives for Information and Related Technologies (COBIT), Committee of Sponsoring Organization's (COSO) Enterprise Risk Management (ERM)... For the implementation or Conceptual Proof of Concepts (CPoC) needed: 1) A specialized framework; 2) A Polymathical approach; 3) Solutions built on blocks; and 4) Offers a set of recommendations on LPE_AG's implementation [1].

KEYWORDS

CPoC, Language Processing, Machine Learning, Artificial Intelligence, Natural Language Processing, Auditing and control procedures, Transformation Projects, Enterprise Architecture, Automation, and Decision-making.

1. INTRODUCTION

This article (and that concerns practically the whole of all author's project and research works) concentrate on complex transformations and AISs' applications in control, audit, and maintenance related activities, that include a set of different-heterogenous Information and Communication Systems (ICS) and AI domains and all related fields. Knowing that AISs are applied to execute automated tasks in various APplication Domains (APD), and tries to clone Human Behaviours (HB) Thinking Processes (simply Thinking); and that requires a Polymathic and Holistic approach to AIS (PHAIS), that offers an avant-garde and complex-cross-functional basis for ICS and EA based Aggregated Models (AModels), which includes Thinking, functional, mathematical-models, and various scientific fields. An Infrastructure, e-Business, Organizational, Audit-Governance, or Common Transformation Project (simply Project) applies AModels to interface generated and Automated Audit, Control, and Governance (AACG) Procedures (AACGP). AACGPs are used in NL like NLP Environments (NLPE) or other ICS and AI environments, to implement different types of implementation-components like routine audit processes, which can use also NL and ML modules. Applying various ICS and AIS fields like DL/ML, or other mediums that include pretrained AI-foundation-models (AIFM). The mentioned AIFMs are prepared, and trained on Massive In-memory DataSets (MIDS) (or data- entities) to be processed by AIFMs' interactions. PHAISs are a new form of AI-enabled collaborations that are required to assemble different AISs like DL/ML, NLP, MIDSs… [10]. The PHAIS is a Generalized Intelligence Approach (GIA), which is very different from the actual statistics based commercial-products' approach, which in fact is a specialized approach that is applied in specific and concise contexts. PHAISs can process large data-sets and has multiple capabilities, like NLPEs' integration/interfacing, Image-recognition processing, Intelligence enabled decision-making processes, and Advanced logical-reasoning, that are efficient in different APDs. PHAISs are closely related to the evolution of GIA as shown in Figure 1, which targets the implementation of ICS components capable of: 1) Using Adavanced Learning Processes (ALP) for complex control-audits; and 2) Defined-understand and apply gained experiences (and concrete professional-knowledge) like Thinking processes. But, PHAISs (or RTEAI_MPR) implies different important considerations for ICS and AISs related Project's finalizations and holistic ALPs, like how can AISs and ICSs clone Thinking processes. PHAISs have the major aim to offer flexible/versatile, and generic decision making processes; to support LPE_AG's activities *[1]*.

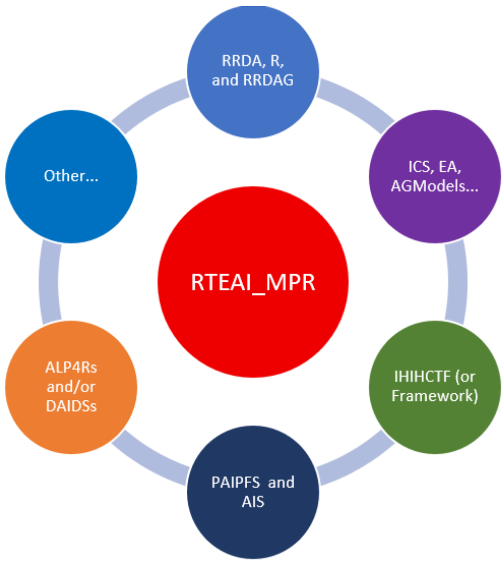

Figure 1. Different PHAIS interactions.

Actual AIS environments are intended to offer more concise AIS services and products, such as OpenAI and DeepMind, which are contributing to the implementation of Polymathic capabilities in AISs [2].

The LPE_AG is analysed in the context of PHAISs based Projects, where [1,24]:

- It is used to manage LPE_AGF's interfaces, integration processes, and enterprise's AACGPs related operations.

- Adopts an ALI concept for the LPE_AGF and PHAISs integrations.
- AISs based audit-analytics process is strategic for maintaining an ICS, where it focuses on automating AACGPs (or internal audit controls and procedures) by using NL, NLP, ML, DL, and other.
- The LPE_AGF contains an ALP Container (LPC) that persists experiences, solutions, and historic-data-volumes; which is used to predict Projects' risks and avoid XHFRs.
- Proposes an optimal Project's architecture and AModels, to support possible solutions by using EA.
- The use of decision-making process to evaluate possible risks and to launch corrective AACGPs' Actions (AACGA).
- Proposes interfaces for interacting with existing major audit frameworks like COBIT, COSO's ERM…
- Uses a specific mixed-method and a Polymathical approach for complex (re)engineering undertakings, like the Project.

AACGAs are the selected and tuned actions that are defined by the Project's AACG policies and control-procedures, which support the implementation of Project's management visions and directives to mitigate possible risks until the achievement of Project's objectives. AACGAs are applied at all Project's levels, and in various Business Processes (BP) or WorkFlows (WF) parts, and in other ICS' artefacts. These AACGAs are preventive and include a set of (semi)manual and automated tasks like: Authorizations (and approvals); Verifications; Reconciliations, and Performances' reviews. Segregation of duties is typically built into the selection and development of control activities [3]. This research article has been adapted for transformational activities and can appear as complex, therefore, it is recommended that the valuable reader refers to the author's In-House Implemented (ALI) Polymathic Transformation Framework (ALIPTF) related articles, works, guides, and resources, like: The ALIPTF Guide [4]; The ALIPTF Glossary [5]; A related syllabus [6]; The AHMM4PROJECT and business transformations' implementation [7,8]; The AI based Projects [9]; and this article's specific used abbreviations and terms, which are found at the end of this article *[1]*.

2. RDP FOR LPE_AG AND RELATED WORKS

2.1. Basic Constructs

This article uses the author's RDP that is defined in detailed in the strongly related article *[1]*. It applies a Polymathic and holistic research mixed-methods' concept that is mainly a qualitative heuristics-based approach. And uses a collection or set(s) of initially selected, initialized, and related Critical Succes Factors (CSF), Critical Success Areas (CSA), Key Performance-Indicators (KPI), and ICS' concrete NLP (or ICS' programming-language) VARiables (VAR).

2.2. Main Issues

The RDP is made up of the following artefacts, facts, modules, and constraints [3,13,14]:

- The Research Question (RQ) is: "How can the LPE_AG support Projects audit, control, and governance activities?". And this article's auxiliary question is: "How can AISs support LPE_AG's automation?".
- A CSA corresponds and links to important LPE_AG's (or major) topics (that are organized in sections); and this article 1st CSA (or section) is the RDP.

- CSFs and CSAs are used to evaluate LPE_AG's integration statuses and Project's feasibility; which are supported by the Applied Holistic Mathematical Model (AHMM) for AI (AHMM4AI) and ALIPTF's modules.
- The evaluation processes are supported by the Decision-Making System (DMS) and Knowledge-Management System (KMS) (simply Intelligence).
- CSFs, CSAs, KPIs, and VARs are labelled as Factors; and these Factors are processed by DMS' ALI Heuristics-Decision-Tree (IHDT).
- Uses sets of Factors and transformed/generated services, to solve Project's and LPE_AG's problem-types.
- It is assumed that the Project's generated services are organized in Blocks to be used by common, ICS', and AIS' calls.
- It is assumed that the Entity's Unbundling (and transformation) Processes (EUP) of legacy common-functional, ICS's modules, templates, and resources, was successful and the needed services were successfully generated.
- Uses different modelling disciplines like standard Enterprise Architecture (EA) Modelling or Models (EAM), Composite AI Models (CAIM), ICS Models (ICSM), and Intelligence interfaces.
- Applies CAIMs which in turn contain EAMs, and other types of models (simply AModels).

3. EXISTING AACG FRAMEWORKS

This section presents the existing major market and standard AACG frameworks which are relevant for this article.

3.1. COBIT's Integration

AISs driven APDs need accountability mechanisms and that implies that the Entity must implement: Comprehensive internal audit procedures and controls (similar to IAACGP); Risk biases mitigations; Eventual misuse of monitoring; and Regulatory roadblocks. The LPE_AGF ensures that risks are minimized and mitigated, and that means that regulators have to improve IAACGPs to block issues and biases that may exist in AIS' algorithms. IAACGPs integrate AI-audibility into AIAWFs to manage the mentioned risks; by including: Ensuring governance mechanisms; Reducing security risks; Supporting Project's lifecycle(s); Applying architecture/design; and Offering Development, Deployment, and Monitoring phases. The LPE_AGF is not just a documentation process, because it includes also tracking inputs-outputs, and the application of MLs. It privileges a proactive approach which enables auditors to discover issues before they can cause major damages; like in the case of a breached algorithm… Existing regulations like the AI-Acts and GDPR, focus on the importance of protecting data-privacy and on the implementation of risks' management. Which implies that auditors must take into account HBs' aspects, in order to ensure that AISs do not interfere with ethical Intelligence (or DMS). The LPE_AGF offers structured audit-processes that evaluate AModels, MIDSs' practices, and ICS' security protocols needed to maintain Entity's integrity. Top AIS-based auditing frameworks (for Internal Audit) are [11]:

- The COBIT framework that provides guidelines for IAACGPs (or internal controls), Risks' metrics, and Performance measurements. It is optimal for Entities which want to streamline operational risks' management and AI governance.
- The COSO ERM framework which focuses on governance, strategy, and stakeholders' collaboration to ensure AIS' based risk management.

- The U.S. Government Accountability Office (GAO) AI accountability framework, which focuses on governance, data-quality, performances, and monitoring, and enhancing compliance; and is based on complementary principles, like: 1) Governance to promote accountability; 2) Data to ensure quality, reliability, and representatives of MIDSs; 3) Performance by producing results that should be consistent with proposed objectives; and 4) Monitoring to ensure reliability and relevance; 5) Specific issues, and audit-procedures.
- The Institute of Internal Auditors' (IIA) AI auditing framework, which focuses on strategy, governance, and ethics. It covers a wide-range of topics from Cyber-resilience to EA (and data architecture), and is designed to align AISs with Project's objectives.
- The Singapore PDPC Model, which is an AI governance framework that focuses on transparency, stakeholders' communication, ethics, and policies management.

Leveraging AI driven auditing frameworks, enhances accountability; and as AISs and ICS are complex, internal audits should be based on defined Factors that come from multiple and various frameworks. An ALI methodologies enable regulatory compliance, mitigation of risks, integration of automated controls, and promotes value creation.

3.2. COSO's Integration

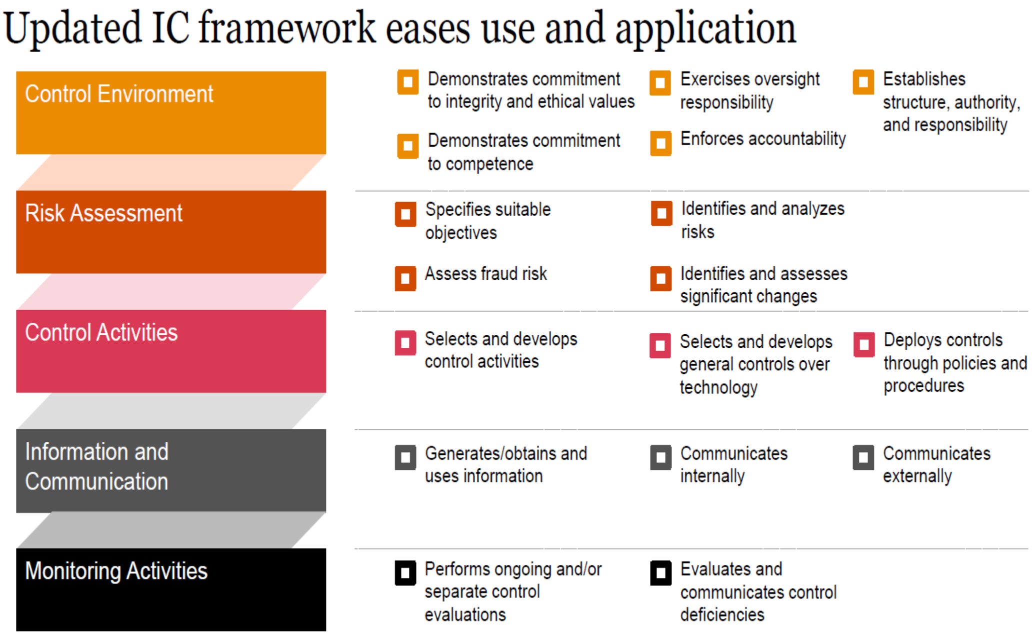

Figure 2. IAACGP's applications [12]

As shown in Figure 2, IAACGPs are affected by Entity's EA and audits' executive management, and in the same time they offer assurance for achieving Project's objectives that are mainly related to: Operations; Reporting; Compliance; and Re-structuring actions [12,13]. COSO's (from the Treadway Commission) control activities, features, principles and basics are [3,12,13]:

- Is a private's sector initiative managed by the American Institute of Certified Public Accountants (AICPA), Institute of Management Accountants (IMA), American Accounting Association (AAA), IIA, and Financial Executives International (FEI).

- The COSO Internal Control Integrated Framework (ICIF), also known as the COSO framework, offers guidance on the implementation of controls to prevent, detect, and manage fraud risks' related to external financial reporting.
  As shown in Figure 3, the COSO Cube (COSOC) presents the pillars and components of the COSOF, where: 1) On the 1st face there are 5 foundations of internal controls; 2) On the top face there are the control objectives' categories (operational, compliance, and reporting objectives); and 3) On the last face there are the levels of AACGAs that need to be implemented.
- The risks which threaten Entity's objectives are identified and assessed; and the Project defines the sets of AACGAs needed to eliminate these risks.
- The Project selects and implements AACGAs, using ICS and AISs, to support risks' mitigation and to achieve defined objectives.
- The Project deploys AACGSs by using policies that establish what should be done.
- Uses matrices which indicate risks that the Entity is exposed to, and the needed AACGAs to handle such risks.
- Proposes various technics to satisfy defined principles, like: Matrices' implementation, Workshops, Inventory of AACGs to map identified risks to control activities, monitoring AACGs…

Figure 3. IAACGP's pillars [12]

- Applies an ALI System Development Life Cycle (SDLC) for packaged software.
- Applies also: The development and documentation of policies and procedures; Deployment of AACGSs through Business Units or functional leaders; and Conducting regular and Ad-hoc assessments of AACGs.

4. LPE_AGF'S IMPLEMENTATION

4.1. Unifying Communication

The LPE_AG needs to install the Model Context Protocol (MCP), which is an open-standard tool that supports AIAs to connect with various environments in a unified way, like communicating with other tools, services, and MIDSs/data, as shown in Figure 4. It makes AIAs, execute complex IAACGPs' actions in a multi-step execution's approach, like Retrieving data; Summarizing documents; and Persisting data/contents to files. AIAs are capable of writing code, summarizing reports, and chatting with HBs, but that needs MCP to access concrete ICS artefacts [14].

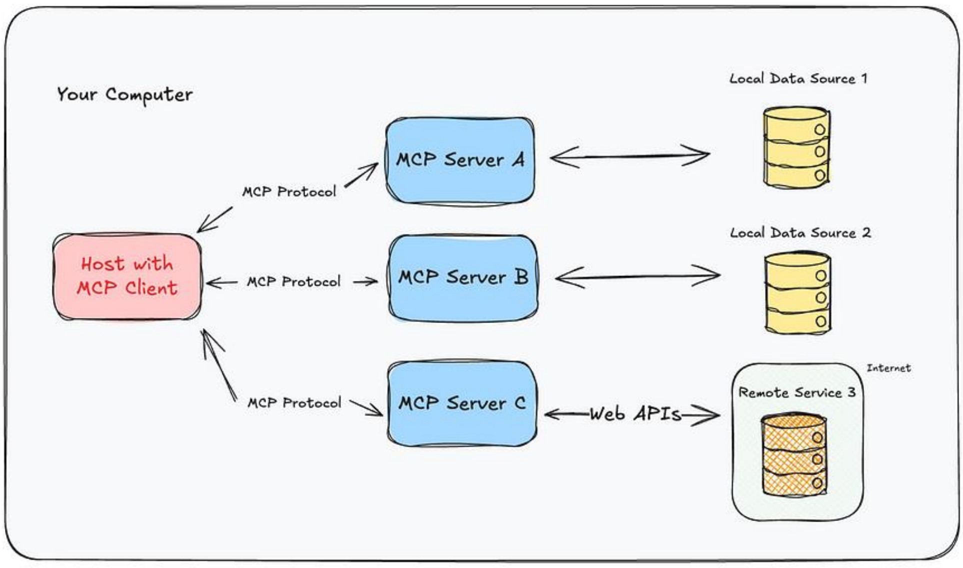

Figure 4. MCP's interactions [14]

4.2. Applying LPs

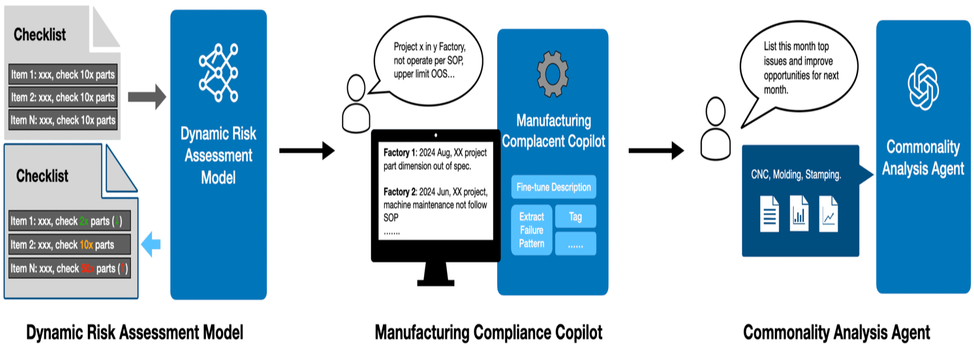

Figure 5. LPE_AGF LLM empowerment [15]

Various APDs' quality-audits are important for ensuring high-quality services and products' standards in complex environments. Traditional auditing approaches and processes, are labor-intensive and are very reliant on HB's expertise, which all create challenges in maintaining transparency, accountability, and continuous improvements across Entity's ICS(s). To improve such a situation the LPE_AG is empowered by LLMs, which offer key improvements, as shown in Figure 5, and that includes [15]: 1) A dynamic risks' assessment concept which streamlines auditing-processes; 2) An APD compliance-AIA that improves data-processing, retrieval, and evaluation for an ALI knowledge base; and 3) The LPE_AGF supports RT actions, and tunable analysis to deliver quality insights. The mentioned improvements elevate auditing efficiencies and effectiveness, by incorporating test-scenarios. The LPE_AGF can also incorporate: 1) The 1st phase for NLPs, to optimize data-collections by applying dynamic risks' assessments; 2) The integration of compliance-AIAs into Entity's Intelligence, using multi-task, directed analysis to convert raw-data into actionable insights; and 3) Deployment of AIAs to enhance accountability [15].

4.3. Applying AIA DPs

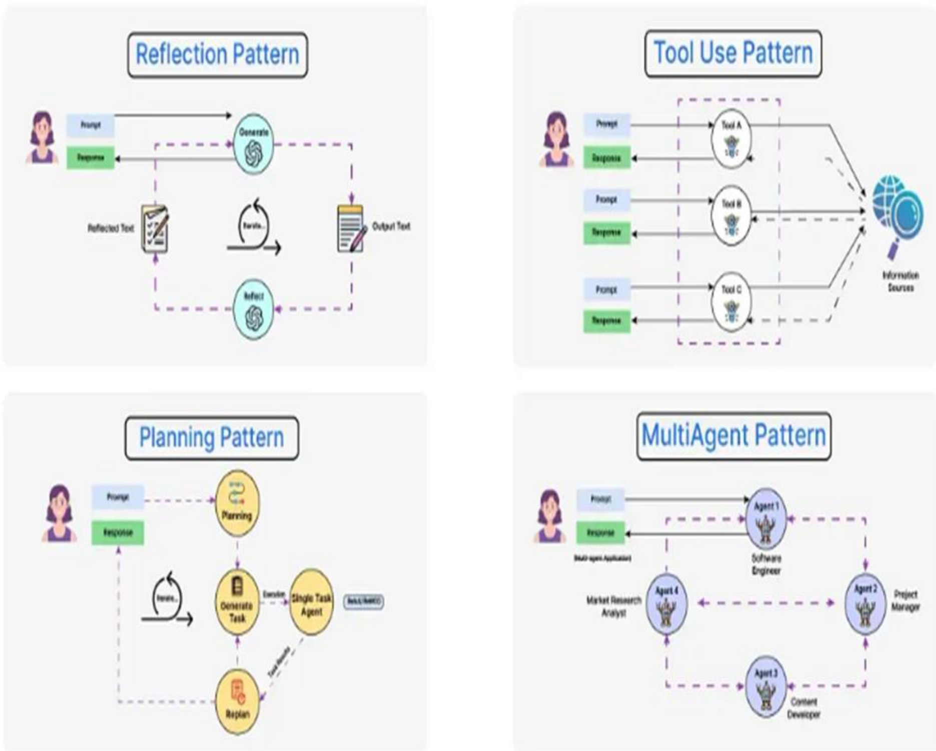

Figure 6. AIA's DPs [16]

The AIA Design Pattern (AIADP) is a solution for enabling LLMs to be autonomous. Rather then, letting the model use "one prompt" and expecting a final answer, the AIAWF-based AIADP enables prompting the LLM many times, using a step-by-step approach. Where each step refines the previous process, and that the model improves its capacities iteratively. The LLM reprocesses the content multiple times, and improves it in each iteration. As shown in Figure 6, there are 4 types of AIADPs: Reflection; Tools' Use; Planning; and Multi-Agent Collaboration. They all propose strategies to make AISs and hence the LPE_AG, autonomous and capable of performing complex tasks. The LPE_AG uses the AIADPs for [16]:

- Applying the reflection pattern which improves AIS' abilities to evaluate and refine NLP-AACG's outputs, by identifying errors, warnings, gaps, and proposing solutions.
- To broaden LLM's capacities by supporting interaction with external tools (and resources) to enhance problem-types solving capabilities.
- Applying the planning pattern to support LLMs in breaking down large, complex tasks into smaller, and more manageable chunks.
- Applying the multi-agent pattern that offers the concept of delegation, similar to classical project management technics in Project teams; where it assigns various agents to manage various sub-tasks, like the implementation of activities.

4.4. Implementation Activities

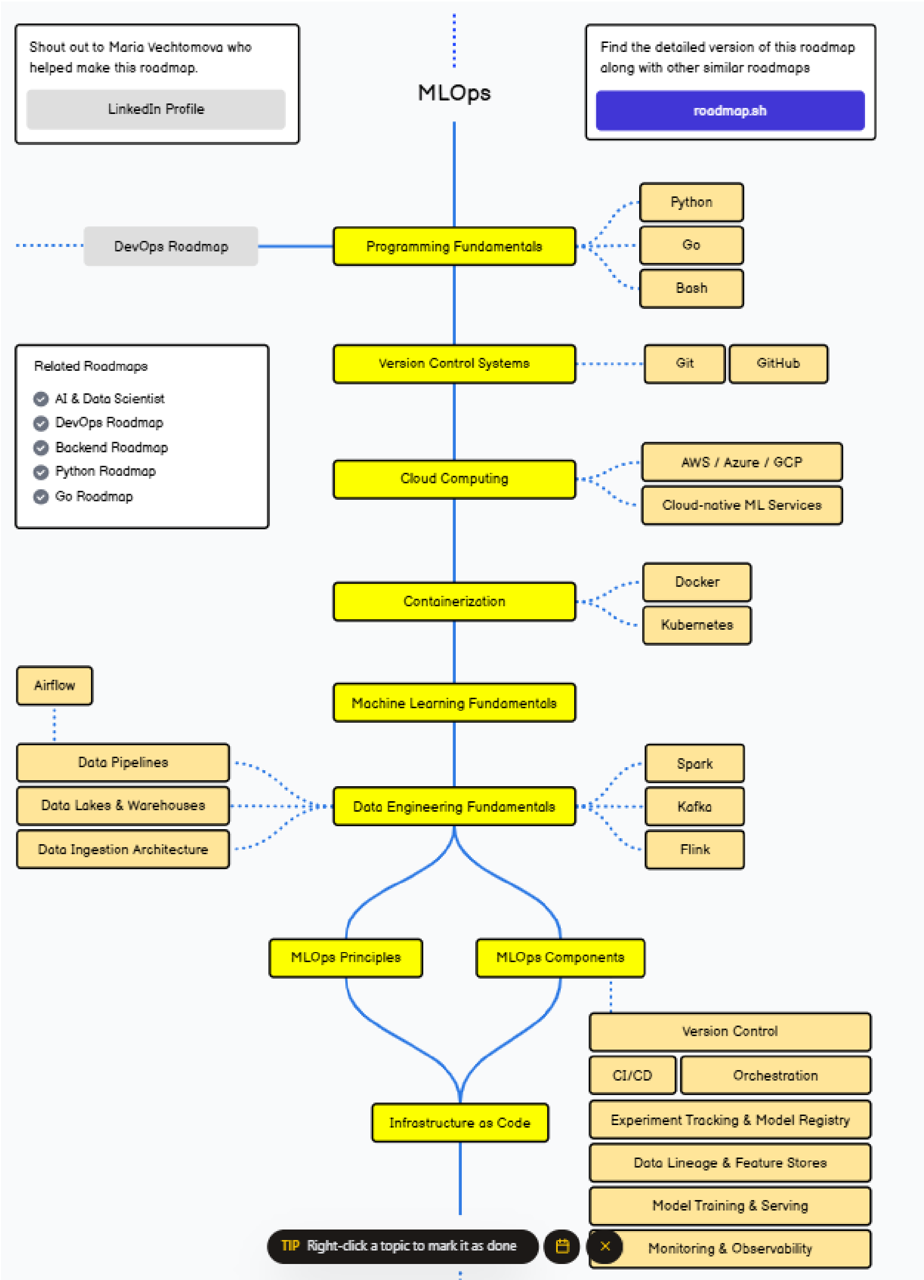

Figure 7. Implementation's roadmap [17]

The LPE_AG implementation activities' management includes [17,18]:

- ML Operations (MLOps) which is an ML engineering's core-function, that focuses on coordinating of MLM's deployments to the production phase, and for maintaining them later; it also sets up their monitoring environment.

- MLOps is collaborative and comprises various Project-team profiles like Data-scientists, Implementation engineers, and ICS specialists, as shown in Figure 7.
- MLOps is applied for the implementations of MLs, and AISs solutions.
- MLOps supports the collaboration of various profiles like Data-scientists, Data-Architects, and ML engineers.
- Improves and speeds up the implementation and production phases, by applying Continuous Integration and Deployment Continuous (CI/CD) approaches supported by monitoring mechanisms, validation procedures, and the governance of MLMs.
- These are complex procedures and ML's lifecycles include the management of complex modules like: Data-ingest; Data-preparations; Models' training and tuning; Models' deployment and monitoring…
- Synchronizes processes' iterations, and ML's lifecycles as shown in Figure 8.

MLOps' main advantages are that it ensures efficiency, scalability, and risks' reduction, as shown in Figure 8; and MLOps ensures [18]:

- Efficiency that allows data-architects to finalize quality MLMs' and their deployment, and production.
- Scalability that enables high-level scalability and the management of many MLMs that includes control, monitoring, integration, delivery, and deployment.
- Risks' reduction by using regulatory-scrutiny, drift-checks, and Entity's (or industry's) policies.

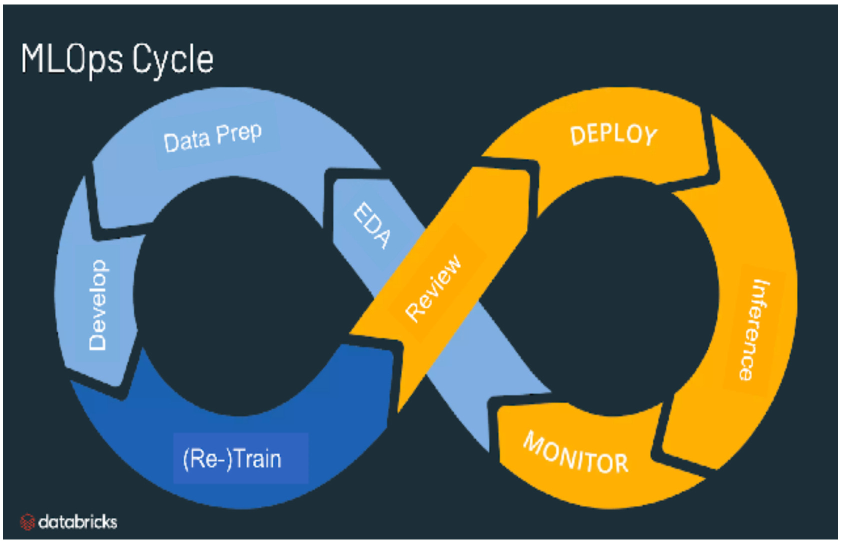

Figure 8. MLOps' cycles [18]

5. THE USED ACSS

This section uses various categories of ACSs to extract the needed Factors and to support the RDP and CPoC.

5.1. COBIT ACSs

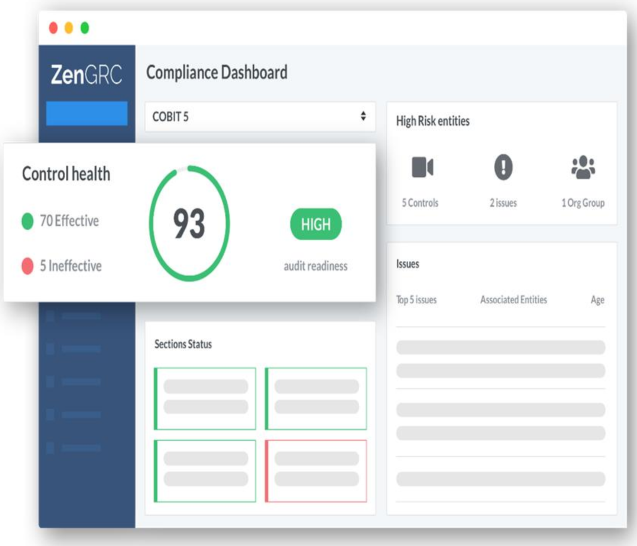

Figure 9. Compliances' dashboard [19]

The COBIT related ACS presents a case of a transformation and implementation process of an ICS and its associated strategy to deliver AACG mechanism, by [19,20]:

- Improving compliance, risks' management, monitoring processes, quality control, reliability, and governance procedures.
- Offers a usable common-language to support auditing, communication, ICS' controls, business-goals achievements, risks' management objectives, and mapping severity-levels to risk-types.
- Managing and preventing unauthorized accesses to ICSs and sensitive data, and applying information architectures.
- Predicting major problems like financial damages, productivity loss, and reputation's degradations.
- Identifying, assessing, and mitigating ICS-related important risks.
- Mapping ICS' processes, infrastructure, and relationships to Entity's and Project's objectives and strategic planning.
- Leveraging communication with Project's management, stakeholders, and team, especially the topics associated with goals, statuses, and requirements.
- Defining Project's goals, investment schemes, and roadmap.
- Assuring that IAACGPs map to COBIT's compliance requirements.
- Implementing continuous monitoring of compliance's objectives and IAACGPs' effectiveness.
- Applying the following principles: 1) Provide stakeholders' value; 2) Use a holistic End-to-end governance approach; 3) Use a dynamic governance approach; 4) Make governance processes to be distinct from management's processes; and 5) Adapt IAACGPs to Project's requirements.

- Offering a rich dashboard as shown in Figure 9.

5.2. AIS based Auditing ACSs

The ACSs associated with the adoption of AISs in auditing and IAACGPs, offer the following facts [21,22]:

- The usage of key Factors that impact the applied AISs in auditing practices and IAACGPs' integration for the Big Four accounting firms, which are using the Technology-Organization-Environment (TOE) framework approach.
- Usage of the Case Study Method (CSM) to drive semi-structured interviews with Entities' executive managers (or decision makers), and is assisted with secondary MIDSs.
- MIDSs' analysis discovered significant irregularities and anomalies to actual theories, presents impacts in the adoption of AISs in audit activities.
- The final results and findings proved that Entities' AISs adoption processes were directly influenced by ICS affordances, complexities/barriers, communication-processes, interfacing-agents, readiness, regulatory environment, industrial-changes and customers' acceptance (or rejections).
- Presents AISs' adoption at Entity's and Project's levels, and fills related integrations' gaps; and shows have to improve theories related to ICSs and AISs adoptions.
- Shows that revising, improving, and extending TOE's framework with concrete audit experiences can be useful.
- Presents a Digital Transformation (DT) which enhances Entity's organizational activities and operations, by using advanced ICS and AISs concepts and solutions.
- DTs are major changes and shifts, which can (re)establishes proven practices and improve efficiencies in various APDs like finance, healthcare, and manufacturing.
- Shows AISs' impacts in auditing and IAACGPs' integration, by presenting important reference cases (from a systematic literature review) used to implement an auditing conceptual framework.
- Proves AISs' transformative capacities in (re)defining auditors' profile (and roles), and shifting from retrospective examination to pro-active RT monitoring.
- Shows that the role management is also decisive in: AISs' integration; Enhancing Intelligence for risks' analysis; Financial management; and Regulatory compliance activities.
- Entities which adopt AISs in auditing and IAACGPs activities, make Projects, and ICS' feasible, robust, and resilient.

5.3. DT, Unbundling, and ICS ACSs

A precondition for a successful Project's termination is that all DTs were successful, which means that ICS' legacy parts were unbundled and were ready to be used by the LPE_AG. Which is a very complex transformation phase and can cause Project's failures. Such an unbundling or transformation phase, delivers a pool of Blocks to be used by AISs and IAACGPs. The LPE_AGF supports IAACGPs' implementation, integrity-checking, and monitoring activities. The mentioned unbundling or transformation activities are included in the insurance domain transformation ACS [23], which presents how ICSs, modelling of AModels, Blocks' usage, and EA subjects are treated. The LPE_AGF needs an agile project management approach (that includes MLOps) for managing Project's activities in various APDs.

6. THE CPOC

6.1. Introduction and Setup

The CPoC, as shown in Figure 10, was developed and implemented using the ALIPTF, AIS based blocks, and the following environments: 1) Microsoft Visual Studio; 2) Java Enterprise Edition (JEE) environments; and 3) AI libraries like ML.NET.

The PLRP that is a part of Phase 1, and analyzes and verifies various sources of references and links, by using the ALIPTF. Afterwards sets of Factors were selected (CSAs, CSFs; and KPIs), and tags were associated to ALIPTF's scripts.

Figure 10. CPoC's interactions

6.2. The Environment

As already presented, this article's CPoC and ACS preparations include the following actions and resources [19,20,21,22,23]:

- The use of Open Group's ACS (ArchiSurance) that presents a case of a DT, EA, and ArchiMate's modelling technics.
- Selected sets of Factors were prepared and tuned, and ALIPTF's and its Polymathic Rating/Weighting Concept (PRWC) activities were synchronized by the ADM.
- Preparing the set of CSAs, where a CSA corresponds to a set of CSFs and IAACGPs.
- Design AModels that represent the used AISs, AIA, AIAWFs, and integrate IAACGPs.
- Phase 1 evaluates Factors and the results are shown in Figure 11.
- The CPoC includes 3 phases and a constraint: "If Phase 1 execution is successful, then an NLP_ASG's problem-type is processed to be solved in Phase 2".

- All KPI values originate from predefined ALIPTF's enumerations; and they are persisted in Figure 11's column 2.
- CPoC's Phase 2 solves a concrete problem and delivers solutions and recommendations.

6.3. Phase 1

A selected CSF has a related collection of actions, that can be executed by the IHDT based Intelligence. Intelligence is responsible for delivering solutions to encountered LPE_AG problem-type. The IHDT is a dynamic heuristic based 'rule of thumb' and uses the PRWC to tune problem-solving processes by applying "trial and error" based iterations. The LPE_AG applies the AHMM4AI to manage and check IAACGPs' validity. The needed Factors are tuned by an Intelligence specialist to support the LPE_AG. The PLRP and related evaluation scripts (in Phase 1) used Factors and offered outcomes that are presented in Figure 11, which have the average of (rounded) 8.80, and which means that such a Project is "Feasible". The mentioned result permits the CPoC to continue to Phase 2, in which an LPE_AG problem-type is selected and the IHDT tries to deliver solutions. The automated PLRP's evaluation processes were successful, and with that Phase 1 ends, and Phase 2 starts.

CSA Category of CSFs/KPIs	Transformation Capability	Average Result	CSA_DT
The RDP's Integration	Transformable-Possible	From 1 to 10. 9.00	1
The Role of CModels, ICS, and EA	Transformable-Possible	From 1 to 10. 9.0	2
AISs' and NLPs' Implementation	Transformable-Complex	From 1 to 10. 8.50	3
Existing ACG Frameworks	Transformable-Possible	From 1 to 10. 9.0	4
NLP_ACGF's Implementation	Transformable-Complex	From 1 to 10. 8.50	5
The Used ACSs	Feasible	From 1 to 10. 8.75	6
Phase 1 Result	Feasible	From 1 to 10. 8.80	7

Evaluate First Phase

Figure 11. CPoC's Phase 1 implementation.

6.4. Phase 2

In this phase, the IHDT (and its linked actions), tries to solve an LPE_AG problem-type (PRB_LPE_AG) that is associated with this article's RQ. A problem-type is linked to selected CSFs and their sets of actions; and IHDT's processing is launched from the root-node. A problem-type, like the PRB_LPE_AG, links to a CSF, and has the following set of actions: ACT_LPE_AG_Define_ProblemType, ACT_LPE_AG_Verify_ProblemType, ACT_LPE_AG_Match_ProblemType, and ACT_LPE_AG_Validate_ProblemType. For this CPoC, the CSF_LPE_AG_Integration CSF was selected, which is an element in the set of CSFs; and the aim is to deliver a set of optimal solutions. ALIPTF's scripts processes the PRB_LPE_AG, to deliver such solutions.

7. CONCLUSIONS

This article proposes the following set of LPE_AG's recommendations:

- The RDP is related to LPE_AG, AIAs, AIAWFs, ADM, and AModels; and uses an adapted mixed research method.
- The proposed AISs and avant-garde technologies replace legacy ICS components.
- Entity's efficiency, and sustainability depend on LPE_AGF's and ALIPTF's integration.
- A Project adopts a Polymathic (and holistic) approach and uses AModels.
- Intelligence mitigates risks and solves problem-types.
- NLP can be adapted to ML to offer a hybrid NLP-ML which is an optimal approach.
- The LPE_AG and IAACGPs replace traditional auditing processes.
- The LPE_AG interfaces the ALIPTF and other frameworks.
- The ALIPTF integrates various methodologies like TOGAF and interfaces other AACG frameworks.
- The ADM supports LPE_AG's activities, and AModels' implementations.
- AModels enable the integration of AIAWFs, and related AISs.
- The LPE_AG supports RT monitoring, and tracing.
- The LPE_AG supports IAACGPs' integration for Entity's auditing processes.
- The LPE_AGR fits in the Entity's global transformation strategy.
- The LPE_AG modules' design, development, and operations are managed by MLOps.
- The CPoC used Factors' to link to: RDP resources; IAACGPs; AIAWFS, Intelligence; RQ, and AISs.
- The CPoC's outcome proves that the LPE_AG is feasible, because of the result of 8.80 (from Figure 11).

ACKNOWLEDGEMENTS

The author has reviewed and edited the output and welcomes all types of comments and feedbacks.

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AUTHOR

I am a holder of a Dr degree in computer sciences degree and a Dr degree in business administration (DBA), with more than 500 articles and projects related to transformation initiatives. Actually, I am a researcher/professor at IBISTM.

My research fields are related to Enterprise Transformation Projects, AI Subdomains based Mathematical Models, Enterprise Architecture… And the needed educational curricula.

This work is intended for future Managers, Professors, Architects, and Engineers in Complex Business Innovation and Transformation Projects. My Research and Development Projects (RDP) have the lead in the mentioned fields. The educational curricula include: complex projects, AI, and enterprise architecture in the context of digital transformations.

After many years working in and researching the mentioned fields, I realize that there is a need for a major change in education; especially in cross-functional domains. And there is the need for a Polymathic approach as presented in my research chapter.

ABBREVIATIONS

The following abbreviations are used in this manuscript:

AACG	Audit, Control, and Governance
AACGA	AACG (or control) Activities or Actions
ADM	Architecture Development Method

AIA	Agentic AI
AIADP	AIA Design Pattern
AIAOF	AIA's Orchestration Frameworks
AIAWF	AIA WorkFlows
AIS	AI Subdomains
GIA	Artificial Generic Intelligence
AHMM	Applied Holistic MM (AHMM)
AHMM4AI	AHMM for Integrating an AI
APD	APplication Domains
API	Application Programming Interfaces
AR	Action Research
BP	Business Processes
BPM	BP Model
CAIM	Composite AI Model
AModel	Composite Model
CSA	Critical Success Area
CSA_DT	CSA Decision Table
CSF	Critical Succes Factor
COBIT	Control Objectives for Information and Related Technologies
COSO	Committee of Sponsoring Organizations
DA	Data-Analytics
DMS	Decision-Making System
DL	Deep Learning
DLM	DL Model
DT	Digital Transformation
EA	Enterprise Architecture
EAM	EA Model
ERM	The COSO Enterprise Risk Management
EUP	Entity's Unbundling (and transformation) Processes
Factors	Is CSFs, CSAs, KPIs, and VARs
GAPA	GAP Analysis
GAO	US Government Accountability Office
GenAI	Generative AI
GenAIM	GenAI Models
HB	Human Factor
HFB	HB Brain
HFI	HB Intelligence
IAACGP	Internal AACG Procedures
ICS	Information and Communication Systems
ICSM	ICS Models
MIDS	In-Memory DataSets
ALI	In-House Implemented
ALIDT	ALI Heuristics-Decision-Tree
ALIPTF	ALI Polymathics Transformation Framework
ALIPTFM	ALIPTF Method or Methodology
ILP	IHDT based ALP
Intelligence	KMS and DMS
ISACA	Systems Audit and Control Association
KMS	Knowledge-Management System
KPI	Key Performance-Indicators
ALP	Learning Process
LPC	ALP Container
MAIA	Multi-AIA
MAIAS	MAIS Systems
MCP	Model Context Protocol
ML	Machine Learning
MLM	ML Model

MLOps	ML Operations
MM	Mathematical Model
NER	Named Entity Recognition
NL	Natural Language
NLG	NL Generation
NLP	NL Processing NL
LPE_AG	NLP for AACG
LPE_AGF	LPE_AG Framework
LPE_AGR	LPE_AG Roadmap
NLPE	NLP Environnements
PHAIS	Polymathics AIS
PDPC	Singapore's Personal Data Protection Commission
PEERM	Polymathic-Empirical Eng Research Model
POS	Part-Of-Speech
PLRP	Polymathic Literature Review Process
XHFR	eXtremely High Failure Rates
VAR	VARiables
WF	WorkFlows