TECHNICAL PROPOSAL

This document has been prepared by Healthix Solutions Kenya Ltd

Date: 7th October 2019

Overview

Claims Management

Healthcare claims management is the single most expensive process done by the payers. The JLN Processes (Claims Management) and the development of Automated Claims Processing with fraud detection using ML and AI technologies are two tasks that Healthix Solutions will be looking to work on in the OpenIMIS project.

Claims management and payment processing currently involves lots of manual processes including:- data gathering, benefit plans mapping and matching, correctly configure deductions and accounting for the payments done.

Development ML & AI

Traditionally, most insurers predict claim payments by taking similar groups of policies and analyzing their historical trends such as frequency of claims, and amounts paid toward such claims. Based on patterns obtained from the datasets, new estimates of claim reserves are manually produced as depicted in Figure 1 below:

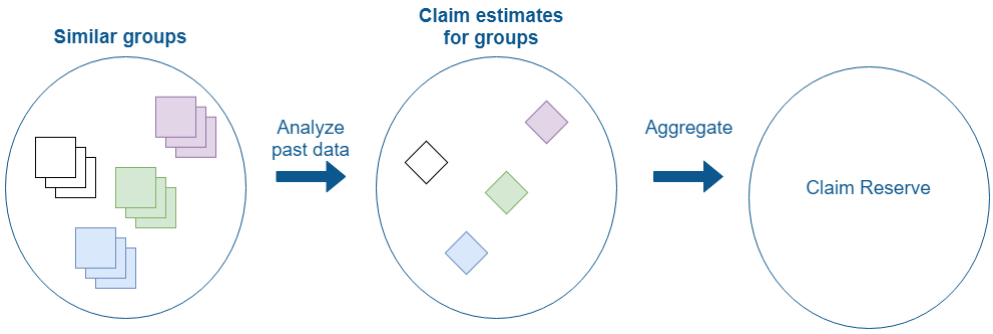


Figure 1: Paper-based insurance claims processing and adjudication workflow

This method produces a good estimate of Claims Reserve, but the **final claim payment is always somewhat different** than the expected one. There are two sources of the difference:

1. Actuaries take the group of similar policies and do not take into account individual characteristics of policyholders. Thus, it can turn out that some individuals are not following the patterns of a group and claims are much smaller or higher for them, impacting the aggregated result.
2. Between a claim's initial filing and full payment, the final amount of the claim can change drastically thus an insurer has set up additional outstanding reserve for possible losses.

High-Level Budget Summary

	Work Package 1 JLN Claims Processing	Work Package 2 AI-based Claim Automated Adjudication and fraud detection	Total Cost (USD)
Total Project Costs	**148, 020.00**	**182,653.20**	**330,673.20**

Executive Summary

The OpenIMIS initiative drives an interoperable agenda for both the provider and payer players globally. The current deployments in Nepal and Tanzania have priority developments focused on Claims Management, and Members management that would greatly impact efficiency for the different stakeholders.

As Healthix, we wish to replicate our success in Kenya to Nepal where we have developed and deployed similar integrated solutions for Payer and Provider stakeholders. We shall automate claim processing with fraud detection while improving on the JLN Processes of improving Claims Management.

Today, Artificial Intelligence (AI) techniques such as Machine Learning (ML) can be used to discover patterns from non-linear datasets (Figure 2).

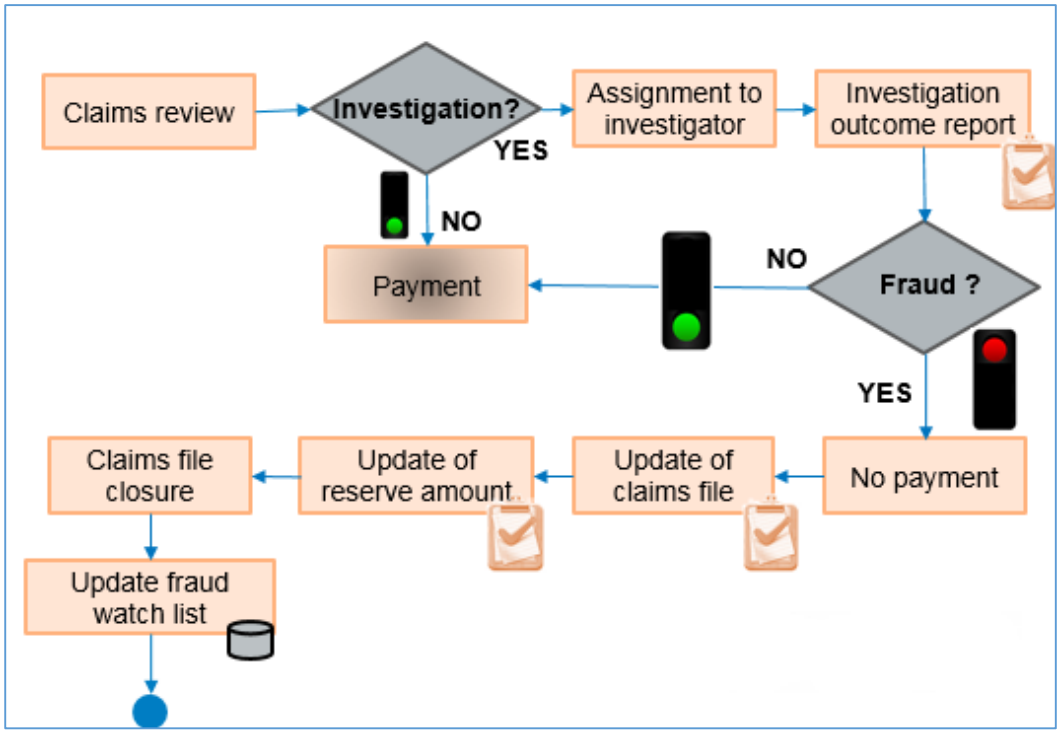


Fig2: shows ML procedures

The AI techniques are coded to ensure that the predictable and linear processes can be flagged out in the claims as early as during submission. Figure 3 shows the sample AI processes that we shall use to discover linear flags that need to be watched.

Based on the learned pattern, the algorithms can predict payments on a claim; or even identify potential fraudulent claims and flag them for investigation. Insurers now have the option of achieving far better claims management by utilizing the technology in the following ways:

1. Use rule-based engine to pre-assess claims while automating the evaluation process.
2. Use artificial intelligence to automate claims fraud detection through rich data analytics.
3. Use machine learning to predict patterns of claim volume.
4. Augment loss analysis.

Improved Claim Review

The Improved Claim Review requirement describes two distinct mechanisms aiming at Claim processing automation. To enhance openIMIS functionality, our specific assignment will be to improve the functionality of the new platform by providing Python-based **Configurable Claim Review Engine;** and **AI-based Claim Automated Adjudication and fraud detection**

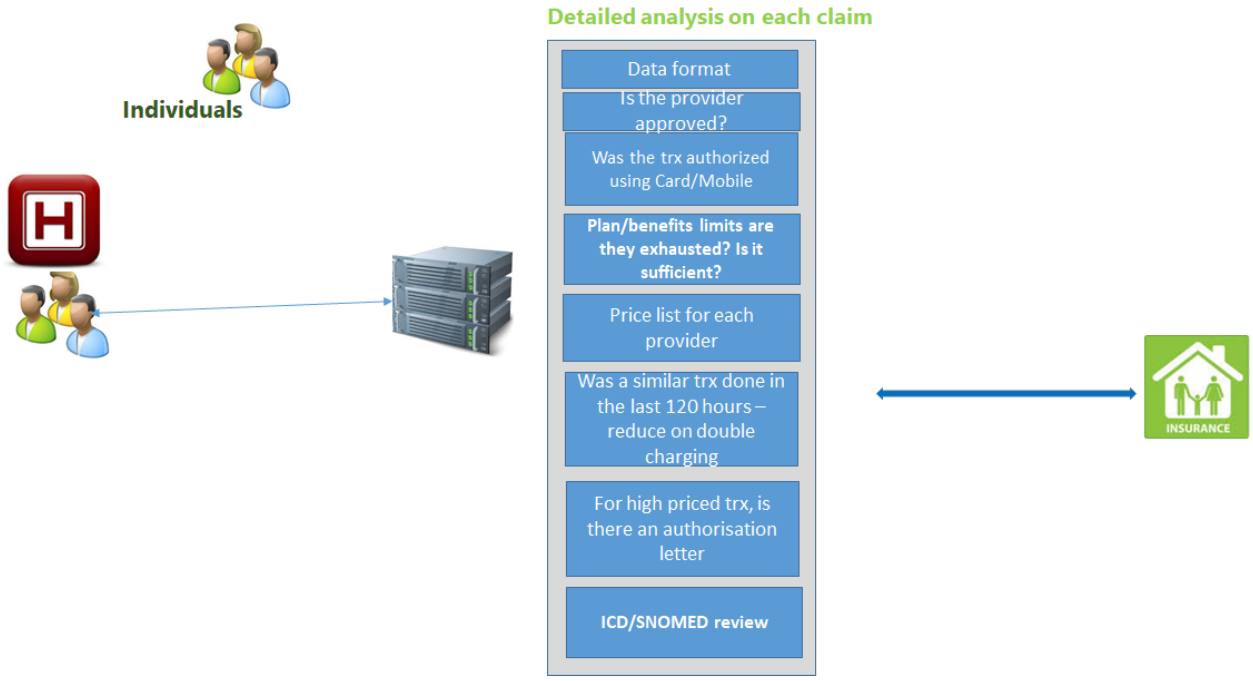


Fig 3: claims AI

Consortium Team

Healthix Solutions registered in Kenya is the lead in this development and deployment of digital health insurance solutions. Healthix is a technology company specializing in Healthcare (Providers) and Insurance (Payers) industry; connecting Insurance/Payers and Providers with a focus to improve patient care. We are enabling a vibrant Healthcare Ecosystem through a Shared Exchange platform (Enterprise Bus) we have developed (seamless integrated exchange services between all Healthcare players).

We provide value in Claims submission, Referral management, Preauthorization requests & responses, member eligibility verification and tracking, Claims adjudication and payment management amongst other services. The shared enterprise gateway makes it possible for the different players to exchange data real-time.

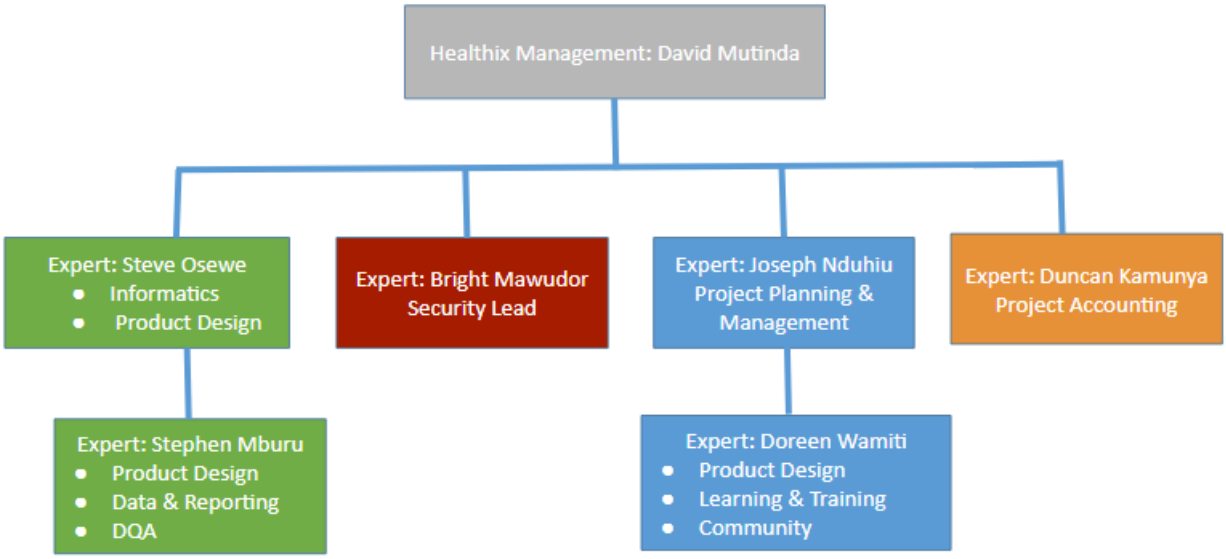
Our team is versatile and well blended to provide expertise in medical health, insurance segment, analytics and visualizations. Our experience spans more than 20 years in senior Level management and technology deployment with specialty is in the development and operationalization of digital health platforms. We have project management, Product Architects, Account Managers, Terminology specialists, Software Developers and Payer expertise.

1. **Healthix Team - David Mutinda:** He is currently the Business Development Director for Healthix Solutions (K) Limited, and is passionate about digitizing the health insurance sector. For this project, he will provide requirements gathering and analysis as well as openIMIS installation and customization capabilities.
2. **Steve Osewe:** Steve Osewe holds an MSC in Computational Intelligence and a BSC in Information Technology. His career over the last 10 years has been spent in the health informatics sector in Sub-Saharan Africa working with local and international agencies to promote use of information systems in patient and hospital management. For this project, he will be the lead expert and will provide health informatics capabilities with regard to engagement with stakeholders and translating needs into technical requirements.
3. **Stephen Mburu: Dr. Stephen Mburu** holds a PhD in Information Systems – Health Informatics. He is an expert in data science, software engineering, and development of digital health policies and software products. Dr. Mburu has supported Kenya and her technology partners key among them Word Bank Group, University of Nairobi and Strathmore University in the development of mHealth, Health Observatories and Telemedicine Solutions. Globally and regionally, Dr. Mburu worked with the United Nations (UN), World Health Organization (WHO), USAID, and KPMG to deliver various projects. Some of the key projects he has supported to successful completion include development of online database for African Network for Soil Biology and Fertility AfNET; Landscape assessment of Kenya Health Information Systems; development of the African Health Observatory (aho2.aho.afro.who.int) and Data Capture Tool (dw.aho.afro.who.int). Currently, He is working as lead developer of the Kenya Health and Research Observatory (KHRO). KHRO is an integrated repository and data analytics platform that will be used by policy and decision makers in monitoring the country's trends towards attainment of Universal Health Coverage (UHC).
4. **Bright Gameli -** holds a PHD in Security and Software Development – Computer Technology and has over 7 years' experience in security management and assessment working with Cellulant, Seven Seas, Access Kenya and Healthix Solutions Kenya Limited. He is the brainchild of the Africa HACK-on Challenge that has been developing Africa's Nextgen security space with more than 20 Hackon Challenges done across Africa in 2018. He has a lot of experience in Security, Pentesting, User eXPerience, API Management and Data Management.

5. **Joseph Nduhiu:** He holds an MBA and BSC in Electronics Engineering. He has over 10 years' experience in the ICT sector in Sub-Saharan Africa and currently works as an independent trainer and consultant in IT Service Management, Project Management and Cyber Resilience. His experience in health informatics involved a stint with AfyaInfo, establishing technical working groups in counties bringing together government agencies, donor agencies and technology companies to synchronize efforts towards enhancing ICT in health. For this project, he will provide project management capacity, training and information management capabilities.

6. **Doreen Wamiti** - is a DHIS2 Consultant with PSI in Kenya. A dedicated and detail-oriented person who is very passionate about eHealth. She strongly advocates for health information systems that ensure evidence based decision making from the lowest to highest health service delivery levels. She provides various DHIS2 services ranging from Android apps development and deployment, core DHIS2 system deployment, she provides capacity building support, DHIS2 system administration, and performs analytics and dashboard development. She has a Masters degree in Applied Computing and a BSC Computer Science degree. She will be part of Product Design, Project Management and training and information management team.

7. **Duncan Kamunya -** He is currently the Chief Financial Officer for Healthix Solutions (K) Limited, and is passionate about digitizing the Health sector. He has a lot of experience in finance and financial analysis, audit and reporting, costing and price review, Fintech products and Account Management. He has a degree in Commerce (Finance), Level 1 – CIMA, and a CPA (K). For this project, he will be part of the Data Science and Business intelligence team and representing the Healthix Management team.



Background or Problem Statement

"Claims adjudication" is a phrase used in the insurance industry to refer to the process of paying **claims** submitted or denying them after comparing **claims** to the benefit or coverage requirements
After a medical **claim** is submitted, the insurance company determines their financial responsibility for the payment to the provider. This **process** is referred to as **claims adjudication**. The insurance company can decide to pay the **claim** in full, deny the **claim**, or to reduce the amount paid to the provider.

In most scenarios, the efficiency of the medical claims adjudication process can be hampered by;

1. Unwanted claims – being processed.
2. Duplicated claims – that are undetected at first instance.
3. Delayed execution by the payer companies on the claims – leading to accumulation.
4. Lack of Automation – technology that looks at key missing components can speed the process
5. Paper-based review – automating paper is a lengthy and laborious process.

There are three possible statuses for Claims submitted by the payers.

1. R**epudiated claim: -** this is a **claim** that has been rejected by an insurance company.
2. Fully Paid
3. Partially Paid Claim

It is a **process** of the examination of claims and determining the outcome of these claim benefits. When the claim is filed and received goes through a 5 stage **process** to determine how the claim should be paid;

1. Initial **processing**,
2. Automated review,
3. Manual review,
4. Determination, and
5. Payment.

After the fifth stage if the provider is dissatisfied with the verdict by the payer (normally on the Repudiated Claim & the partially paid Claim), the provider is allowed to appeal using the reasons used by the payer to deny the claim so that the claim submission is readdressed.

AI and ML are critical for the Automated, Manual review and determination of the payments to be made to a claim in the claims adjudication process. AI and ML processes will work hand in hand to deliver better, accurate and timely claims adjudication procedures to the OpenIMIS project.

Our Approach to JLN Process for Claims Management

To achieve this objective, we propose the incorporation of the Domain Driven Design (DDD) in modelling the new openIMIS functionalities. Below are the benefits of the DDD approach in terms of openIMIS architecture.

- Being Aligned – talks to the business model strategies and processes.
- Being Isolated - from other domains and layers and business.
- Being loosely designed.
- Being reusable – Models re-used via endpoints and avoids duplication.
- Be an abstract and cleanly separated layer.
- Minimum dependencies on infrastructure and frameworks.
- Agile by design – allows for incremental development and delivery.
- The use of micro services concept for each service to connect with a particular MNO
- Provide REST services which can be consumed by any client regardless of the technology in use.

We shall redesign the following aspects in the OpenIMIS project;

1. Claim statuses – add new statuses involving delivery, appeals, repudiated claims, Claims Partially accepted, fully accepted, paid fully
2. Review the payment statuses for the claims submitted to the
3. Identify a criteria to randomize the claims appeal processes from the first reviewer so that there is fairness in review of the claims appeal procedures.

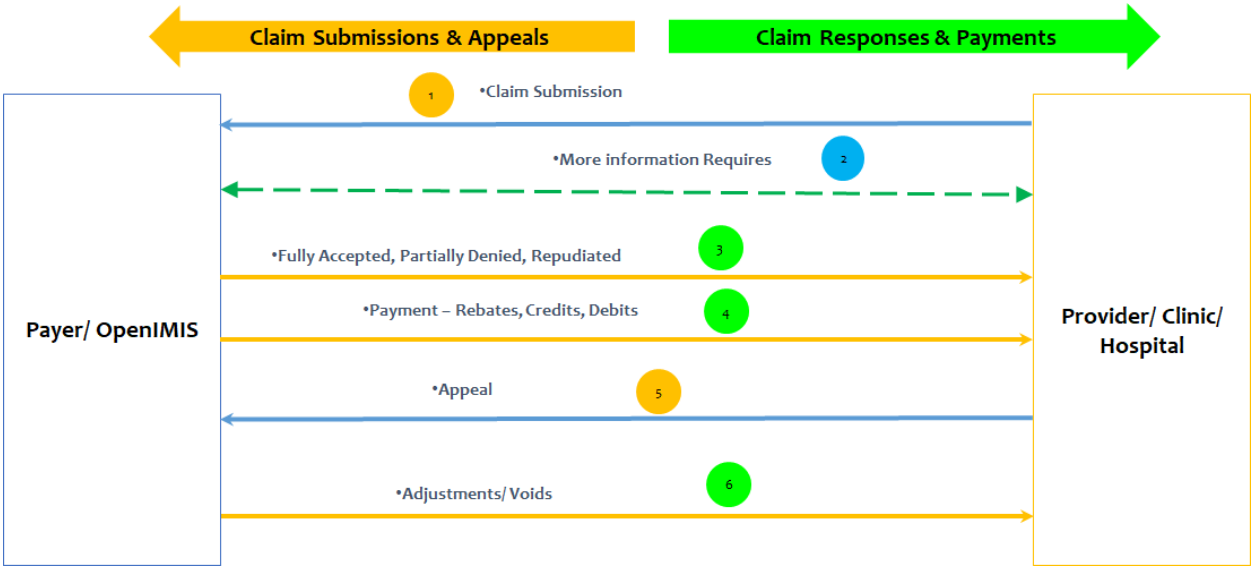


Fig1 – Shows the revised claims adjudication procedures that will allow for more automated responses on the same.

Use Cases and User Stories

Work Package 2: AI-based Claim Automated Adjudication and fraud detection

Objective 2:1:1 Build Configurable Claim Review Engine

A **Configurable Claim Review Engine** can be used at Claim entry or submit level to validate a claim prior to any further treatment. The new openIMIS architecture already integrates Django-rules for access management. We will use Django Framework capability to build rule-engine claim validation engine as an extension to current claim module. The Django module will allow countries to dynamically change the validations performed (via rules) when a claim transits from entered to submitted as shown in one of our application developed in Django

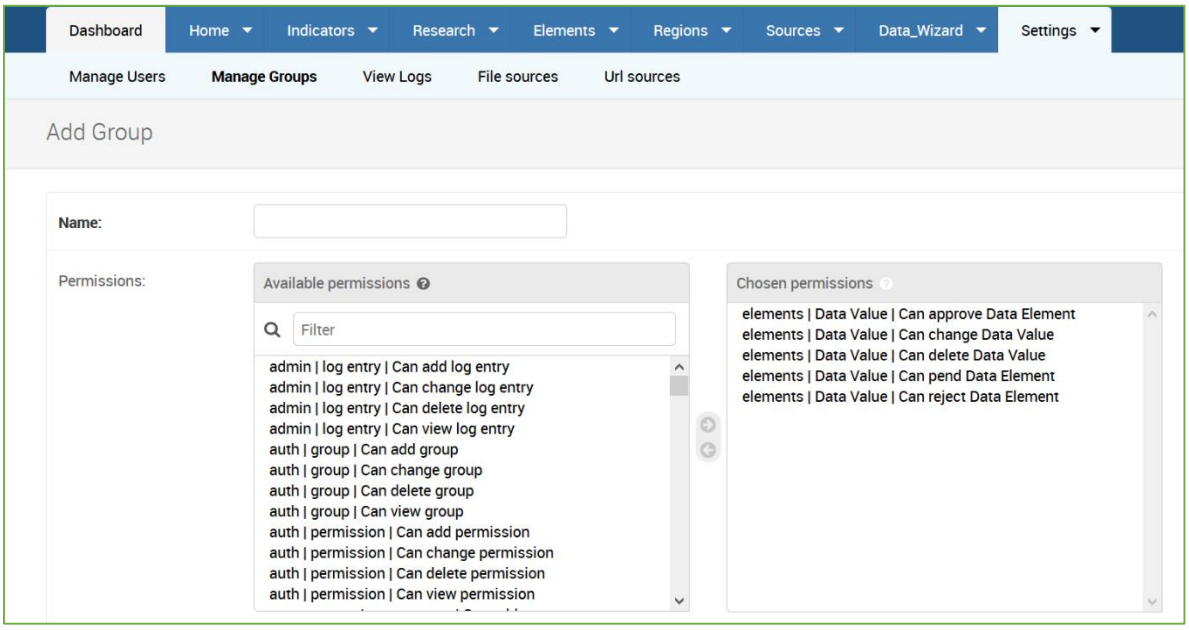


Figure 3: Django rule-based context implemented in one of our solutions

For example, if the rule requires that the insuree gender, date of birth, the health facility type, available such rules will be moved from the left box to such **(available rules**) to the right box **(chosen rules).** All the datasets loaded from database into the claim core must be evaluated against these chosen rules. The available rules will be created and configured by (admin) users and tested against established data governance framework.

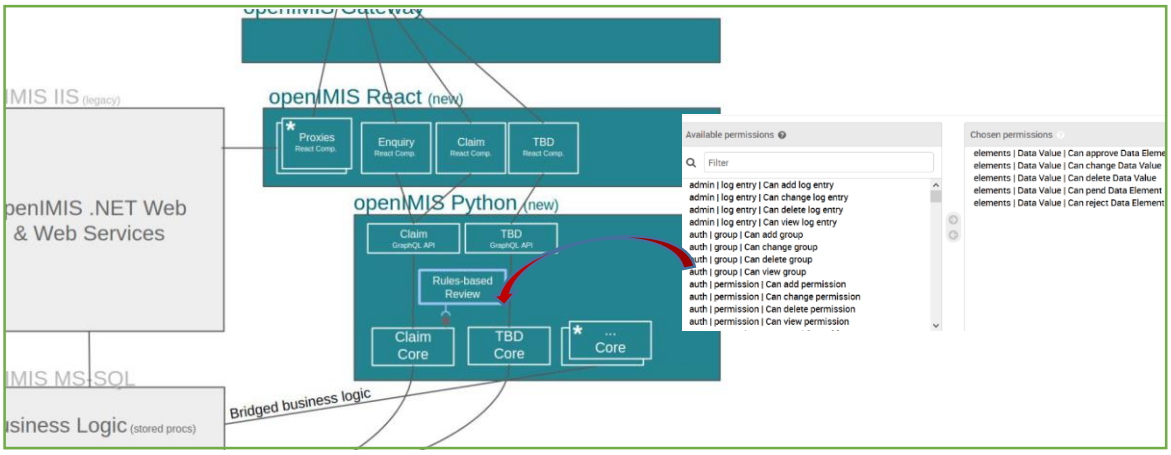


Figure 4: How Django rule-based context will be applied in claims processing

Objective 2:1:2: Build AI-based Claim Adjudication and fraud detection

Rule-based algorithms use relational rules to describe data. However, as systems become operationalized, a rule-based approach to machine learning can become very complex. For example, it is likely that hundreds of exemptions to 100 predefined rules might emerge to register incoming data. Artificial Intelligence (AI) technologies can be seen as an extension of the rule-based mechanisms. In claims automation, AI-based technologies such as pattern recognition and machine learning will be used to will support the following:

1. Fraud detection: Machine learning models can be used to detect possible fraudulent claims hence save on revenue and corporate image;
2. Policy compliance: Provide flexible techniques for calculating coverage and payment for each claim according to set insurance policies;
3. Decision making: AI eliminates much of the guesswork associated with decision-making; thus decisions become more accurate, correct, and consistent;
4. Time and cost saving: Drastically reduce processing time between insurance and healthcare provider systems.

Fraud detection

Insurance companies lose an estimated **US$30 billion** a year to fraudulent claims. In fact, as more and more customers use online services, the potential for fraud has increased dramatically. To mitigate this risk, machine learning may be used to identify potential fraudulent claims faster and more accurately, and flag them for investigation.

Linear techniques, neural networks, and deep learning are used together in order to spot fraudulent behavior. Because rule based and linear regression models cannot detect advanced fraudulent behaviour, we will adopt a holistic approach to implementing our solution as depicted in the figure below:

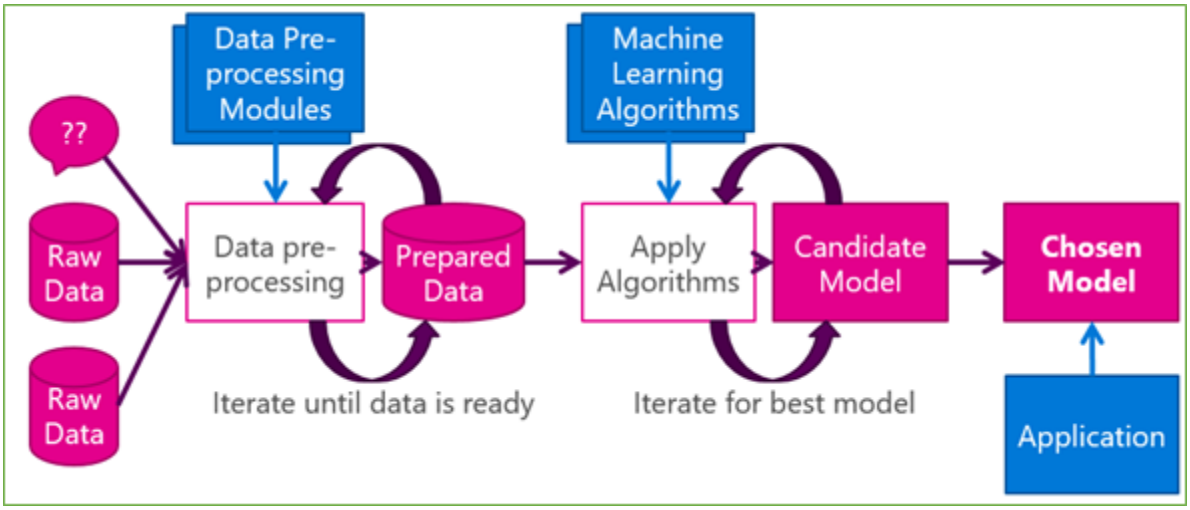


Figure 5: Methodology for implementing AI-based Claim Adjudication and fraud detection

The motivation behind this iterative approach is that deployment of ML module in openIMIS will focus on building the proper machine learning pipeline required for prediction. The following is a brief explanation of each of the stages of the above workflow:

1. **Identify raw data:** Identifying the relevant data sources will be the first step in the cycle. The raw data may come from health facilities or insurance takers in the formal sector.

2. **Pre-process data:** The will be used to make sure that the data received from source systems is clean, secured, and governed. Tools such as Talend Open Studio will be used for data Extraction Transformation and Loading (ETL) into a database

3. **Apply machine learning algorithm:** Based on the nature of the prepared data, we will apply several machine learning algorithms on the training and test datasets. The candidate algorithm will be from supervised ML models such as Naive Bayes, Linear Regression, Random Forest, and support vector machines). Candidates for unsupervised learning include K-Means clustering and Hidden Markov Model
4. **Iterate and Train:** To identify the most optimal model, iterative training will be done depending on the type of data and algorithm. The training process may be supervised, unsupervised, or reinforcement learning to find the best performing algorithm.
5. **Deploy and Maintain Chosen Model:** The optimal machine learning algorithms will be used to create the automated adjudication and fraud detection module that will be integrated into openIMIS. After deployment, we will continuously review the model to evaluate its capability of making predictions based on new incoming data.

Work Plan for Claims Automation

Proper planning is crucial to identifying and mapping the project activities, and resources and scope the system requirements specification. Figure 6 shows a breakdown of high-level tasks and activities that will be undertaken to realize the objective of automating claims processing and adjudication:

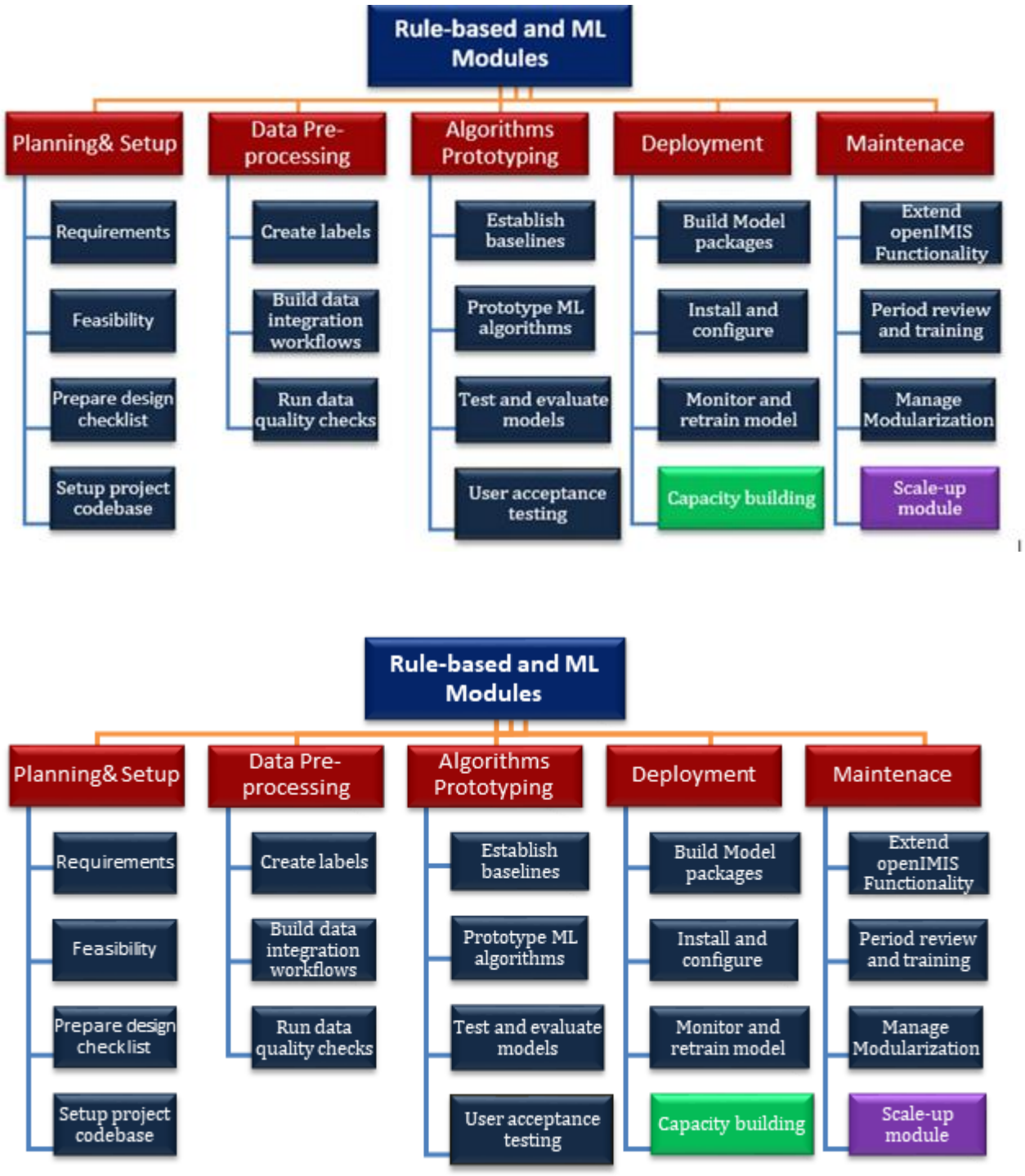


Figure 6: Work breakdown structure for automated Claims adjudication and fraud detection

The following is a breakdown of each of the high-level project activities depicted in the WBS illustrated above:

1. **Planning and project setup.** This the most fundamental stage in the lifecycle of the rule-based and AI module development that will entail the following sub-activities:
   1.1. Define the task and scope out requirements
   1.2. Determine project feasibility
   1.3. Prepare design checklists
   1.4. Set up project codebase

2. **Data Pre-Processing.** This is a crucial step that will be used to prepare and label data mined from openIMIS and other sub-systems. The data will be used for training and testing the ML models. Sub-activities include:
   2.1. Define ground truth and create labeling documentation
   2.2. Build data integration workflows and pipelines
   2.3. Use validation tools to check quality of data received from source systems

3. **Prototyping and Validation**. This is the most demanding activity broken down into the following sub-activities:
   3.1. Establish baselines for model performance
   3.2. Implement a simple ML model using initial data pipeline and continuously overfit the model to training data. The following is a sample Python codebase of the ML module to be implemented within a Docker container or virtual environment:

```
data/
docker/
api/
 app.py
project_name/
 networks/
  resnet.py
  densenet.py
 models/
  base.py
  simple_baseline.py
  cnn.py
 configs/
```

   3.3. Test and evaluate model on test distribution to understand the differences between train and test set distributions as shown in Figure7.
   3.4. Refine the model to ensure it provides desirable results and downstream user behavior
   3.5. Conduct User Acceptance testing on the alpha and beta versions of the prototype

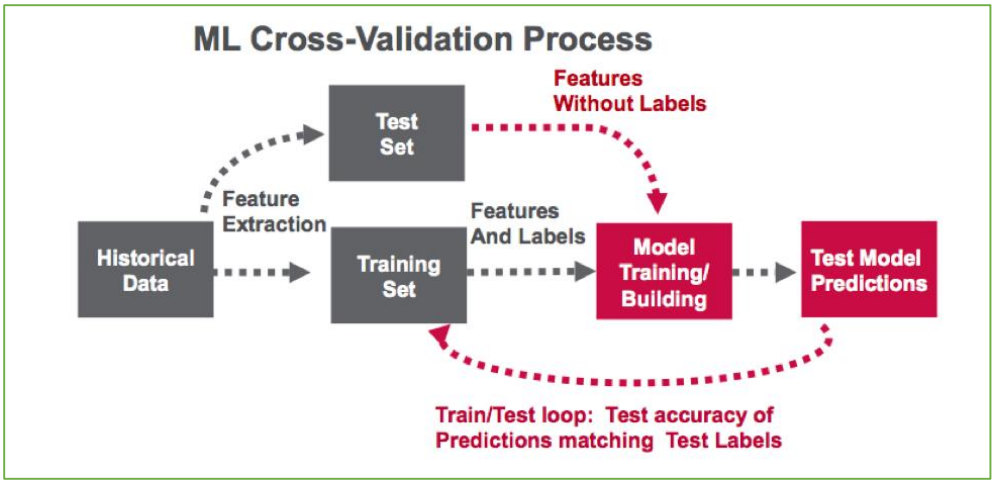


Figure 7: ML model testing and evaluation

4. **Model deployment and maintenance.** The chosen model will be integrated into openIMIS for deployment and utilization. The following are sub-activities of this work package:
   4.1. Package the module into a Docker container and expose a REST API for inference
   4.2. Install and configure the new module for limited number of users before rolling out to scale
   4.3. Monitor live data and model prediction distributions for possible adjustments
   4.4. Periodically retrain model to prevent model staleness
   4.5. Provide capacity building and knowledge transfer to users for ownership, and better utilization of the new openIMIS prediction features.

The expected deliverables for the Rule-based and AI-based claims automation work packages include: incremental rule-based and ML prototypes; solution specification document; architectural and ML Models; metadata dictionaries; workspace configuration tools; and REST API for integration with other sub-systems connected to openIMIS. Figure 8 shows the overall conceptual view of our solution:

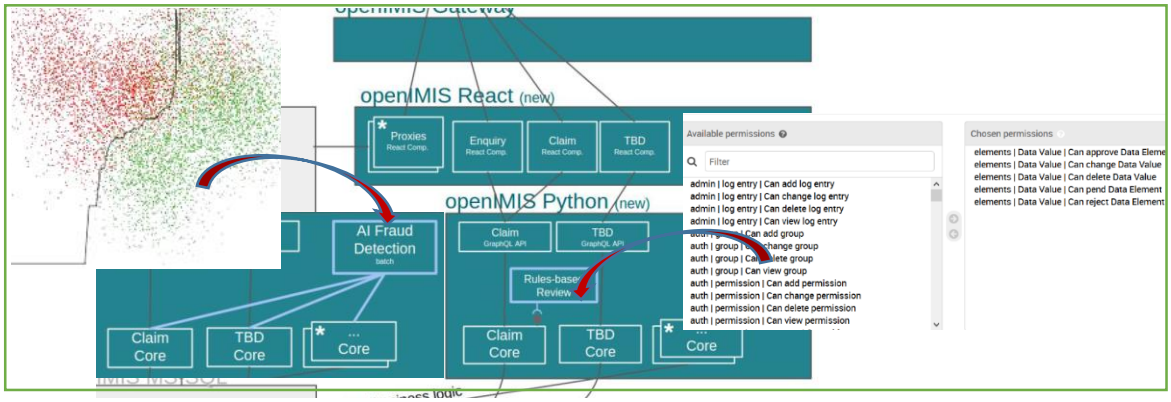


Figure 8: Conceptual view of rule-based and AI Claims processing module to be integrated into openIMIS

Objectives and Activities

Work package 1: JLN Claims Processing

Claims processing Automation, claims appeal processes and Payment tracking is key to driving efficiency in the claims management processes.

Objective 1.1: Automated Claims Processing Management

Activity 1.1.1: Improve claims review by developing a configurable claims review engine:

1. Develop the Claim Statuses for the different stages of adjudication
2. Develop configurable linear controls on claims
3.

Activity 1.1.2: Automating the claims adjudication support;

1. Create flags for all controls
2. Configure controls for all claim status flags
3. Create completed claims, partially accepted and repudiated claims

Objective 1.3: Payment Configuration

Activity 1.3.1: Configure payment statuses

- Create flags and statuses for all payments made:
- Ensure payments can be made in different tranches for the same claim
- Ensure payments can be adjusted to rebates, credits and debits

Objective 1.4: Create Appeals procedures

Activity 1.3.1: Configure Appeals and Adjustments

- Reintroduce a claim to the appeal process
- Ensure adjustments can be made to the total value of the claim and also the claim status

Community Feedback

The following schedule is proposed to ensure that all the project outcomes are achieved:

Time Driven Activities

Deliverable	Timeline	Responsible
Inception Evaluation and reporting	2 weeks after project kick off	Lead Expert
Status updates on the designs & progress	Every 2 weeks	Lead Expert
Monthly publishing of the completed modules and source Code	Monthly updates on Attlasian	Lead Expert
Quarterly reports and updated work plans	5th day of every month	Project Team
Final report	Oct.2020	Lead Expert

Event Driven Activities

Deliverable	Event	Responsible
Conceptual Design of the new modules and the migration path	Review of the different deployments and any enhancements.	Project Team
Review and monthly discussions of Designs of the API endpoints	After conceptual review of the new system & monthly reviews	Project Team
Gap Analysis	After collective review of the new system architecture	Project Team
Design and Testing of the APIs	After agreed design is commissioned	Healthix Team
OpenIMIS modules Appended to the new architecture	After new system has been deployed and is operational	Project Team
Project Completion	After the system architecture has been adopted and deployed.	Healthix Team

Schedule

The following is a high-level work plan.

Activity	Team / Location	[Month]						
	Month/	Dec	Jan	Mar	Apr	May	Jun	Jul
	Quarter	1	2	3	4	5	6	
JLN Claims Management								
Improve claims review by developing a configurable claims review engine:	[Healthix, TZ, Nepal]							
Automating the claims adjudication support;	[Healthix, Kenya]							
Develop configurable linear controls on claims	[Healthix, Kenya]							
completed claims, partially accepted and repudiated claims	[Healthix, TZ, Nepal, Kenya]							
Payment Configuration	[Healthix, Kenya]							
Create Appeals procedures	[Healthix, Kenya]							
Automated claim processing with fraud detection using ML and AI technologies								
Build configurable claims engine	[Healthix, TZ, Nepal]							
Build AI-based Claim Adjudication and fraud detection	[Healthix, Kenya]							
Prototyping, Data Pre-processing and Data modelling	[Healthix, TZ, Nepal]							
Develop machine algorithms	[Healthix, Kenya]							
Model Deployment and Maintenance	[Healthix, Kenya]							
Both Processes								
End to end Testing	[Healthix, Kenya]							
UATs with other platforms	[Healthix, TZ, Nepal]							
End user acceptance tests & Signoffs	[Healthix, TZ, Nepal]							

Deliverables

Deliverable	Month Due
Improve claims review by developing a configurable claims review engine:	Jan-20
Develop configurable linear controls on claims	Mar-20
Create Appeals procedures	May-20
Build configurable claims engine	May-20
Build AI-based Claim Adjudication and fraud detection	Jun-20
Develop machine algorithms	Jun-20

Global Good Maturity Model Assessment

Example Rating of a Digital Health Software Global Good (make a copy of this document to use)			
Core Indicator and Calculated Score [0-10]	**Sub-Indicator**	*change rating here*	
Global Utility - 2	Country Utilization	Low	Less than two countries or states actively use the tool as part of their health information system
	Country Strategy	Low	Less than two countries or states have included the tool as part of their eHealth strategy or framework
	Digital Health Interventions	Medium	The tool partially meets digital functional requirements (as defined by WHO's Classification of Digital Health Interventions) without signifigant customization or configuration
	Source Code Accessibility	Low	Source code not publically available or not released under an open-source license
	Funding and Revenue	Medium	Multiple revenue streams/funders exist across project implementations
Community -5	Developer, Contributor and Implementor Community Engagement	Low	Less than 10% of estimated total number of developers, contributors, and implementers are on a communication platform
	Community Governance	Medium	Some informal processes for community management exist to direct continued development of the digital health tool
	Software Roadmap	High	New features and functionality are documented as part of a software roadmap as part of a release cycle. There are forums for community members to discuss new feature requests. A clear prioritization process exists and is utilized for the development of new features and functionality as part of a product backlog
	User Documentation	High	A full suite of user documentation exists including training manuals, online courses, tutorials and implementation guides addressing most of the common functionality. Documentation has been released under a Creative Commons license
	Multi-Lingual Support	Low	Limited or no support in the software for multiple languages. Multi-lingual documentation / user resources are practically non-existent
Software - 7	Technical Documentation	Medium	Some technical documentation exists of the source code, use cases, and functional requirements
	Software Productization	Medium	Full documentation available for deployment and configuration. A new implementation does not require the involvement of the core development team

	Interoperability and Data Accessibility	High	A robust API is available for key data and metadata exchange needs for the primary business domain with functional requirements for the API having been developed in conjuction with appropriate country, regional and global stakeholders. API endpoints exist for core data and metadata elements which adhere to standards developed by an appropriate Standards Development Organization relevant to the tools business domain. Standards-based API endpoints are used in at least four jurisdictions (e.g. countries or states)
	Security	Medium	Role-based authorization exists, if appropriate. Guidance on encrypting all remote access (web interface, APIs) is available to implementors
	Scalability	High	There is at least one jurisdicions (e.g. country, state) deployment for which 30% of all "entities" are managed within the software. Performance and load testing is a part of routine releases and results are publicly available.