Use of Domain Engineering in Hyperautomation Applied to Decision Making in Government

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Abstract: This article presents the domain engineering process carried out to obtain the requirements for the implementation of an Artificial Intelligence (AI) compliance framework aimed at the public sector. Owing to the current competitive and fast economy, which generates huge demand for increasingly efficient, reliable, and transparent intelligent systems, decision-support architectures should also be developed under strong restrictions of cost and time. Such a context requires adequate structures, processes, and technologies for coping with the complexity of building such intelligent systems. Currently, many public organizations have adopted applications for process automation, with the aim of refraining from repetitive work and producing more efficient results. However, what is not so often observed is the development of intelligent engines to support complex public decision-making. Possible explanations are the plethora of available data sources and the number of legal norms to be abided by. Moreover, it is important to highlight the need to incorporate transparency, auditability, reusability, and flexibility into such systems. Thus, they can be safely utilized in various analogous situations, reducing the need to develop new applications from scratch. An architecture suitable for supporting public decision-making with so many features and increasingly unstructured data, as well as abundant regulation, needs well-crafted formal specifications. This article aims to analyze three existing frameworks and carry out domain engineering studies in three cases to produce some guidance for future public applications and services based on AI. Next, we provide a conceptual preliminary architectural definition for the public sector. The proposed architecture targets were identified in the three cases studied, namely, frequent tasks of process mining requirements, detection of anomalies, and extraction of rules and public policies for helping public servants. All these aim at expedient AI development for public decision-making.

Keywords: Decision making, domain engineering hyperautomation, government

1. Introduction

Requirement formalization is a major software engineering task that must be performed before every system development [1]. As a task that requires plenty of reflection and attention, it is often hard to perform. It normally involves (1) standardization, (2) multidisciplinary teams, (3) judicious work, and (4) substantial effort and time investment from the team [2]. There may be an even higher level of work when the goal is to apply domain engineering to projects that are to be used to test and analyze hypotheses, that is, intelligent systems. It is noteworthy that all additional work involved in the formalization of the conceptual model due to the use of Artificial and Computational Intelligence yields back in the form of productivity and reliability gains, both of which are necessary in the public sector.

Nowadays, complex, and interactive systems are quite frequent. Thus, quality and value aggregation in such systems are not only a challenge, but also highly necessary [3]. This scenario is still a fertile field for applications of AI, which in most cases end up as technological facilitators as they are naturally suitable for solving complex, for example, compliance problems [4].

In this 4th Industrial Revolution, AI is quickly becoming one of the most strategic assets because it enables organizations to offer new data-driven products and services, which endow greater agility for the decision-making process [5]. Therefore, organizations are increasingly using AI, as they need explanatory theories, smart tools, and evolvable systems.

Recently, new tools have been required to perform legal analysis, aiming to promote agility in compliance tasks [6]. Thus, Machine Learning (ML) algorithms seem quite suitable, as they can be used to monitor risk and add value to mitigation mechanisms, both of which are especially important in the public sector.

Despite the great potential of AI technologies to solve complex problems, there are still many hurdles to conquer [7]. Among some shortcomings of AI, in the public sector, the observance of the principles of good administration and the protection of fundamental rights invites further research on SW Frameworks equipped with mechanisms readily available for such relevant demands of the public administration. Three existing frameworks were then studied and commented upon.

To exemplify actual demands for AI requirements in the public service, the authors selected three ML projects, whose topics are (1) process mining, (2) detection of anomalies, and (3) rule extraction from written legal texts. Next, through domain engineering, the formal requirements of these cases are drawn. This, aiming to be used in a future framework for compliance with AI-based application in the public sector.

The obtained structure is deemed to offer: (1) configuration of hyperparameters for the built models; (2) core engines to multiple objective problems; (3) data-driven generative rules and models; (4) database stubs so that they can be used in simulations; (5) specialized models for greater accuracy; (6) provision of resources for supervised, unsupervised and reinforcement training; (7) hybridization readiness of ML techniques; and (8) 'ISO' quality and safety standards.

To meet the high objectives mentioned above, we utilized the concept of domain engineering to identify objects and operations that use AI concepts, so they could support (i) compliance activities, (ii) verifying the characteristics to be designed in the form of frozen spots and hotspots, and (iii) allowing points of variation with the implementation of specialized functionalities of those involved. In the end, this task can help the documentation of actions and the implementation of an architecture that can be instantiated in the public sector for compliance tasks that use AI technologies.

This paper is organized into five sections. Following this introduction, the second section presents some of the theoretical bases. Section three contains the study of related works (three frameworks), and section four explains how domain engineering was performed and presents the requirements of the three cases studied. Section five presents the conclusions.

2. Background

2.1. Requirements Engineering

Requirement engineering deals with the identification of the operation, interface, and constraints that the software must meet. This research work uses requirements engineering for quality applications because it is necessary to produce good results during the planning and implementation phases [8]. Selecting the adequate set of requirements is a mandatory step in any complex project development because it greatly reduces the probability of failures or shortcomings [9].

As software development ultimately aims to solve problems, it is often related to improvements, functional updates, or even innovations, so it is necessary to follow well-defined and mature processes. In summary, requirements engineering covers processes, methods, and tools to meet the need for componentization, reuse, and agile development using estimates. Therefore, in cases like the above described, the option of choice should be to develop a framework, where componentization is critical to provide flexibility [10–12].

2.2. Domain Engineering

In this research, requirements gathering will be carried out with data capture based on domain engineering, which is a modeling process that yields future parts to be reused in other applications of the same area [13, 14]. When performing an analysis to identify patterns, it is advisable that the specification through a catalog is recommended to facilitate its reuse in other projects of the same domain. Here, the term domain is a set of applications that have common characteristics. Thus, domain engineering relates to a collection of software components that can be used in other applications in the same area so that software engineers can use them swiftly in future applications [15]. Moreover, quality and productivity can be increased by reducing the costs associated with the use of this technique [16]. Hence, the application of domain engineering aims at the encapsulation of knowledge [17, 18], which consequently can be reused to develop new applications with the knowledge previously acquired.

2.3. Framework

Domain Engineering (DE) yields frameworks that can be seen as a generic solution to a set of problems related to the same area [19, 20]. As noted by Fowler [21], DE is motivated by the need to quickly solve the excess crossings of various problems. In the current competitive economy, which generates tremendous demand for increasingly efficient and reliable systems, software development is usually carried out under immense cost and time restrictions. Therefore, frameworks are a promising technique for the wide reuse of code [22, 23]. Indirectly, frameworks also improve the quality of the final application, offering stable and well-tested implementations and allowing development with substantially fewer lines of code.

2.4. Decision Making (Compliance)

According to Serpa [24], decision making in compliance is an organized set of components that interact with each other and depend on a complex structure composed of people, processes, systems, documents, actions, and ideas. It is fair to state that compliance is not only about laws but also about work done properly that abides by the laws. It is also essential to consider that compliance programs are not only anti-corruption programs but also much more comprehensive [25]. Some frequent applications of compliance in the public sector are (1) risk assessment and response determination; (2) definition of policies and procedures; (3) support for senior management; (4) communication and training; (5) monitoring and auditing of the program; (6) provision of aid mechanisms; (7) investigation of inconsistent conduct; and (8) continuous improvement. Compliance policies vary substantially when describing processes and controls, in addition to other regulations, especially regarding definitions of corruption, public agent, bribery, undue advantage, value, third parties, intermediaries, and consultants [26].

2.5. Hyperautomation (Artificial Intelligence)

Ultimately, AI aims to create applications that can learn from data and user experience. Thus, AI improves with these inputs in a self-sufficient way, solving problems of classification, prediction, grouping, association, optimization, search, and recommendation, among others. According to Russel and Norvig [27], AI can be defined as “human-like thought systems that automate decision-making activities and seek to solve problems through learning.” Complementarily, ML algorithms also learn, but here they use mathematical calculations on the data [28]. Both approaches can predict and helping decide events that may occur. Therefore, instead of explicit programming instructions, providing the computer with each problem ‘nuance,’ it can learn by reasoning upon the general characteristics. Instead of programming with defined rules as of deductive logic, intelligent algorithms learn inductively.

3. Related Works

Ultimately, the present research aims to propose a framework that provides help to the development of solutions to compliance problems for the public sector using artificial and computational intelligence. Thus, a literature review was performed to collect studies aiming to answer the following question: "How to propose a framework that should use artificial intelligence concepts to support compliance activities in the public sector?"

The identification of such studies was carried out with the application of the keywords: "government, compliance, internal control, accountability, auditing, risk management, artificial intelligence, computational intelligence, machine learning, deep learning, neural network, swarm intelligence, Bayesian network, and data mining." As of October 2020, in the titles and abstracts of the bases ACM Digital Library, ArXiv, Google Scholar, IBM Research, IEEE Xplore, Science Direct, SCOPUS, and SpringerLink resulted in a total of 931 publications.

For each identified publication, the title, authors, abstracts, keywords, and year of publication were retrieved. Two independent researchers conducted the relevance analysis by applying inclusion and exclusion criteria to match the survey objectives. Subsequently, divergences were identified and resolved by a third researcher. There were 61 publications were accepted to be fully read. Not surprisingly, only three studies were deemed to answer the following questions: (1) What is the applicability of the framework? (2) How is the architectural design of the framework defined? (3) What are the implementation areas of the proposed framework? (4) Which artificial intelligence and computational intelligence techniques have been employed in compliance? (5) What types of compliance issues can be addressed using this framework? (6) What contributions have been identified by instantiation of the framework? (7) What limitations have been identified in these frameworks? The three frameworks identified are detailed and commented upon below.

3.1. Framework-1: "Compliance for the Legal Area"

The applicability of the Eunomos framework lies in knowledge management for the legal segment, which aims to address the challenges of a complex regulatory environment [29]. The Eunomos architecture was elaborated on three levels: (1) Management of legal documents; (2) legislative classification base in different areas; and, (3) Mechanisms for collecting new legislation with the application of natural language processing.

The use of AI to solve the classification problem in the legislative field, present in Eunomos, is primarily to identify cross-references. The aim is to construct a layer of norms that allows the connection with legal concepts to learn from available legal taxonomy.

The idealization and structure of Eunomos meet the legal domain, invariant points, and variants previously defined for future implementations. The proposal sought to contribute to the solution of problems related to the large amount of legislation resulting from the increase in volume and complexity, generating the need for knowledge management. The authors of that architecture point out that the difficulty posed by the non-availability of a legal semantic web is most likely due to the heterogeneity of legal data and the difficulty associated with its development.

A careful reader quickly finds out the usefulness of the Eunomos framework for this kind of knowledge management (especially the amount, dynamicity, and specialized terminology of the legislation). It was also evident that AI was successful in coupling legal knowledge and its legislative sources, that is, associating the concepts of its legal ontology with the regulations that define them.

3.2. Framework-2: "Integration of AI in the Public Sector"

The second studied framework is an attempt to prompt AI for public management; it tackles the expanding data processing time for document analyses and its applicability in public management [30]. Despite all the advances in applying AI in the private sector, relatively little progress has been achieved in the public sector [31–33], so the framework at hand is quite important. The current shortcomings to be fulfilled are ethical and legal support for public decisions, which produces unnecessary long waiting times in the interactions of government bodies with their citizens [34–36].

To address the abovementioned problems, a three-tier architecture was proposed: (1) Application layer and AI services, which deal with the interconnection of techniques and applications to portray well decisions given the wide AI taxonomy, as it usually is a low/ascendant approach that culminates in useful toolboxes; (2) Functional Layer of AI, which includes the internal hardware and software interconnection structures, through environmental perception devices, processing, and data storage, resulting in an flexible inference mechanism; and, (3) AI infrastructure layers, which are generally conceptual models composed of four basic technological sublayers [37–39] (from general algorithms and techniques reaching up at application levels).

The compliance problems that the framework proposed to solve are the integration of technological tools with AI to obtain: (*i*) efficiency of human services, (*ii*) reduction of administrative burdens, (*iii*) automation of routine actions, and (*iv*) reduction in hours worked.

The official adoption of the techniques applied in this framework in public administration seems to increase administrative efficiency. Thus, we perceive the contribution of artificial and computational intelligence approaches in providing additional public value for citizens. Of course, to be adaptable to the specific circumstances existing in this sector, it is seminal to consider three components: regulatory monitoring, economic efficiency, and technical design.

3.3. Framework-3: "AI Services for the Public Sector"

The last framework reported here is interdisciplinary research on AI in the public sector, which concludes that even with the increase in investments, its applicability is still low due to the lack of theoretical understanding [40]. This research aims to fill this gap (low utilization) by providing an integrated overview of applications and challenges.

The framework was conceived with four layers: (1) Services deal with applications focused on the provision of services and their challenges, highlighting the bilateral relationship between the needs of the sector and the solutions provided, which should focus on optimization [41, 42]; (2) Impact on the social environment, which should indicate consequences of the use of technology in society [43–45]; (3) legislation related to public policy and technology, as technology can support surveillance for the protection of people through risk prevention strategies [46, 47]; and, (4) Applications, which deal with the increasing popularization of the use of AI.

Naturally, practical efforts to foster utilization confront the impact on ethical issues that become increasingly important [48], mainly because those can lead to misunderstandings and loss of control. The framework is based on previous works [31, 49–52] and reports the constant and increasing loss of human control due to the transfer of human activities and knowledge to machines, generating concerns related to government policies and ethical issues.

The authors of the study state that, as research on artificial intelligence and the public sector is still in the early stages, several opportunities can be addressed for expanding theoretical and empirical knowledge [53].

The framework also alerts almost all public organizations regarding the proper use of AI. In addition, it proposes the application of educational programs, such as training courses for public managers. This also helps minimize the potentially negative impacts of substitution and transition. Another aspect that such educational measures for public managers can be very promising is on issues of security and privacy of data to ensure that the responsible treatment of these critical areas is highly relevant to citizens.

3.4. Benefits and Risks Associated with Public AI

The problems identified in the above studies were many and of several orders, all partly due to the complex nature of AI, compliance, frameworks, and the government. This further evidence the need to better guide successful AI systems, aiming to protect the public against incorrect processing and adding other public values. Table 1 contains the results of an analysis performed on the abovementioned material as a list of the potential benefits and risks of implementing AI in the public service.

Table 1. Benefits Table and Public AI Risks

Benefits	Risks
Processes: Improved information processing speed by generating an efficient allocation of public resources.	Loss of control: knowledge about what happens in the system can be lost due to excessive machine learning algorithms and this may threaten human control.
Protocolization: accelerates the submission and processing of tasks.	Legitimacy: artificial judgment and evaluation of human behavior without rules of social coexistence, may exceed admissible limits.
Automation: Routine tasks that require a low level of knowledge are performed well by AI.	Management: replacing humans in all areas of everyday life with autonomous systems, transferring important management decisions is also debatable.
Bureaucracy: replacing human labor with machine processing creates room for a marked reduction of bureaucracy.	Privacy: wide range of data privacy protection issues can pose risks to citizens.

Our analysis revealed a lack of conceptual models to employ AI in the public sector. Many contributions were identified in three different aspects of operation, technological infrastructure, and function of AI for applications and services.

The literature shows that in several countries, especially in the United States and China, the government has not comprehensively addressed the entire spectrum of AI applications for the public sector. This, despite the recognition of the value of AI for public use and after numerous high-profile initiatives were launched, many of which successfully yielded a wide range of potential areas of application and good results. Thus, we elaborate on and provide a summary of the challenges encountered in the development of a framework using AI for compliance in the public sector in Table 2.

Table 2. Unresolved Challenges in Research

Framework	Challenges
Framework for Compliance in the Legal Area	(1) Difficulty in navigating laws, due to the breadth of legal crossings; (2) Legislative updates, due to the fact that laws not often indicate which articles they modify on other legislations; (3) Legal terminology, due to some terms acquire different meanings according to their context; (4) Polysemy because some terms may have different meanings between distinct jurisdictions; and (5) Information management, because it is difficult to understand the legality and discrimination in the use of computing technology to ensure that the solutions are reliable and cost-effective.
Framework for the Integration of AI in the Public Sector	(1) Lack of evidential study with managers of what public values can be effectively obtained; (2) Lack of studies on how to incorporate artificial intelligence-based systems into the organizations; and (3) Lack of micro-level studies that can help the creation of a macro model based on the widespread use of AI in public spaces.
AI Services Framework for the Public Sector	(1) The need to generate the ability to understand human emotional expressions is a crucial challenge for AI systems; (2) Replacing human interaction requires a better understanding of how the world works and how communication intentions work; (3) Machine-machine interactions are developing rapidly, and require better human control; (4) Real risk of losing control of human and machine interactions, with loss of understanding of what artificial intelligence is producing; and (5) Creation of artificial intelligence governance mechanisms to ensure transparency and responsibilities.

4. Domain Engineering Application in Requirements

Among the three studies analyzed, one can observe that there are many gaps to be filled in AI research, especially when it is applied to the public sector. The construction of architecture in this area is found to be an arduous but necessary task. The studies at hand were produced with different focuses within the public sector, that is, for the legal, ethical, social, and technological areas. However, we stress that an integrative architecture for the aggregation of processes, methods, techniques, and algorithms that aims to support public managers in auditing and control tasks can be an important contribution to the sector.

To illustrate the processes of obtaining requirements with domain engineering, we describe the work carried out in three projects of applying AI to decision-making problems in the Government of the State of Pernambuco (one of the 27 states of the Brazilian federation). The three selected cases were performed by the Compliance research team of the University of Pernambuco – Brazil.

The following identified elements are also being considered for the construction of a new framework that will be a white box, aiming at the delivery to users a structural set that can be evolved by stakeholders. The availability of points of flexibilization is deemed to examine compliance problems from a more educational perspective rather than a coercive manner, initially in the areas of process mining, anomaly detection, and rule extraction.

4.1. Pillars of the Proposed Framework

The first selected work with the title "Selection of characteristics of process models using artificial intelligence techniques" deals with the modeling of processes that can be used in organizations to guide and optimize business processes [54]. Its objective is to evaluate the factors that impact the search for compliance, thus gaining quality by identifying which processes need correction before they can generate negative impacts. The work helps solve the problem related to the difficult task of analyzing a large set of data for some normative or descriptive models.

The second selected work with the title "Detecting multiple classes anomalies" deals with the discovery of contours that can be used to find deviation patterns [55]. The authors of that work found that the definition of rules for auditing has always been important but setting them in advance and considering event patterns relevant to the topic, especially in critical applications, is an important step forward. The search for data that is not fully known or that is not in accordance with the expected behavior is still a challenge, and thus, the focus of the research is precisely on making use of methods to detect anomalies.

The third selected work with the title "A model for selecting relevant topics in documents applied to compliance" deals with natural language processing, which is one of the fields of AI research that aims to process the meaning of words in natural language [56]. This research deals with an approach applied to the characterization of information for conformity analysis. It contains a combination of two topic modeling techniques, namely Latent Semantic Analysis and Latent Topic Allocation. Together, they yielded effective and useful characterizations for the common demands of the public service.

4.2. Domain Engineering Application

By applying the domain engineering technique to the above projects, we seek to develop models that can facilitate the construction of compliance policies. The domain analysis here allowed the cataloging of generic classes, with the following categorization of patterns: (1) thematic, (2) object, and (3) technique, all aiming to base structures that can contribute to the development of new applications in this same field.

Initially, it was necessary to verify the differences between the class diagram of the process mining project and the diagrams of the anomaly detection and rule extraction projects. This produces the domain analysis class diagram with similarities, leaving the small differences found outside the conceptual representation. The verification among the projects considered similarities whatever is applicable to compliance. It can be reported that the three studies presented the following common characteristics: the theme, the object to be worked on, and the technique used. The thematic characteristic deals with the subject to be explored or solved, recording the project data so that information can be obtained for management and control. The objective, in turn, is what one wants to work effectively in compliance analysis, whether to optimize, detect, extract, etc. In this technique, activities are carried out within the scope of applications in the same domain.

Within the three studies and their collected data, domain analyses were performed for the composition of an *ad hoc* AI framework. The objective was to collect, analyze, and define requirements and resources at the conceptual level, focusing on the resources necessary by those involved and identifying the reasons that lead to these needs. Our goal is to propose a simple and responsive framework that allows the resolution of compliance-related problems with the use of AI, initially for anomaly detection, rule extraction, and process mining, and subsequently complemented with fraud detection and risk management. The first three analyses are described below.

4.2.1. Thematic commonality

The thematic scheme addresses the structure necessary for its identification. The projects analyzed have different themes because they seek to solve different problems, but from the same domain area, which is compliance. The following common points have been found user types and user profiles.

Three types of users were analyzed: administrators, specialists, and managers. The administrator is the user responsible for the administration of the projects to be added as well as for carrying out the control activities. The specialist is the user who performs the activities corresponding to the project adherent to his specialty, being allowed to include, change, delete, and consult the activities of the instantiated project. Finally, the manager is the user who receives the result of the application of the project in production, returns the code that has already been implemented, and is executed to solve the problem with the data that enters the instantiation of the architecture.

Modeling-wise, an abstract class called a user is suggested as the point of variation, because there could be several types of users in this mapping. However, only these three were initially identified, and others may be added later. In this model, the three types of users are subclasses that inherit the characteristics and behaviors of the user's parent class and implement the inherited abstract method called 'keepUser()' passing as parameters the object and sequence of the action to be performed. Although the Administrator, Expert, and Manager classes have inherited attributes from the User class, they may differ by having their own behaviors and performing different actions depending on the type of user. Considering that these three classes have access to profiles, the profile class is a subclass of the three, considering that the implementation will be an inheritance.

4.2.2. Object commonality

The object schema represents the diagram of the classes that depict the framework required to identify the category of classes related to the object relative to the selected analyzed cases. In all three, we verified the need for their administration, that in the conceptual model of the architecture, the class is called an object, which indicates the class of the problem to be solved. For example, the classes of problems include classification, prediction, grouping, search, optimization, and recommendation. The object must be created by an expert, but it can also be created by an administrator. However, a domain analysis of a manager's profile should not have permission for this action.

This conceptual model was also placed in the log class that records all activities performed on the architecture, such as user data, data and time, and action performed. It is important to note that the specialized user profile can create multiple projects so that other profiles can interact by adding activities to the application flow. The manager profile should not be allowed to create or sustain objects because its goal is to manipulate the application by performing experiments and querying the results.

4.2.3. Technical commonality

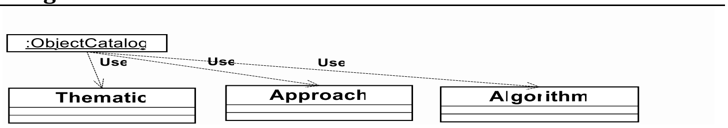
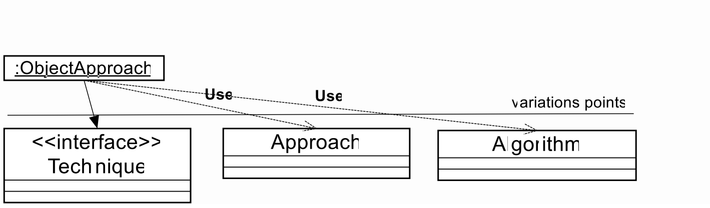
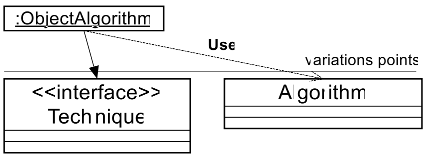
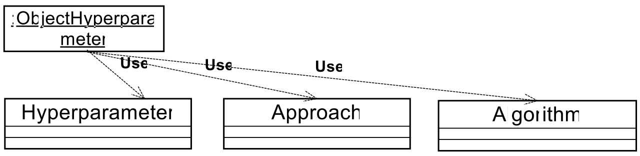
The technical schema represents the necessary framework to identify the category of techniques related to the cases analyzed. For the technical schema, the following classes were mapped: techniques, approaches, hyperparameters, and algorithms. These classes allow other algorithms with various approaches to be added to instantiate the framework. This indicates that different techniques and approaches can be employed to solve problems within the same domain.

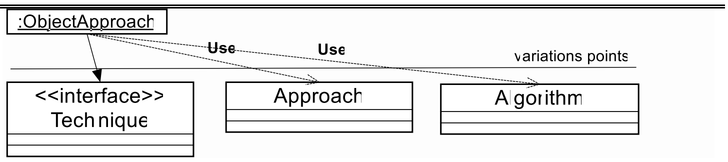
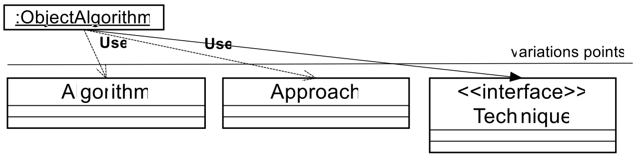
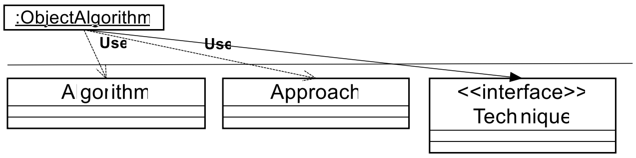
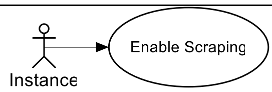
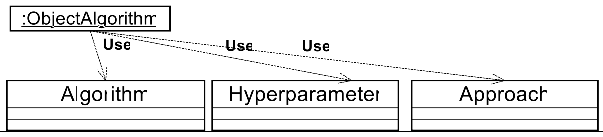
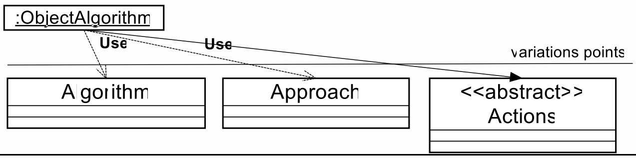
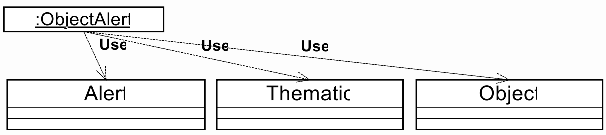
The technical class is one of the points of variation (hotspots) of the framework, and it is a class of the interface type. That is, it has only the signatures of the methods, these being the ‘compileCode()’ and ‘executeCode(),’ which will be implemented in the concrete class called the algorithm, and this allows the algorithm to compile and execute each implemented logic differently. Moreover, it allows, in the instantiation of the framework, implementation of the needs of stakeholders appropriately. In addition to this point of variation in the model, the class of the concrete type of algorithm is a composition of the Class Approach and Hyperparameter, where the first defines whether the technique is neural, swarm, or evolutionary. Thus, it can detail what type of problem can be solved, and the second is the Class Hyperparameter, which defines which parameters can be used for the chosen technique.

4.2.4. Gathered requirements

Eleven Functional (FR) and five non-functional requirements (NFR) gathered with the application of domain engineering in the three selected projects are presented in the diagrams of Table 3. These results also used information collected through interviews with the authors of the three selected cases. This is especially aimed at obtaining their views on the characteristics and high-level benefits that need to be provided as functionalities for future frameworks.

Table 3. Functional and Non-functional Requirements RESUME

Description	**Diagrams**
FR01. Catalog: make system catalog available on inference templates based on decision support rules. (1) Dependencies – there will be dependence between the thematic, approach and technical domain classes.	
FR02. Approaches: allow the use of models of neural approaches, swarms and evolutionary approaches. (1) Variability – related to the limits of the application of techniques that should be of the same approach; (2) Dependencies – between the technical and approach classes; (3) Mutual exclusivity – the methods of executing the technical class cannot occur at the same time.	
FR03. Templates: make hotspots available so that new models, already tested, can be added to the framework. (1) Variability – related to the limits of the use of models already tested; (2) Dependencies – between the technical and approach classes; (3) Mutual exclusivity – the methods of executing the technical class cannot occur at the same time.	
FR04. Parameterization: provide Artificial and Computational Intelligence algorithms of neural, swarm and evolutionary approaches, allowing the configuration of the hyperparameters used by each of the added techniques. (1) Variability – related to the determination of acceptable limits of parameterization is at the discretion for each technique the inclusion of the necessary hyperparameters; (2) Dependencies – there is dependence between the class of hyperparameters and those of the approach and techniques; (3) Mutual uniqueness – the threads of the techniques class execution methods cannot occur at the same time.	

FR05. Multi-objectives: enable the solution of multi-objective optimization problems through exam approach techniques. (1) Variability – related to the limits of the use of techniques exclusively from the swarm approach to solving optimization problems; (2) Dependencies – between the technical and approach classes.	
FR06. Hybridization: allow hybridizing techniques allowing the creation of new ones in an easy and agile way. (1) Variability – related to the limits of the use of techniques related to the same approach; (2) Dependencies – between the technical and approach classes; (3) Mutual exclusivity – the methods of executing the technical class cannot occur at the same time.	
FR07. Training: provide supervised, unsupervised, and reinforced training models. (1) Variability – related to the limits of the use of models already tested; (2) Dependencies – between the technical and approach classes; (3) Mutual exclusivity – the methods of executing the technical class cannot occur at the same time.	
FR08. Data: make up-to-date data available for experiments by automated open database capabilities.	
FR09. Mining: provide resources to perform pre-processing, with the possibility of data mining, standardization, and balancing.	
FR10. Data: make abstract classes available so that they have predefined methods for the default actions of persistence and query and abstract methods so that they can be implemented as needed for the actions to connect, extract, transform, and load data.	
FR11. Feedback: will follow the standard of tools for agile management, interacting quickly whenever an activity is performed between those involved with the theme making use of standard media. (1) Variability – related to the determination of acceptable limits of feedback as alerts will only occur for those that are enabled via prior configuration; (2) Dependencies – the feedback relationship will occur between actions of the thematic, object and technical domains.	
NFR01. Paradigm: build structure based on object-oriented paradigm.	
NFR02. White box: so that all the solutions worked in the instantiation of the structure incorporate the concept of responsible artificial intelligence.	
NFR03. Standards: apply communication standards (TCP/IP); standards of compliance with platforms; quality and safety standards (ISO).	
NFR04. Security: Provide access with defined user profiles.	
NFR05. Usability: allow users to do activities in the framework by simply dragging and dropping components.	

5. Conclusion

Using domain analysis focused on code reuse, this article proposes using this technique to gather requirements for the construction of conceptual schemes for a future AI framework for compliance in the public service.

With this architecture, applications may be instantiated in the areas of control and auditing to facilitate and optimize the application creation process. This paper analyzed three currently available frameworks and pointed out their shortcomings. Next, we analyzed selected applications in distinct areas of the public service as three cases of AI application so that conceptual schemas could be put forward. The first study delves into process mining, the second into anomaly detection, and the third into rule extraction.

The studies have similarities that have helped in the construction of generic classes. This allows the construction of a preliminary architecture that could be used to instantiate applications to solve complex problems in the public sector.

The development of the future framework followed the architectural pattern of control, model, and vision, and should be written for the model layer, interaction classes in the visualization layer, and business rules in the control layer, with the implementation of a persistence layer ensuring independence between classes. The use of object orientation and the established concepts of inheritance, polymorphism, and encapsulation will be of great help.

We conclude by stating that the use of domain analysis should be a mandatory tool for requirements gathering, evidencing that the investigation of commonalities in projects can generate new knowledge and thus facilitate the construction of new systems. We also argue that this can easily produce high-quality and adequate applications, in addition to the complexity of the application domain and large AI taxonomy.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

AFP: carrying out the research for foundation; application of the methodology; survey of requirements; definition of common characteristics; proposition of contributions; construction of diagrams; and, article writing. FBLN: conducting the research; definition of the methodology; proposition of contributions; and, writing analysis.

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