



WHITE PAPER

BayesAML

Anti-money laundering and counter terrorist financing

A functional and technical description of the approach and tool

COMBITECH

HUGINEXPERT

WHITE PAPER

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Introduction

This white paper contains a functional and technical description of a tool for anti-money laundering and counter terrorist financing designed to comply with the requirements in the 4th European Union anti-money laundering directive (2015). In addition to describing the tool's core functionality, this document also outlines the tasks required for solution development and implementation.

A key element of the established solution is customizing the tool to the conditions at each particular institution : customers, products and other business activity, to ensure a high level of accuracy in flagging suspicious transactions.

Figure 1 below illustrates the overall functionality for identifying money laundering. The customized money laundering models of the tool power a filter that helps advisors manage customer relationships through the risk classification of customers, and provides guidance for establishing a level of customer due diligence that corresponds to the risk indicated. If suspected money laundering is detected, the system based on available information suggests measures to be taken to clarify the suspicion. If the suspicion is due to lack of information, the system contains functionality to advise on which information is most useful to collect in order to disprove or confirm the suspicion.

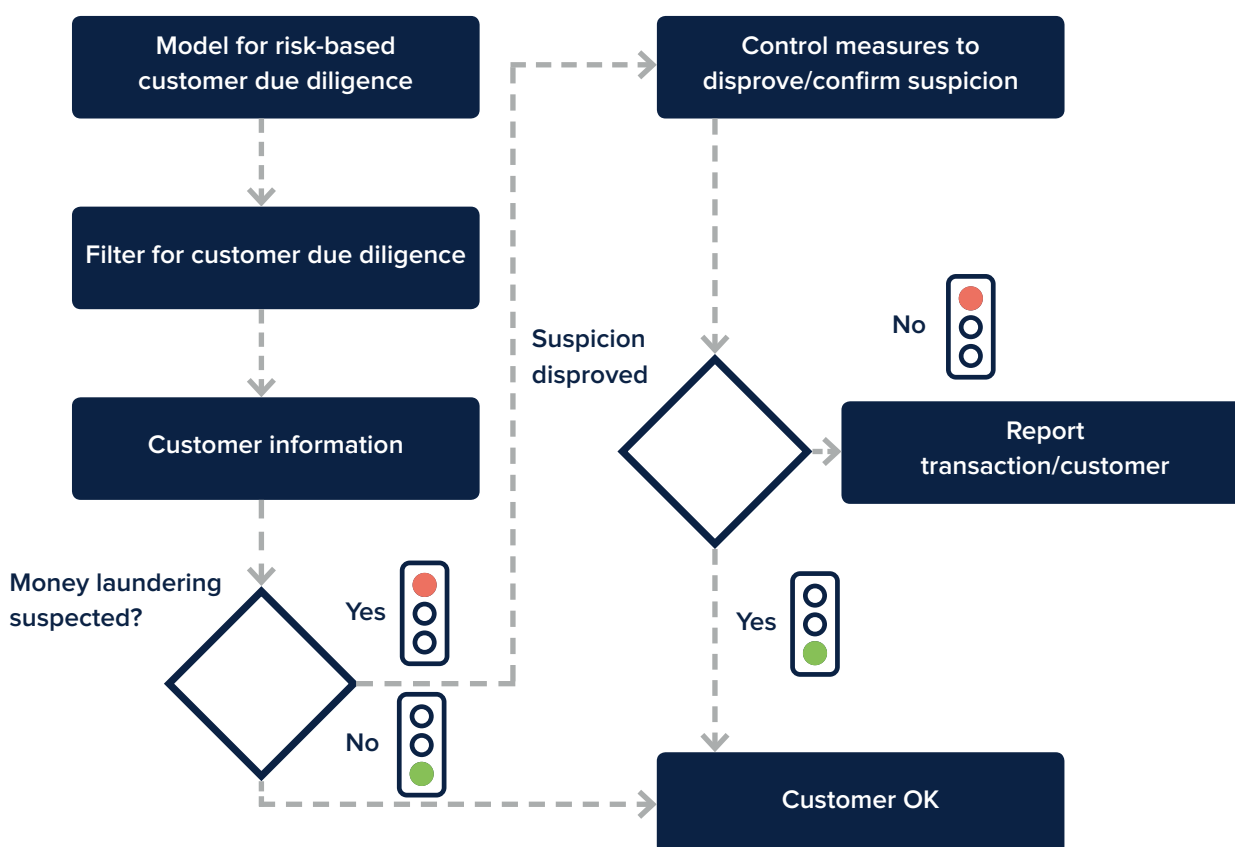


Figure 1: Description of functionality in the money laundering filter

The proposed system is an effective solution for detecting attempts at money laundering based on advanced statistical graphical models. This document describes Combitech's process for developing money laundering models using HUGIN analysis and simulation software, and how to integrate models into existing IT platforms using the HUGIN Java Application Programming Interface (API). It also provides concrete examples of integration using the HUGIN Java API.

The core principle of current anti-money laundering regulations is that individual institutions must establish a risk-based approach to preventing money laundering. In practice this means that the obliged entities are required to assess the level of money laundering risk present in its operations and business relationships. For banks this means risk classification of customers, products and services in order to adapt control measures and customer due diligence to the associated level of risk. It is also a requirement to monitor transactions, to demonstrate the ability to detect suspicious transactions, investigate transactions and if the suspicion holds, report the transaction to the relevant authority.

Combitech has extensive experience developing and implementing anti-money laundering solutions for financial institutions and providers of gambling services, and in collaboration with HUGIN has developed the methods, framework and tools described here. Upon adoption of the described solution, institutions achieve a genuine risk based approach for combating money laundering and terrorist financing that complies with current laws and regulations.

Solution development and implementation is carried out in the following five steps:

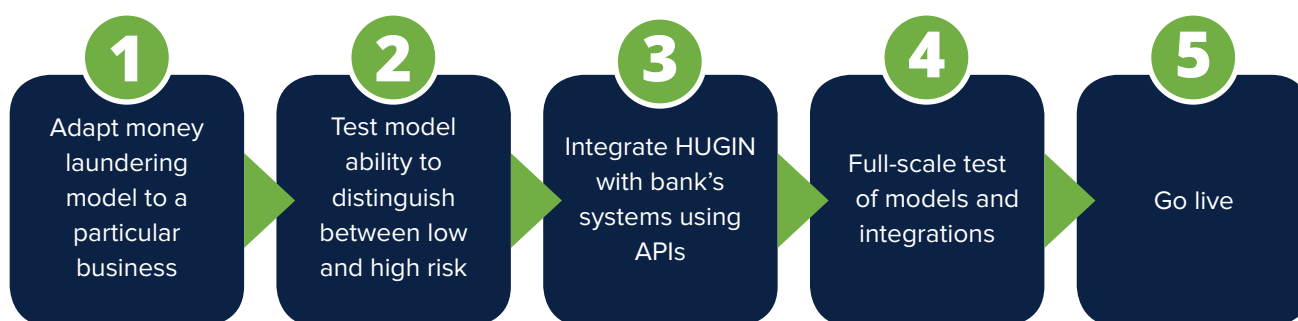


Figure 2: Step by step process for developing and implementing the solution

1

Develop anti-money laundering models adapted to a specific business. The development of graphical models is carried out in cooperation with the bank. Combitech formulates a starting point for discussion based on laws and regulations related to anti-money laundering and counter terrorism, best practices, past experience, and FATF (Financial Action Task Force) case studies, etc. Based on the bank's needs and business activity, models are developed for risk analysis of customers and customer relationships, products and services, geography and possibly channels.



Figure 3: Process for developing customized risk-based customer due diligence for a specific business

2

Test the ability of the model(s) to distinguish between high and low risk. This test is carried out based on data such as the customer data of a selection of customers from the client bank. Test results are the starting point for model adjustment/calibration and rendering of results, which ensures compliance with existing laws and regulations.

3

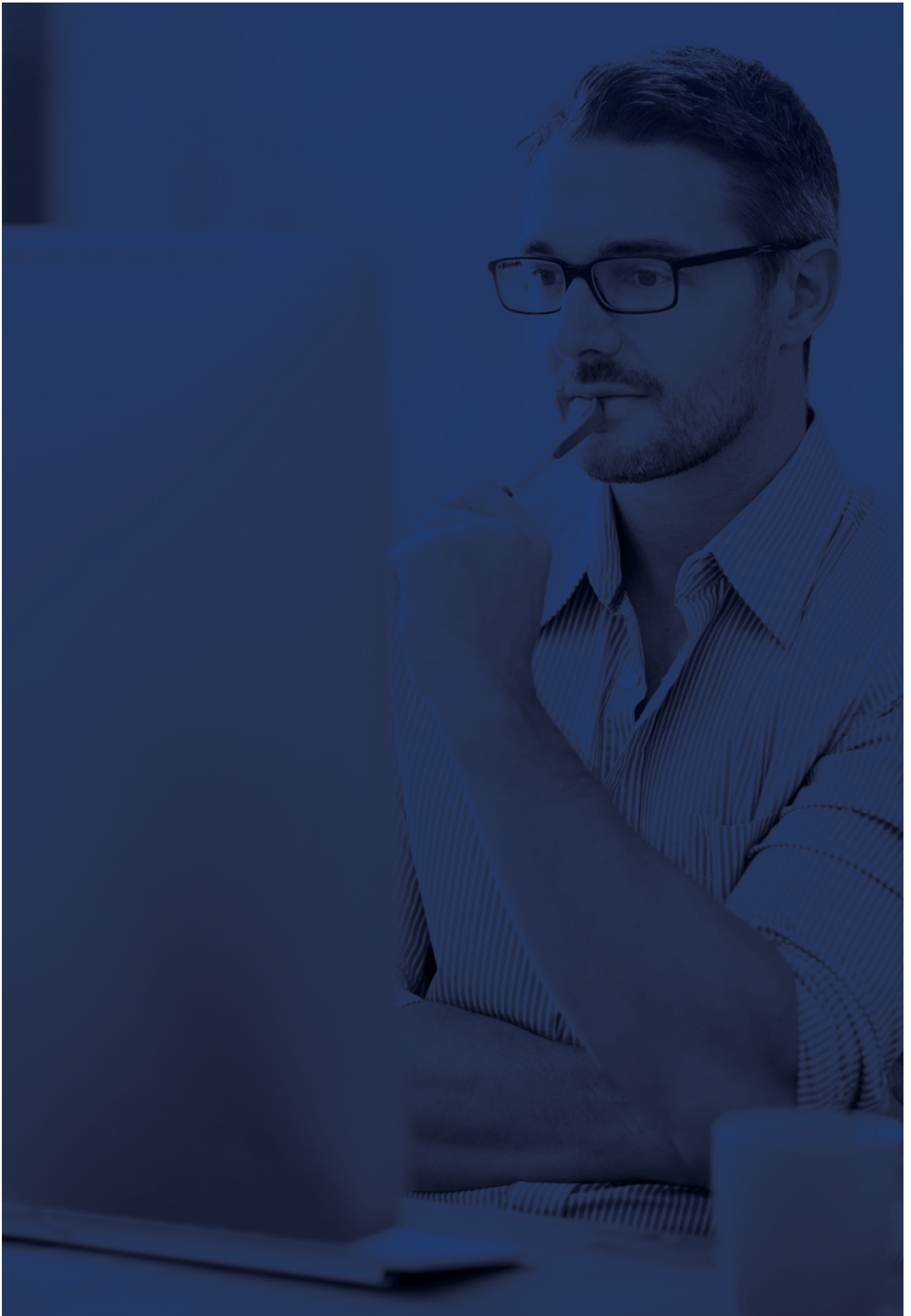
Integration of HUGIN model(s) into existing client systems using the HUGIN Java API. This is normally carried out by the client with support from Combitech or HUGIN. The starting point for this work is an integration description with supporting examples.

4

Full-scale test of models and integration to ensure the solution meets quality and performance requirements.

5

Go live. The solution is put into production.



A hand holding a credit card over a laptop keyboard. The credit card is tilted and shows some text, including "Authorized Signature / The Cardholder". The laptop keyboard is visible in the foreground, and the background is blurred.

Functional description of risk-based customer due diligence and transaction monitoring tool.

Behind risk-based customer due diligence are regulations that require banks to establish and maintain the tools and processes necessary to differentiate high risk customers from normal and low risk customers. This capability makes it possible to focus time and resources on high risk customers and to make adjustments to the level of transaction monitoring and customer knowledge, and enables banks to fulfill their investigative obligations. Using network models, it is possible to classify customers, products and geographical locations into risk categories. The models are developed using Bayesian Network modeling tools in the HUGIN software.

The main component of the solution for risk-based customer due diligence is the graphical model (the network) itself which represents the risk analysis. The model(s) calculate the probability of a money laundering attempt based on given information about customers, customer relationships, products, services, geography, etc. And while in principle, model(s) may contain as many variables/indicators as desired and have any graphic structure, experience has shown that even a system consisting of a simple model with a limited number of indicators produces highly accurate results. To ensure the relevance of the tool and its associated models, the model development process is based on the historical data and information from a specific institution and adapted to suit its conditions and business activity.

The development of risk classification models is first done graphically as illustrated in Figure 4. This involves systemizing all available information about the factors shown to have an influence on the likelihood of money laundering and terrorist financing. The visualization of identified causal relationships provides important insight and awareness about the causes of money laundering/TF. In addition to providing a visual overview that can be used for documentation and training, the network is built on a powerful mathematical platform that is the “brain” of the automated ongoing monitoring of business relationships and transactions filter.

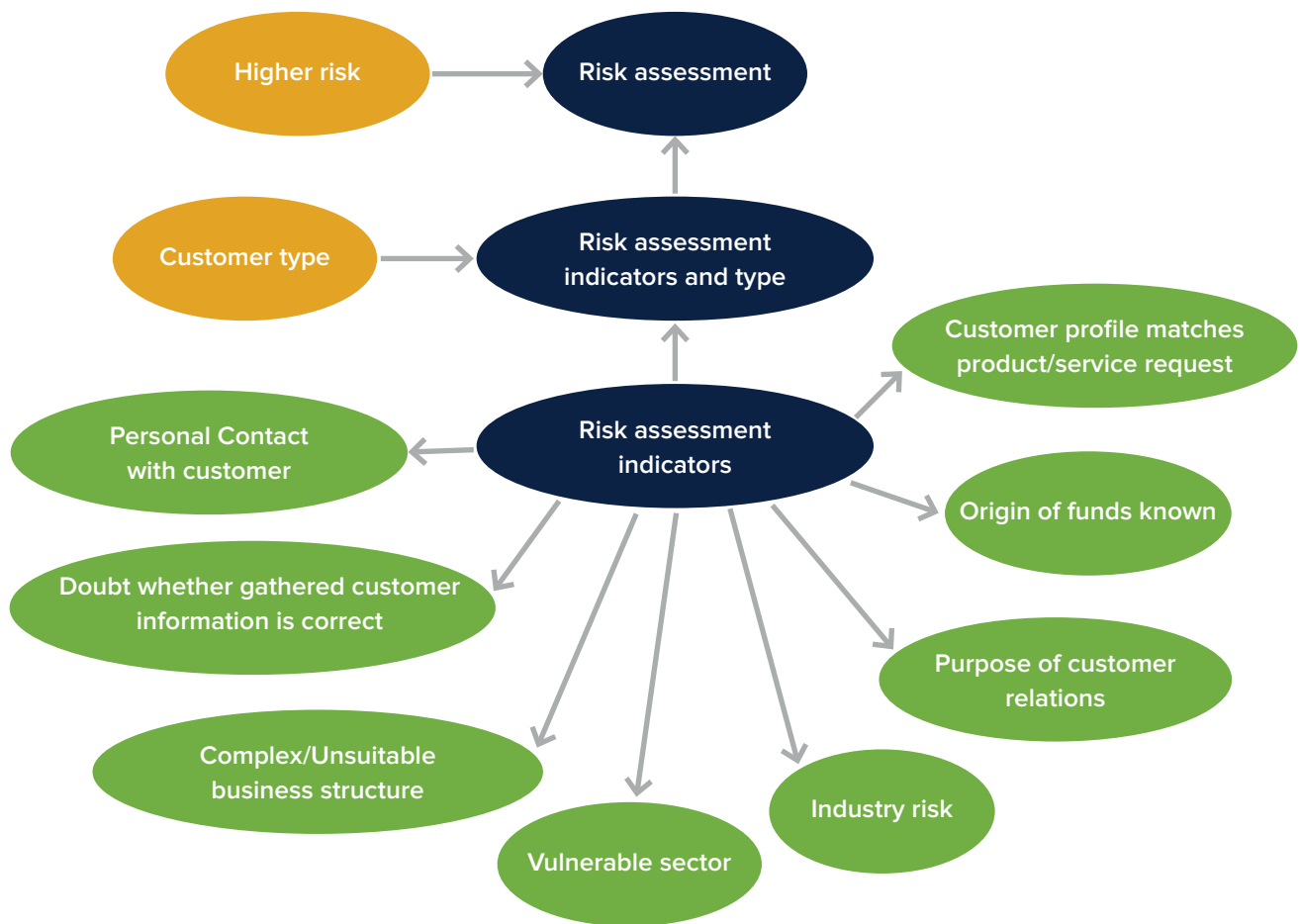


Figure 4: Graphical model of customer risk (private persons)

The system categorizes customers into risk groups based on the established set of indicators. This risk analysis is the basis for risk-based follow-up and adjusting customer control measures to the actual risk posed by the individual customer. Customers classified as extra high risk or high risk for money laundering and terrorism require enhanced customer due diligence, whereas customers that fall into the normal risk category can be followed up with normal control measures. In certain cases, reduced risk may justify less rigorous controls and simplified due diligence measures.



Figure 5: Risk classification and adjusted control measures.

When establishing a new business relationship or updating customer information, a money laundering filter supports the bank advisor. The money laundering filter counsels the bank advisor on which information should be collected, and if this information indicates an increased risk of money laundering/terrorist financing, the system counsels the advisor on what action to take, i.e. that more information is needed to disprove or confirm the suspicion of money laundering/TF.

Based on the bank's needs, risk analyses can also be carried out for products and services, geography and channels.

The money-laundering filter has a web-based interface:

Attempt of money laundering or terror financing - customer appears suspicious

This tool indicates whether a customer intends to launder money through the bank.

Single factors that give lower risk

Customer type

Single factors that give higher risk

Higher risk

Customer Identity

Personal contact with customer?

Doubt whether gathered customer information is correct/sufficient

Industry sector of the customer

Complex/Unsuitable business structure

Vulnerable sector

Industry risk

Purpose and intention of customer relationship

Purpose of customer relationship

Origin of funds known?

Customer profile matches services/product requested

Risk assessment

27% Suspicious

72,99% Normal

Control measures

More information about the customer is required

Figure 6: Web-based interface of the money laundering filter. See example at: http://demo.hugin.com/example/Money_Laundering_Bank

The tool for ongoing monitoring of business relationships and transactions specifies the dependence relations between indicators of money laundering attempts and risk characteristics, and differentiates suspicious transactions from normal transactions. Together, the aggregate information and aggregate assessment of risk based on a combination of customer risk characteristics, customer relationship, product and services and geography provide a solid decision-making basis for identifying suspicious transactions. It ensures resources are correctly dedicated to customers and transactions that pose the highest risk, and reduces the number of “false positives” and unnecessary use of resources.

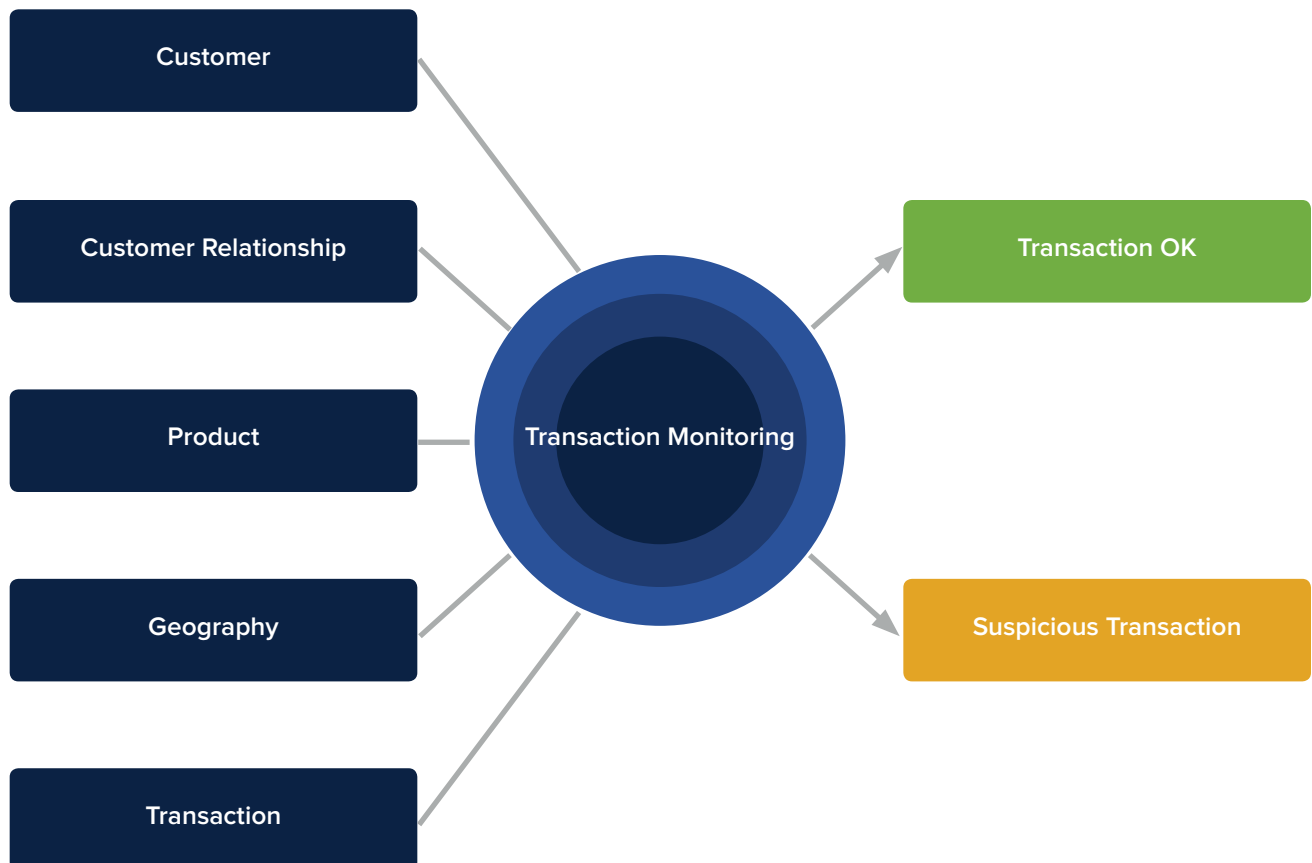


Figure 7: Transaction monitoring based on a total assessment of risk.



Integration description

Here we describe how to integrate a money laundering tool into an existing IT platform. Integration involves two main tasks:

1. Linking each model variable/indicator to the appropriate data source.
2. Reading/Exporting and presenting the probability of money laundering/TF as soon as new values are calculated.

Experience shows that integrating the money laundering tool into an existing IT platform is a simple task using the HUGIN API. Before integration it is important to decide how to display the probability of money laundering/TF to the user. We suggest showing the probability of money laundering/TF using “traffic lights” with red, yellow and green lights, or just red and green lights, as the threshold limits for when yellow turns to green, for example, are defined during the implementation phase. Integration consists primarily of three steps:

1. Link each indicator variable to a data source in the existing IT platform.
2. Link threshold limit values for the state that indicates money-laundering/TF to the traffic lights.
3. Implement a method and routine/process description that defines how to collect and register relevant data, update model probabilities and present results.

The below link contains a complete example of how to integrate a sample money laundering model.
<http://download.hugin.com/Combitech/MoneyLaundering.zip>

The example shown in the link uses the HUGIN Java API and involves the following steps:

1. Load the money-laundering model from file
 2. Define how to obtain variables represented in the model
 3. Compile the model into a calculation structure
 4. Enter observations from a test example
 5. Propagate evidence to calculate the probability of an indication of money laundering
 6. Present the results
 7. Remove observation
- Steps 1-3 are only required the first time. Steps 4-7 are performed each time the probability of money laundering is calculated.

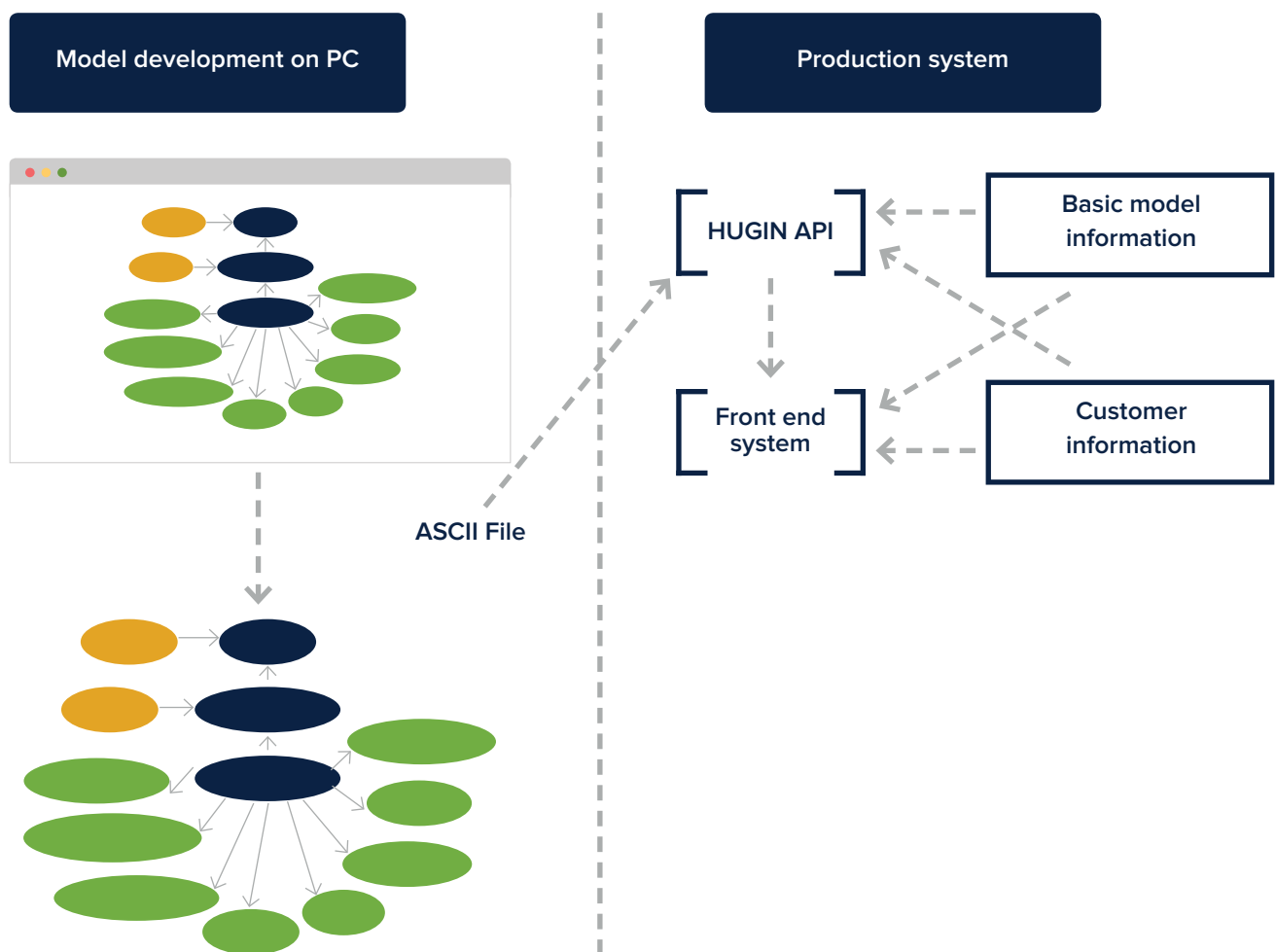


Figure 8: Clear distinction between model development and system integration.

One of the benefits of the money-laundering solution is the clear distinction between model development and model integration into an existing IT platform. Figure 8 illustrates the clear distinction between model development and system integration, - usually performed by client IT staff and supported by HUGIN consultants if needed.

As soon as integration is completed, it is a simple task to replace an existing model with a new one. If no new variables are added to the model, the model can be updated by replacing a simple ASCII text file. If new variables are added to the model, these must be linked to the relevant data source.

As part of the development process, the HUGIN Decision Engine is integrated into the existing or new IT platform used by a bank for managing customer data and customer transactions. The HUGIN Decision Engine comes with a set of APIs (Application Programming Interfaces) which makes integration simple. However, it is common to build what is called a “HUGIN driver” that acts as a mediator between the existing IT platform and the HUGIN Decision Engine. The purpose of the HUGIN driver is to control the use of the HUGIN Decision Engine. The figure below illustrates this principle.

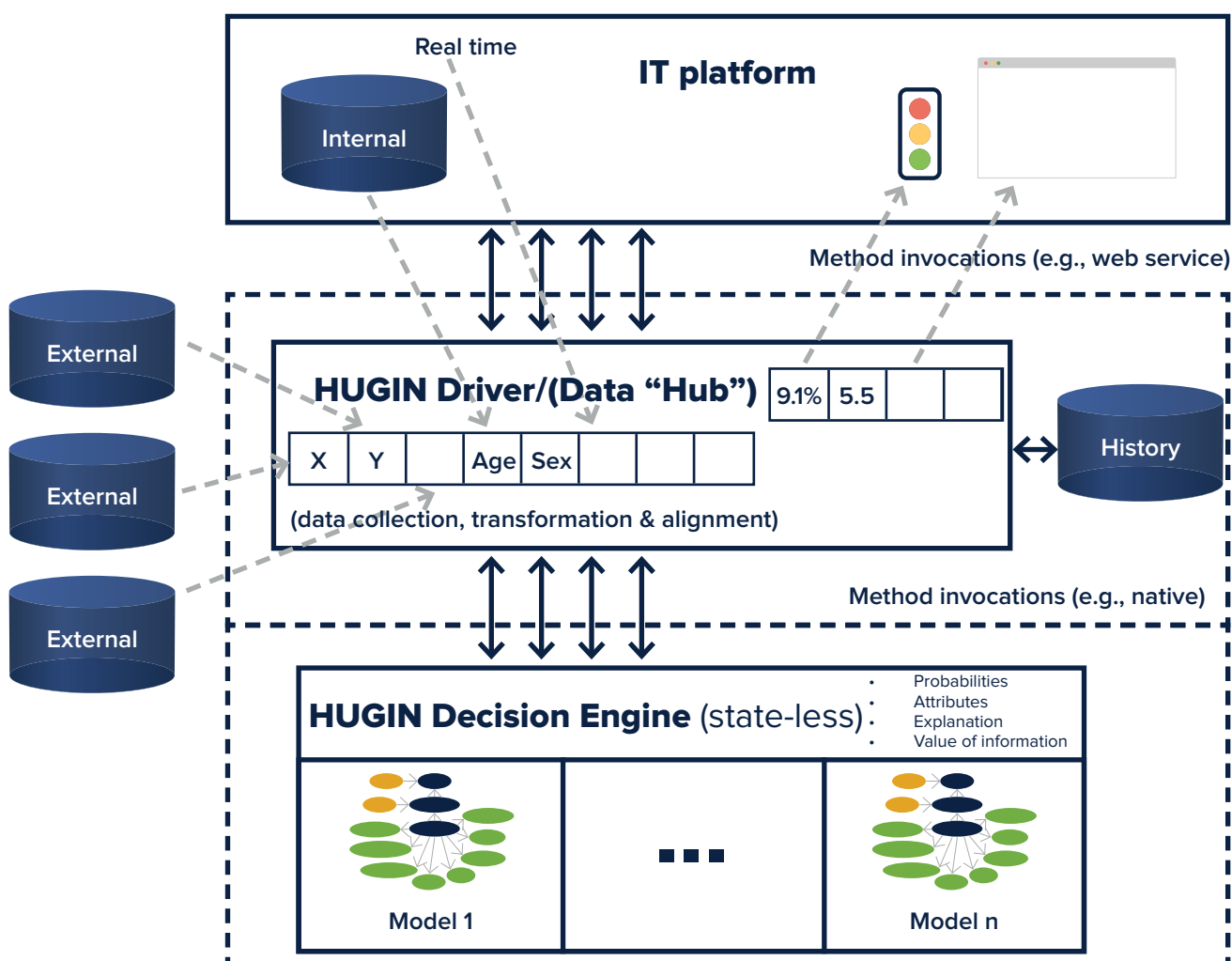


Figure 9: Illustration of the driver principle

The top part of the figure shows the platform's user interface for system users, and the bottom part the HUGIN Decision Engine. The layer in between is the HUGIN Driver, an application that can be developed by the client (or client's IT partner, assisted by HUGIN or Combitech if needed) to meet data format requirements. The task of the HUGIN Driver is to gather all data fed into the models and convert these into the proper data format (to match the data format in the models), and to convert the results produced by the HUGIN Decision Engine. The HUGIN Driver is also in charge of storing information in the form of data, which is registered in the models in addition to the model information used in each calculation. This historical data can be useful, for example, in testing future models.

See Chapter 1 of the HUGIN API Reference Manual (<http://download.hugin.com/webdocs/manuals/api-manual.pdf>) for further technical details about using APIs with other software and platforms, including information about how to compile and run applications using API functionality.



Technology

The technology behind the money laundering models is Bayesian Networks (also known as Bayesian Belief Networks, causal models of probability, Bayes nets, etc.). Bayesian networks are graphical models that structure the knowledge about a topic into a map of causes and effects between key variables. For each variable associated with a cause, probability is used to specify the extent to which one variable affects another.

HUGIN software has long list of advantages compared to competing systems:

- It can combine expert knowledge and historical data
- It handles missing values and calculates using incomplete information
- Efficient inference engine makes real-time inference possible
- Models and implementation are flexible and easy to maintain, extend and revise
- The models are simple to integrate into existing systems
- Intuitive graphical models make it easy to communicate and discuss the risk of money laundering and terrorism connected with customers and products





Technical Information

Description of Software

A HUGIN software package consists of the HUGIN Graphical User Interface (GUI) for developing models for money laundering, and the HUGIN Decision Engine for integration. HUGIN Decision Engine has APIs for C, C #, C++, Java and VBA via a COM server. The HUGIN GUI is a Java implementation (which uses JNI) and the HUGIN Decision Engine is implemented using ISO C.

Description of data requirements

The HUGIN Graphical User Interface reads CSV files. The HUGIN Decision Engine has API functionality for entering data in real time. The HUGIN tool stores no data.

How the tool integrates with existing workflow

Money laundering model(s) are integrated into existing systems using one of the API's for the HUGIN Decision Engine. The API's are available for C, C #, C++, Java and VBA through a COM server. The HUGIN Decision Engine contains functionality for entering information, making calculations and assessing the probability of money laundering.

The money laundering solution is especially useful in three different areas:

- For bank advisors when registering new customers, during periodic review of existing customers and for training purposes. The money laundering filter is usually implemented as a traffic light/color indication on the user's (advisor's) screen.

- The graphical user interface is only used for developing models, during peer review, internal-external communication about the money laundering solution, and training.
- Monitoring of transactions - transactions are run through the HUGIN Decision Engine, which issues a warning about suspicious transactions in the form of a report, or by Email to the person in charge.

Technical requirements for required user interface

The HUGIN Graphical User Interface is implemented in Java using the HUGIN Java API for the HUGIN Decision Engine. The core of the HUGIN Decision Engine is implemented using the ISO C for portability and efficiency. HUGIN Decision Engine has been used in various hardware and operating systems, including PC s running on Windows and Linux, MAC for Mac OS, PCs and SUN servers on Solaris, and HP servers on HPUX and IBM mainframes.

Description of tool performance

HUGIN Decision Engine does not support user administration. Users of the HUGIN Decision Engine are responsible for using mutual exclusion variables, for example, when multiple users have access to the model at the same time. Alternatively, you could have a dynamic set of processes running on the same model. Time and space complexity for the most common money laundering models are linear in the number of indicator variables. Response time is dependent on hardware.

Description of required administration of the tool

The HUGIN Graphical User Interface is installed on the desktop of PC users. The HUGIN Decision Engine is distributed as a single file or a few files installed on the host computer. There is no user administration. The money laundering model is stored as a single file (usually as an ASCII file). This file can be opened in the HUGIN graphical interface and in the HUGIN Decision Engine. If minor adjustments are made to an existing model, the update consists of replacing the file on the server.

Management of software updates

The HUGIN graphical user interface (GUI) is a separate one-user program. The HUGIN GUI contains functionality for automatically installing new upgrades issued on the HUGIN website. A new version of the HUGIN Decision Engine can be installed by replacing the existing files on the host computer. Normally, new software versions are released 1-2 times per year, and active software users are notified of releases. The functionality of the HUGIN Decision Engine is tested using a series of test programs. Updates are not mandatory. New updates are usually installed on a host computer when new functionality is needed. This is rare with regard to money laundering models. HUGIN operates on the principle of reversed compatibility, meaning that files established in a previous software version will always function in new versions of the software.



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About Combitech AS

Combitech is one of the Nordic region's largest technology consulting firms, with more than 1,400 employees in Sweden, Norway and Finland. We combine technical expertise with in-depth industry knowledge, all-round capability and a particular focus on the environment and security. This results in customised, sustainable solutions for demanding clients who are active both in the Nordic region and internationally. For more information visit www.combitech.no

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HUGINEXPERT

About HUGIN EXPERT A/S

HUGIN EXPERT A/S is a provider of predictive analytic software for building model-based risk analysis and decision support solutions that can handle uncertainty. HUGIN EXPERT A/S was established in 1989 and is headquartered in Aalborg, Denmark. Clients use HUGIN tools to create intelligent decision support solutions for fraud detection, credit default prediction, operational risk management, medical diagnosis, health monitoring, risk analysis, data mining, troubleshooting, safety assessment, forensic identification and more. For more info visit www.hugin.com

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