



Moving Picture, Audio and Data Coding  
by Artificial Intelligence  
[www.mpai.community](http://www.mpai.community)

## **MPAI Technical Specification**

# **Compression and Understanding of Industrial Data MPAI-CUI**

**V1.1**

### **WARNING**

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Readers are invited to review Annex 2 - Notices and Disclaimers.

# Compression and Understanding of Industrial Data

## V1.1

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## 1 Introduction

In recent years, Artificial Intelligence (AI) and related technologies have been applied to a broad range of applications, have started affecting the life of millions of people and are expected to do so even more in the future. As digital media standards have positively influenced industry and

billions of people, so AI-based data coding standards are expected to have a similar positive impact. Indeed, research has shown that data coding with AI-based technologies is generally *more efficient* than with existing technologies for, e.g., compression and feature-based description.

However, some AI technologies may carry inherent risks, e.g., in terms of bias toward some classes of users. Therefore, the need for standardisation is more important and urgent than ever.

The international, unaffiliated, not-for-profit MPAI – Moving Picture, Audio and Data Coding by Artificial Intelligence Standards Developing Organisation has the mission to develop *AI-enabled data coding standards*. MPAI Application Standards enable the development of AI-based products, applications and services.

As a part of its mission, MPAI has developed standards operating procedures to enable users of MPAI implementations to make informed decision about their applicability. Central to this is the notion of Performance, defined as a set of attributes characterising a reliable and trustworthy implementation.

For the aforementioned reasons, to fully achieve the MPAI mission, Technical Specifications have to be complemented by an ecosystem designed, created and managed to underpin the life cycle of MPAI standards through the steps of specification, technical testing, assessment of product safety and security, and distribution.

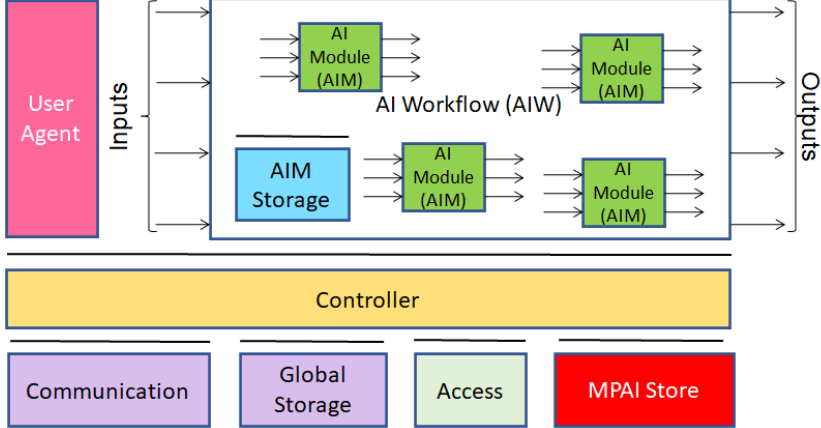
In the following, Terms beginning with a capital letter are defined in *Table 1* if they are specific to this Standard and in *Table 10* if they are common to all MPAI Standards.

The MPAI Ecosystem is fully specified in [12]. It is composed of:

- MPAI as provider of Technical, Conformance and Performance Specifications.
- Implementers of MPAI standards.
- MPAI-appointed Performance Assessors.
- The MPAI Store which assigns Implementer identifiers (ImplementerID’s) and distributes validated Implementations.

*Figure 1* depicts the MPAI-AIF Reference Model under which Implementations of MPAI Application Standards and user-defined MPAI-AIF Conforming applications operate.

An AIF Implementation allows execution of AI Workflows (AIW), composed of basic processing elements called AI Modules (AIM). MPAI Application Standards normatively specify Syntax and Semantics of the input and output data and the Function of the AIW and the AIMs, and the Connections between and among the AIMs of an AIW.



*Figure 1 – The AI Framework (AIF) Reference Model and its Components*

In particular, an AIM is defined by its Function and data, but not by its internal architecture, which may be based on AI or data processing, and implemented in software, hardware or hybrid software and hardware technologies.

MPAI Standards are designed to enable a User to obtain, via standard protocols, an Implementation of an AIW and of the set of corresponding AIMs and execute it in an AIF Implementation. The

Store in *Figure 1* is an entity from which Implementations are downloaded. MPAI Standards assume that the AIF, AIW, and AIM Implementations may have been developed by independent implementers. A necessary condition for this to be possible, is that any AIF, AIW, and AIM implementations be uniquely identified. MPAI has appointed an ImplementerID Registration Authority (IIDRA) to assign unique ImplementerIDs (IID) to Implementers.<sup>1</sup>

A necessary condition to make possible the operations described in the paragraph above is the existence of an ecosystem composed of Conformance Testers, Performance Assessors, and an instance of the IIDRA and of the Store. Reference [12] provides an informative example of such ecosystem.

The chapters and the annexes of this Technical Specification are Normative unless they are labelled as Informative.

## 2 Scope of the MPAI-CUI Technical Specification

*Compression and understanding of industrial data* (MPAI-CUI) is an MPAI standard using AI to extract the most relevant information from industrial data. It includes the “AI-based Company Performance Prediction” Use Case.

The current version of MPAI-CUI has been developed by the MPAI Compression and Understanding of Industrial Data Development Committee (CUI-DC). Future Versions of the MPAI-CUI Standard may extend the Scope of the Use Case and/or add new Use Cases in Compression and Understanding of Industrial Data.

“AI-based Company Performance Prediction” normatively specifies the AIW and the Connections of the AIMs, the AIMs and the Formats of the input and output data of the AIW and the AIMs.

The word *normatively* implies that an Implementation claiming Conformance to:

1. The *AIW*, shall have:
  - a. Its Function specified in Section 5.1.1.
  - b. Its input and output data specified in Subsection 5.1.2
  - c. Its AIM Topology specified Subsection 5.1.3.
  - d. Its AIMs with the Functions specified in Subsection 5.1.4.
2. An *AIM*, shall:
  - a. Have the AIM Function specified by the Subsection 5.1.4.
  - b. Receive as input and produce as output data in the formats specified in Section 6.2.
3. A *Data Format*, shall have a format specified in Section 6.2.

Users of this Technical Specification should note that:

1. This Technical Specification defines the possible levels of conformance of an Implementation but does not mandate any.
2. Implementers decide the Interoperability Level their Implementation satisfies.
3. Implementers can use the Reference Software to develop their Implementations [2].
4. Implementers can use the Conformance Testing specification to test the Conformance of an Implementation with this Technical Specification [3].
5. Performance Assessors assess the Grade of Performance of an Implementation based on the results of Performance Assessment [4].
6. The Governance of the MPAI Ecosystem is outlined in Annex 3 - and specified in [12].
7. Implementers and Users should consider the notices and disclaimers of Annex 3 - .

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<sup>1</sup> At the time of publication of this standard, the MPAI Store was assigned as the IIDRA.

### 3 Terms and definitions

The Terms used in this Technical Specification that are specific of MPAI-CUI and whose first letter is capital have the meaning defined in *Table 1*. The general MPAI Terms are defined in *Table 10*.

*Table 1 – MPAI-CUI terms*

<b>Term</b>	<b>Definition</b>
Business Discontinuity	An interruption of the operations of a company for a period of time less than 2% of the Prediction Horizon.
Company Default	The status of a company who has failed to make full and timely payments on its obligations.
Cyber Risk	Risk of financial loss, disruption, or damage, caused by the failure of the digital technologies due to unauthorised access, use, disclosure, disruption, modification, or destruction of the systems.
Financial Features	A set of indexes and ratios computed using financial statement data.
Financial Statement	Data produced based on a set of accounting principles driving maintenance and reporting of company accounts so that financial statements can be consistent, transparent, and comparable across companies.
Governance Features	A set of indexes/parameters that are used to assess the adequacy of the organisational model.
Risk Assessment	Attributes indicating the internal company assessment to identify and measure potential or existing Vertical Risks, and their impact on Business Continuity.
Risk Matrix	Table composed of two rows for the risks (cyber and seismic) and four columns for the characteristics (occurrence, business impact, gravity and risk retention) as evaluated by the company.
Seismic Risk	The measure of the possible losses associated with the behavior of a building or structure in likely earthquakes [8].
Vertical Risk	A risk that must be understood in a specific context/domain of the business.

### 4 References

#### 4.1 Normative references

The following documents are Normatively referenced by this Standard.

1. MPAI Technical Specification: AI Framework (MPAI-AIF), V1.1; <https://mpai.community/standards/mpai-aif/>
2. MPAI Reference Software: Compression and Understanding of Industrial Data (MPAI-CUI) V.1; <https://mpai.community/resources/>
3. MPAI Conformance Testing: Compression and Understanding of Industrial Data (MPAI-CUI) V.1; <https://mpai.community/resources/>
4. MPAI Performance Assessment: Compression and Understanding of Industrial Data (MPAI-CUI) V.1
5. International Financial Reporting Standard; List of IFRS Standards; <https://www.ifrs.org/issued-standards/list-of-standards/>
6. International Organisation for Standardisation; ISO 31000 – Risk Management; <https://www.iso.org/files/live/sites/isoorg/files/store/en/PUB100426.pdf>
7. International Organisation for Standardisation; ISO 27005 Information technology -- Security techniques -- Information security risk management

- 8. Federal Emergency Management Agency (FEMA); Earthquake-Resistant Design Concepts. An Introduction to the NEHRP Recommended Seismic Provisions for New Buildings and Other Structures; FEMA P-749/December 2010.
- 9. MPAI; The MPAI Statutes; <https://mpai.community/statutes/>
- 10. MPAI; The MPAI Patent Policy; <https://mpai.community/about/the-mpai-patent-policy/>.
- 11. Framework Licence of the Compression and Understanding of Industrial Data (MPAI-CUI); <https://mpai.community/standards/mpai-mmc/framework-licence/>

**4.2 Informative references**

- 12. MPAI Standard: Governance of the MPAI Ecosystem (MPAI-GME) V1; <https://mpai.community/resources/>
- 13. An introduction to MPAI-CUI, MPAI N371, <https://mpai.community/standards/mpai-cui/>

**5 Use Case Architecture**

**5.1 AI-based Company Performance Prediction**

**5.1.1 Function**

The “AI-based Company Performance Prediction” Standard measures the Performance of a Company by providing Default Probability, Organisational Model Index, and Business Discontinuity Probability (see 6.2.8, 6.2.9 and 6.2.10) of the Company within the given Prediction Horizon (see Subsection 6.2.1) using its Governance, Financial and Risk data (see Subsections 6.2.2, 6.2.3 and 6.2.4).

**5.1.2 Input/output data**

<b>Input</b>	<b>Comments</b>
Prediction Horizon	Number of months of prediction.
Governance	Governance data.
Financial Statement	Full financial statement.
Risk Assessment	The company assessment of the impact of vertical risks: cyber and seismic assessed according to ISO 31000 Risk Management [6], and ISO 27005 Information security risk management [7], specific for cyber risk management.
<b>Output</b>	<b>Comments</b>
Default Probability	the probability of the company default in the specified prediction horizon.
Organisational Model Index	the adequacy of the organisational model expressed as a linear score in the 0 to 1 range in the specified prediction horizon.
Business Discontinuity Probability	the probability of an interruption of the operations of the company for less than 2% of the specified prediction horizon.

**5.1.3 Implementation Architecture**

Figure 2 gives the normative Architecture of the “AI-based Company Performance Prediction” Use Case.

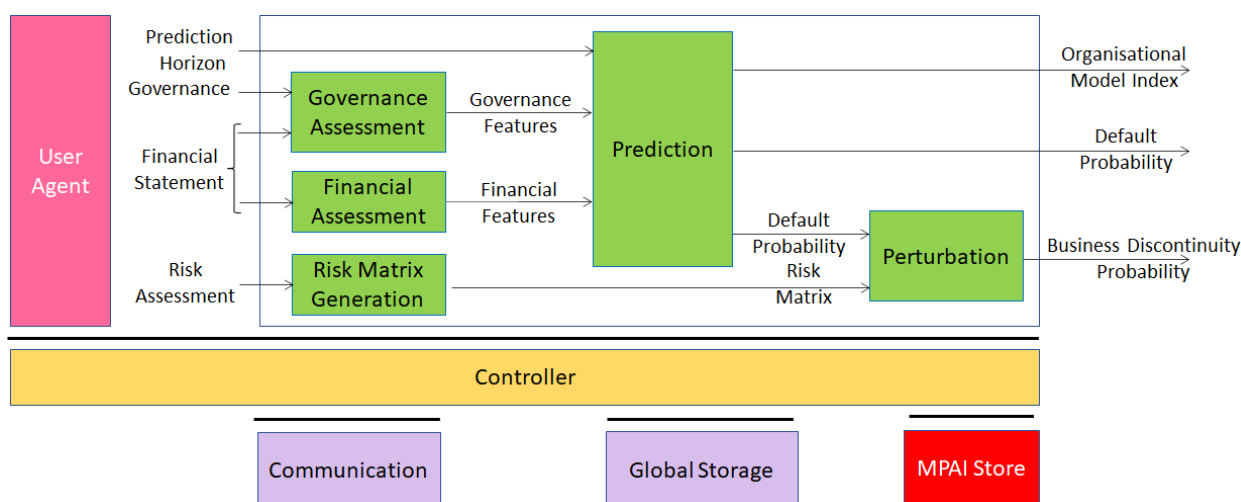


Figure 2 – Reference Model of Company Performance Prediction (MPAI-CUI)

In the “AI-based Company Performance Prediction” Use Case:

1. User defines a Prediction Horizon and feeds Governance, Financial Statement and Risk Assessment data.
2. Governance Assessment produces Governance Features by processing Governance and Financial data.
3. Financial Assessment produces Financial Features by processing Financial Statement data.
4. Risk Matrix Generation produces the Risk Matrix by processing Risk Assessment data.
5. Prediction produces Organizational Model Index and Default Probability by processing Governance Features and Financial Features.
6. Perturbation produces Business Discontinuity Probability by processing Default Probability and Risk Matrix.

#### 5.1.4 AI Modules

The AI Modules in *Figure 2* perform the Functions specified in *Table 2*.

Table 2 – AIMS of AI-based Company Performance Prediction

AIM	Function
<b>Financial Assessment</b>	Computes the Financial Features defined in 6.2.5.
<b>Governance Assessment</b>	Computes the Governance Features defined in 6.2.6.
<b>Risk Matrix Generation</b>	Builds the Risk Matrix defined in 6.2.7.
<b>Prediction</b>	Computes 1. The Default Probability (see 6.2.8) in the Prediction Horizon. 2. The Organizational Model Index (see 6.2.9).
<b>Perturbation</b>	Computes the Business Discontinuity Probability (see 6.2.10) in the Prediction Horizon by perturbing the Governance Features and Financial Features.

#### 5.1.5 AIW Metadata

Specified in Annex 5 - Section 1.

## 6 AI modules

### 6.1 MPAI-CUI AIMs and their data

#### 6.1.1 AI-based Performance Prediction

Table 3 gives the I/O data of AI-based Company Performance Prediction.

Table 3 – I/O data of the AI-based Company Performance Prediction AIW

AIM	Input Data	Output Data
Financial Assessment	Financial Statement data	Financial Features
Governance Assessment	Governance data	Governance Features
Risk Matrix Generation	Risk Assessment	Risk Matrix
Prediction	Financial Features Governance Features Prediction Horizon	Default probability Organisational Model Index
Perturbation	Default Probability Risk Matrix	Business Discontinuity Probability

The AIM Metadata are specified in Annex 5 - Section 2.

### 6.2 Data Formats

Table 4 gives the links (column 2) to the Subsections where the Data Formats (column 1) are defined. Column 3 gives the Use Cases that uses the Data Formats.

Table 4 – Data formats

Name of Data Format	Subsection	Use Case
Prediction Horizon	6.2.1	CUI
Financial Statement	6.2.2	CUI
Governance	6.2.3	CUI
Risk Assessment	6.2.4	CUI
Financial Features	6.2.5	CUI
Governance Features	6.2.6	CUI
Risk Matrix	6.2.7	CUI
Default Probability	6.2.8	CUI
Organisational Model Index	6.2.9	CUI
Business Discontinuity Probability	6.2.10	CUI

#### 6.2.1 Prediction Horizon

The number of months into the future that represents how far ahead Prediction computes the Default Probability.

#### 6.2.2 Financial Statement

FinancialStatementData.json specifies the format of the Financial Statement data to be provided by the Company. The JSON file is accessible from <https://mpai.community/resources/cui/Input data to CUI-CPP.zip>.



### 6.2.3 Governance

GovernanceData.json specifies the format of the Governance data to be provided by the Company. The JSON file is accessible from <https://mpai.community/resources/cui/Input data to CUI-CPP.zip>.

### 6.2.4 Risk Assessment

RiskMatrix-JSON.json specifies the format of Risk Assessment data to be provided by the Company. The JSON file is accessible from <https://mpai.community/resources/cui/Input data to CUI-CPP.zip>.

### 6.2.5 Financial Features

The Financial Features, computed from the Financial Statement data, are given in *Table 5*.

*Table 5 – Financial Features*

Feature	Name	Feature type	Feature value
1	Revenues	Revenue/Profit	Absolute value
2	EBITDA Margin	Revenue/Profit	Percentage (%)
3	EBITDA	Revenue/Profit	Absolute value
4	Quick Ratio	Revenue/Profit	Absolute value
5	Current Ratio	Revenue/Profit	Percentage (%)
6	Net Working Capital	Revenue/Profit	Absolute value
7	Net Financial Position	Cost/Debt	Absolute value
8	Net Short-Term Assets	Cost/Debt	Absolute value
9	Shareholder Funds-Fixed Assets	Cost/Debt	Absolute value
10	Long-Term Liability Ratio	Cost/Debt	Percentage (%)
11	Coverage Of Fixed Assets	Cost/Debt	Absolute value
12	Amortisation Rate	Cost/Debt	Percentage (%)
13	Debt On Sales	Cost/Debt	Absolute value
14	Interest Coverage Ratio	Cost/Debt	Percentage (%)
15	Average Stock Turnover	Production	Absolute value
16	Stock Coverage Days	Production	Absolute value
14	Return On Investments (ROI)	Revenue/Profit	Percentage (%)
15	Return On Asset (ROA)	Revenue/Profit	Percentage (%)
16	Return On Sales (ROS)	Revenue/Profit	Percentage (%)
17	Return On Equity (ROE)	Revenue/Profit	Percentage (%)
18	Cash Flow	Production	Absolute value
19	Interest On Sales	Cost/Debt	Percentage (%)
20	Type Of Financial Statement	Financial statement type	Enumeration

Feature n. 20: enumeration elements: Abbreviated, Micro, Detailed.

*Table 6* specifies how the features of *Table 5* (column 2) are normatively computed according to International Financial Reporting Standard (column 4) [5]. The definitions of column 3 are normative.

*Table 6 – Financial Features specifics*

Feature	Name	Definition	Formula	Data type
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<b>1</b>	Revenues	The total amount of revenues	Directly provided in the financial statement	String of real numbers
<b>2</b>	EBITDA Margin	A measure of a company's profitability by comparing its gross revenues with its earnings	EBITDA/Revenues	Percentage
<b>3</b>	EBITDA	A measure of a company's profitability	Operating margin + (Depreciation + Amortisation + Writedowns)	String of real numbers
<b>4</b>	Quick Ratio	The company's ability to meets the short-term obligations with its only liquid assets	(Current assets - inventory)/Current liabilities	String of real numbers
<b>5</b>	Current Ratio	The company's ability to meets the short-term obligations with its current assets (e.g., cash, inventories, etc.)	(Current assets)/Current liabilities	String of real numbers
<b>6</b>	Net Working Capital	A measure of a company's liquidity and its ability to meet short-term obligations, as well as fund operations of the business	Current assets - Current liabilities	String of real numbers
<b>7</b>	Net Financial Position	A financial ratio that expresses the overall financial position of the company by including all liabilities of financial nature	Due to banks + Due to lenders – Total liquid funds	String of real numbers
<b>8</b>	Net Short-Term Assets	A margin that expresses the company's ability to meet current short-term liabilities through the use of cash and cash equivalents and short-term receivables	Trade and other accounts + Total liquids funds – Short term liabilities	String of real numbers
<b>9</b>	Shareholder Funds-Fixed Assets	The company's financial solidity, thus its ability to finance itself from shareholders' equity	Shareholders' funds – Fixed assets	String of real numbers
<b>10</b>	Long-Term Liability Ratio	The incidence of long-term debts on the total liabilities	Long- and medium-term liabilities /Total assets	String of real numbers
<b>11</b>	Coverage Of Fixed Assets	An asset self-coverage ratio, which expresses the ratio of equity to tangible assets	Tangible fixed assets/Shareholders funds	String of real numbers

<b>12</b>	Amortisation Rate	The portion of capital invested in tangible fixed assets that has already been recovered	Amortisation funds/ Tangible assets	String of real numbers
<b>13</b>	Debt On Sales	The company's ability to cover its debts with the revenues from sales	Total debts /Revenues	Percentage
<b>14</b>	Interest Coverage Ratio	The degree to which the operating profit is able to cover the cost of financial interests.	Operating margin + Depreciation, Amortisation and Writedowns/ Interests	String of real numbers
<b>15</b>	Average Stock Turnover	The measure that expresses how often the warehouse is renewed	(Stocks- Advances)/Turnover *365	String of real numbers
<b>16</b>	Stock Coverage Days	The average length of time during which the stocks are in warehouses	Stocks/ Cost goods sold *365	String of real numbers
<b>14</b>	Return On Investments (ROI)	The profitability of an investment, measuring the amount of return of that particular investment, relative to its cost	Operating margin / (Shareholder's funds + Bonds + Due to banks + Due to shareholders for loans + Due to other lenders)	Percentage
<b>15</b>	Return On Asset (ROA)	The profitability of a company in relation to its total assets	Operating margin / Total assets	Percentage
<b>16</b>	Return On Sales (ROS)	Efficiency of a company in turning sales into profits	Operating margin / Total revenues	Percentage
<b>17</b>	Return On Equity (ROE)	The company's annual result divided by the value of its total shareholders' equity	Result (profit or loss)/Shareholder's funds	Percentage
<b>18</b>	Cash Flow	The money coming in and going out of the company during a specific accounting period	Result (profit or loss) + (Depreciation + Amortisation + Writedowns)	String of real numbers
<b>19</b>	Interest On Sales	A measure of the incidence of interest expenses on turnover created by the company and absorbed at the service of the third-party capital employed	Interest/Revenues	Percentage
<b>20</b>	Type Of Financial Statement	The type of financial statement that the company prepares according to accounting regulations	Given by the reference jurisdiction	Enumeration

Feature n. 20: enumeration elements: Abbreviated, Micro, Detailed.

## 6.2.6 Governance Features

The Governance features, computed directly from the governance data, are given in *Table 7*.

*Table 7 – Governance Features*

<b>Feature</b>	<b>Name</b>	<b>Feature value</b>
<b>1</b>	Number Of Stakeholder Individuals	Integer
<b>2</b>	Number Of Stakeholder Companies	Integer
<b>3</b>	Shareholder Share	Percentage (%)
<b>4</b>	Shareholders Gender	Enumeration
<b>5</b>	Decision-Makers Gender	Enumeration
<b>6</b>	Number Of Decision-Makers	Integer
<b>7</b>	Members Of The Revision And Advisory Board	Integer
<b>8</b>	Presence Of The Advisory Company	Binary
<b>9</b>	Number Of Decision-Makers By The Same Family	Integer
<b>10</b>	Company Phase	Enumeration

Features n. 4 and n. 5: enumeration elements: Female, Male.

Feature n. 10: enumeration elements: Startup, Mature, Historical.

*Table 8* specifies how the features of *Table 7* (column 2) are normatively computed. The definitions of column 3 are normative.

*Table 8 – Governance Features specifics*

<b>Feature</b>	<b>Name</b>	<b>Definition</b>	<b>Data type</b>
<b>1</b>	Number Of Stakeholder Individuals	The total numbers of stakeholder individuals in the company	Integer
<b>2</b>	Number Of Stakeholder Companies	The total numbers of stakeholder companies in the company	Integer
<b>3</b>	Shareholder Share	The share owned by each shareholder in the company	Percentage
<b>4</b>	Shareholders Gender	The gender of shareholders	Enumeration
<b>5</b>	Decision-Makers Gender	The gender of decision-makers	Enumeration
<b>6</b>	Number Of Decision-Makers	The total numbers of decision-makers, members of the board of directors and representatives	Integer
<b>7</b>	Members Of The Revision And Advisory Board	The total numbers of auditors and advisors	Integer
<b>8</b>	Presence Of An Advisory Company	The presence of a company specialised in the corporate advisory	Binary
<b>9</b>	Number Of Decision-Makers By The Same Family	The number of decision-makers that have the same family name	Integer
<b>10</b>	Company Phase	The company phase according to its age	Enumeration

Features n. 4 and n. 5: enumeration elements: Female, Male.

Feature n. 10: enumeration elements: Startup, Mature, Historical.

### 6.2.7 Risk Matrix

The Risk Matrix is a table composed of two rows for the risks and four columns for the characteristics. *Table 9* gives the four characteristics, defined by [6] for the Vertical Risks considered. Each risk has four characteristics as indicated in *Table 9*.

*Table 9 – Risk characteristics*

N.	Characteristic	Data type
1	Occurrence	Real
2	Business Impact	Real
3	Gravity	Real
4	Risk retention	Percentage (%)

1. **Occurrence:** The likelihood of the risk happening [6] measured with three possible outcomes:
  - Low      1    the risk may occur only in exceptional circumstances or is unlikely to occur.
  - Medium   2    the risk may occur at some time.
  - High      3    the risk is expected to occur.
  
2. **Business Impact:** consequences of a risk event [6]. It can take three values:
  - Minor      1    Relatively minor changes in the company processes, and/or products and services.
  - Moderate   2    Some minor changes in the company processes and/or products and services.
  - Major      3    Company processes and/or products and services are altered significantly.
  
3. **Gravity:** impact on the ability of the company to deliver compliant products to the customer; to the internal efficiency; to damage to people, the environment, or property measured in terms of the estimated time needed to restore normal business activities. It can take five values:
  - Irrelevant   1    The risk has no impact on the ability to deliver compliant products to the customer; no loss of internal efficiency; no damage to people, environment, or property. The estimated recovery time is from 1 to 8 hours.
  - Not very relevant   2    The risk has minor impacts on the ability to deliver compliant products to the customer; marginal loss of internal efficiency; no damage to people, environment, or property. The estimated recovery time is from 2 to 5 days.
  - Relevant    3    May result in significant sensitive consequences on product conformity or on-time delivery; may lead to a substantial loss of internal efficiency (massive rework or 100% selections); no damage to people and the environment but possible major damage to property. The estimated recovery time is from 3 to 10 days.
  - Very relevant   4    Can have very important consequences on the conformity of the products or the impossibility of their delivery; no damage to persons, any marginal damage to the environment or major property damage. The estimated recovery time is from 4 to 14 days.
  - Serious      5    The occurrence of the risk has very important consequences on the conformity of products or the impossibility of delivery; involves damage to people, the environment or damage important damage to property. The estimated recovery time is greater than 15 days.
  
4. **Risk Retention** portion of the risk that the Company decides to retain (percentage) [6].

### **6.2.8 Default Probability**

The probability of the company Default in a specified number of future months, computed by Prediction using the Financial Features.

### **6.2.9 Organisational Model Index**

It is a score in the 0 to 1 range that linearly represents the adequacy of the organisational model. Its value can be used to identify potential critical points or conflicts of interest that can lead to an increase in the risk of default. It is computed by Prediction using the Governance Features and the Financial Features.

### **6.2.10 Business Discontinuity Probability**

It is computed by Perturbation using Default Probability and Risk Matrix.

## Annex 1 - – MPAI-wide terms and definitions (Normative)

The Terms used in this standard whose first letter is capital and are not already included in *Table 1* are defined in *Table 10*.

*Table 10 – MPAI-wide Terms*

<b>Term</b>	<b>Definition</b>
Access	Static or slowly changing data that are required by an application such as domain knowledge data, data models, etc.
AI Framework (AIF)	The environment where AIWs are executed.
AI Module (AIM)	A data processing element receiving AIM-specific Inputs and producing AIM-specific Outputs according to its Function. An AIM may be an aggregation of AIMs.
AI Workflow (AIW)	A structured aggregation of AIMs implementing a Use Case receiving AIM-specific inputs and producing AIM-specific outputs according to its Function.
Application Standard	An MPAI Standard designed to enable a particular application domain.
Channel	A connection between an output port of an AIM and an input port of an AIM. The term “connection” is also used as synonymous.
Communication	The infrastructure that implements message passing between AIMs
Component	One of the 7 AIF elements: Access, Communication, Controller, Internal Storage, Global Storage, MPAI Store, and User Agent
Conformance	The attribute of an Implementation of being a correct technical Implementation of a Technical Specification.
Conformance Tester	An entity authorised by MPAI to Test the Conformance of an Implementation.
Conformance Testing	The normative document specifying the Means to Test the Conformance of an Implementation.
Conformance Testing Means	Procedures, tools, data sets and/or data set characteristics to Test the Conformance of an Implementation.
Connection	A channel connecting an output port of an AIM and an input port of an AIM.
Controller	A Component that manages and controls the AIMs in the AIF, so that they execute in the correct order and at the time when they are needed
Data Format	The standard digital representation of data.
Data Semantics	The meaning of data.
Ecosystem	The ensemble of the following actors: MPAI, MPAI Store, Implementers, Conformance Testers, Performance Testers and Users of MPAI-AIF Implementations as needed to enable an Interoperability Level.
Explainability	The ability to trace the output of an Implementation back to the inputs that have produced it.
Fairness	The attribute of an Implementation whose extent of applicability can be assessed by making the training set and/or network open to testing for bias and unanticipated results.
Function	The operations effected by an AIW or an AIM on input data.
Global Storage	A Component to store data shared by AIMs.

Internal Storage	A Component to store data of the individual AIMS.
Identifier	A name that uniquely identifies an Implementation.
Implementation	<ol style="list-style-type: none"> <li>1. An embodiment of the MPAI-AIF Technical Specification, or</li> <li>2. An AIW or AIM of a particular Level (1-2-3) conforming with a Use Case of an MPAI Application Standard.</li> </ol>
Implementer	A legal entity implementing MPAI Technical Specifications.
ImplementerID (IID)	A unique name assigned by the ImplementerID Registration Authority to an Implementer.
ImplementerID Registration Authority (IIDRA)	The function within the MPAI Store to assign ImplementerID's to Implementers.
Interoperability	The ability to functionally replace an AIM with another AIM having the same Interoperability Level
Interoperability Level	<p>The attribute of an AIW and its AIMS to be executable in an AIF Implementation and to:</p> <ol style="list-style-type: none"> <li>1. Be proprietary (Level 1)</li> <li>2. Pass the Conformance Testing (Level 2) of an Application Standard</li> <li>3. Pass the Performance Testing (Level 3) of an Application Standard.</li> </ol>
Knowledge Base	Structured and/or unstructured information made accessible to AIMS via MPAI-specified interfaces
Message	A sequence of Records transported by Communication through Channels.
Normativity	The set of attributes of a technology or a set of technologies specified by the applicable parts of an MPAI standard.
Performance	The attribute of an Implementation of being Reliable, Robust, Fair and Replicable.
Performance Assessment	The normative document specifying the procedures, the tools, the data sets and/or the data set characteristics to Assess the Grade of Performance of an Implementation.
Performance Assessment Means	Procedures, tools, data sets and/or data set characteristics to Assess the Performance of an Implementation.
Performance Assessor	An entity authorised by MPAI to Assess the Performance of an Implementation in a given Application domain
Profile	A particular subset of the technologies used in MPAI-AIF or an AIW of an Application Standard and, where applicable, the classes, other subsets, options and parameters relevant to that subset.
Record	A data structure with a specified structure
Reference Model	The AIMS and theirs Connections in an AIW.
Reference Software	A technically correct software implementation of a Technical Specification containing source code, or source and compiled code.
Reliability	The attribute of an Implementation that performs as specified by the Application Standard, profile and version the Implementation refers to, e.g., within the application scope, stated limitations, and for the period of time specified by the Implementer.
Replicability	The attribute of an Implementation whose Performance, as Assessed by a Performance Assessor, can be replicated, within an agreed level, by another Performance Assessor.



Robustness	The attribute of an Implementation that copes with data outside of the stated application scope with an estimated degree of confidence.
Scope	The domain of applicability of an MPAI Application Standard
Service Provider	An entrepreneur who offers an Implementation as a service (e.g., a recommendation service) to Users.
Standard	The ensemble of Technical Specification, Reference Software, Conformance Testing and Performance Assessment of an MPAI application Standard.
Technical Specification	(Framework) the normative specification of the AIF. (Application) the normative specification of the set of AIWs belonging to an application domain along with the AIMs required to Implement the AIWs that includes: <ol style="list-style-type: none"> <li>1. The formats of the Input/Output data of the AIWs implementing the AIWs.</li> <li>2. The Connections of the AIMs of the AIW.</li> <li>3. The formats of the Input/Output data of the AIMs belonging to the AIW.</li> </ol>
Testing Laboratory	A laboratory accredited by MPAI to Assess the Grade of Performance of Implementations.
Time Base	The protocol specifying how Components can access timing information
Topology	The set of AIM Connections of an AIW.
Use Case	A particular instance of the Application domain target of an Application Standard.
User	A user of an Implementation.
User Agent	The Component interfacing the user with an AIF through the Controller
Version	A revision or extension of a Standard or of one of its elements.

## **Annex 2 - Notices and Disclaimers Concerning MPAI Standards (Informative)**

The notices and legal disclaimers given below shall be borne in mind when [downloading](#) and using approved MPAI Standards.

In the following, “Standard” means the collection of four MPAI-approved and [published](#) documents: “Technical Specification”, “Reference Software” and “Conformance Testing” and, where applicable, “Performance Testing”.

### Life cycle of MPAI Standards

MPAI Standards are developed in accordance with the [MPAI Statutes](#). An MPAI Standard may only be developed when a Framework Licence has been adopted. MPAI Standards are developed by especially established MPAI Development Committees who operate on the basis of consensus, as specified in Annex 1 of the [MPAI Statutes](#). While the MPAI General Assembly and the Board of Directors administer the process of the said Annex 1, MPAI does not independently evaluate, test, or verify the accuracy of any of the information or the suitability of any of the technology choices made in its Standards.

MPAI Standards may be modified at any time by corrigenda or new editions. A new edition, however, may not necessarily replace an existing MPAI standard. Visit the [web page](#) to determine the status of any given published MPAI Standard.

Comments on MPAI Standards are welcome from any interested parties, whether MPAI members or not. Comments shall mandatorily include the name and the version of the MPAI Standard and, if applicable, the specific page or line the comment applies to. Comments should be sent to the [MPAI Secretariat](#). Comments will be reviewed by the appropriate committee for their technical relevance. However, MPAI does not provide interpretation, consulting information, or advice on MPAI Standards. Interested parties are invited to join MPAI so that they can attend the relevant Development Committees.

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The Reference Software of an MPAI Standard is released with the [MPAI Modified Berkeley Software Distribution licence](#). However, implementers should be aware that the Reference Software of an MPAI Standard may reference some third party software that may have a different licence.

## Annex 3 - – The Governance of the MPAI Ecosystem (Informative)

### Level 1 Interoperability

With reference to *Figure 1*, MPAI issues and maintains a standard – called MPAI-AIF – whose components are:

1. An environment called AI Framework (AIF) running AI Workflows (AIW) composed of inter-connected AI Modules (AIM) exposing standard interfaces.
2. A distribution system of AIW and AIM Implementation called MPAI Store from which an AIF Implementation can download AIWs and AIMs.

A Level 1 Implementation shall be an Implementation of the MPAI-AIF Technical Specification executing AIWs composed of AIMs able to call the MPAI-AIF APIs.

Implementers' benefits	Upload to the MPAI Store and have globally distributed Implementations of
	- AIFs conforming to MPAI-AIF.
	- AIWs and AIMs performing proprietary functions executable in AIF.
Users' benefits	Rely on Implementations that have been tested for security.
MPAI Store's role	- Tests the Conformance of Implementations to MPAI- AIF <sup>2</sup> .
	- Verifies Implementations' security, e.g., absence of malware.
	- Indicates unambiguously that Implementations are Level 1.

### Level 2 Interoperability

In a Level 2 Implementation, the AIW must be an Implementation of an MPAI Use Case and the AIMs must conform with an MPAI Application Standard.

Implementers' benefits	Upload to the MPAI Store and have globally distributed Implementations of
	- AIFs conforming to MPAI-AIF.
	- AIWs and AIMs conforming to MPAI Application Standards.
Users' benefits	- Rely on Implementations of AIWs and AIMs whose Functions have been reviewed during standardisation.
	- Have a degree of Explainability of the AIW operation because the AIM Functions and the data Formats are known.
Market's benefits	- Open AIW and AIM markets foster competition leading to better products.
	- Competition of AIW and AIM Implementations fosters AI innovation.
MPAI Store's role	- Tests Conformance of Implementations with the relevant MPAI Standard <sup>3</sup> .
	- Verifies Implementations' security.
	- Indicates unambiguously that Implementations are Level 2.

### Level 3 Interoperability

MPAI does not generally set standards on how and with what data an AIM should be trained. This is an important differentiator that promotes competition leading to better solutions. However, the performance of an AIM is typically higher if the data used for training are in greater quantity and

---

<sup>2</sup> At the time of this publication, MPAI has promoted the establishment of the MPAI Store, an entity in charge of distributing implementations checked for security and tested for conformance to ensure that Users can assemble and operate AIWs. This information is given for the convenience of users of this standard and does not constitute an endorsement of the implementations downloaded from the MPAI Store. Equivalent products may be used but they will be outside of the MPAI Ecosystem.

<sup>3</sup> See footnote 1.

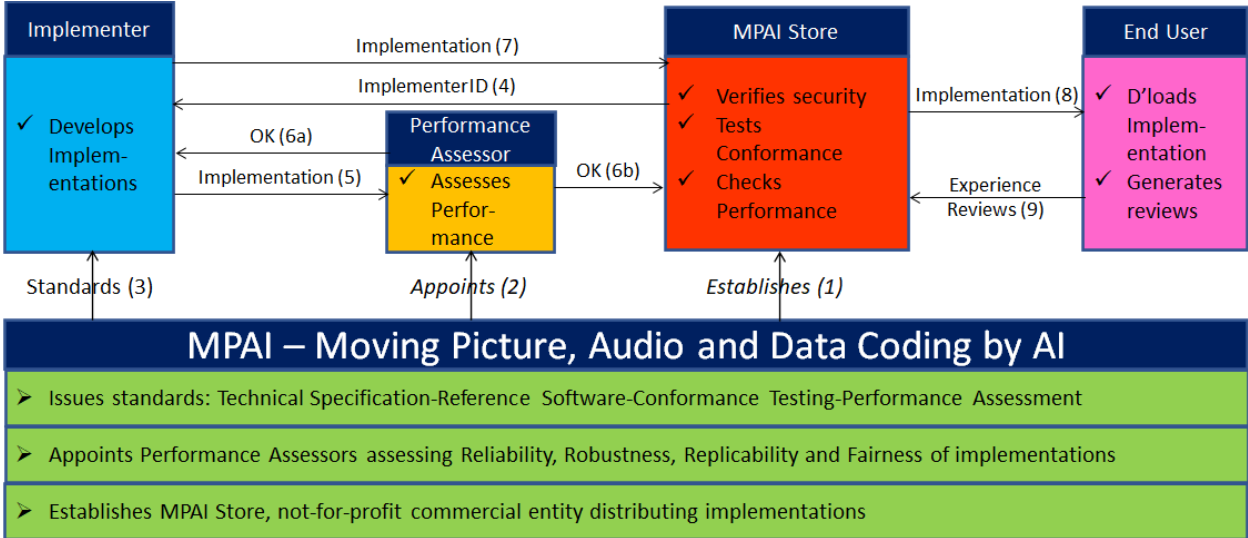
more in tune with the scope. Training data that have large variety and cover the spectrum of all cases of interest in breadth and depth typically lead to Implementations of higher “quality”. For Level 3, MPAI normatively specifies the process, the tools and the data or the characteristics of the data to be used to Assess the Grade of Performance of an AIM or an AIW.

- Implementers’ benefits: May claim their Implementations have passed Performance Assessment.
- Users’ benefits: Get assurance that the Implementation being used performs correctly, e.g., it has been properly trained.
- Market’s benefits: Implementations’ Performance Grades stimulate the development of more Performing AIM and AIW Implementations.
- MPAI Store’s role:
  - Verifies the Implementations’ security
  - Indicates unambiguously that Implementations are Level 3.

**The MPAI ecosystem**

The following *Figure 3* is a high-level description of the MPAI ecosystem operation applicable to fully conforming MPAI implementations as specified in the Governance of the MPAI Ecosystem Specification [12]:

1. MPAI establishes the not-for-profit MPAI Store (Step 1).
2. MPAI appoints Performance Assessors (Step 2).
3. MPAI publishes Standards (Step 3).
4. Implementers must request ImplementerID’s from the MPAI Store (Step 4) to be Interoperable with other Implementations that are part of the Ecosystem. The IID registration process is established and managed by the MPAI Store.
5. Implementers may submit Implementations to Performance Assessors (Step 5).
6. Performance Assessors Assess Performance and inform Implementers and the MPAI Store if the Implementation Performance is acceptable (Step 6).
7. Implementers submit Implementations to the MPAI Store (Step 7).
8. The Store verifies security and Tests Conformance of the Implementation.
9. Users download Implementations (Step 8).
10. Users may send reviews of their experience to the MPAI Store (Step 9) who publishes the reviews.



*Figure 3 – The MPAI ecosystem operation*

Implementers shall obtain an ImplementerID (IID) from the ImplementerID Registration Authority (IIDRA). The IIDRA is managed by the MPAI Store. An Implementer is allowed to obtain only one IID. That IID shall be unique in the MPAI Ecosystem. MPAI is not involved in the IIDRA. The MPAI Store execute its IIDRA role based on an agreement between MPAI and the MPAI Store that sets the MPAI Store's obligations, including the IID registration process and ImplementerID syntax.

## **Annex 4 - – Patent declarations**

The MPAI Multimodal Conversation (MPAI-MMC) Technical Specification has been developed according to the process outlined in the MPAI Statutes [9] and the MPAI Patent Policy [10]. The following entities have agreed to licence their standard essential patents reading on the MPAI Multimodal Conversation (MPAI-MMC) Technical Specification according to the MPAI-AIF Framework Licence [11]:

<b>Entity</b>	<b>Name</b>	<b>Email address</b>
Speech Morphing, Inc.	Fathy Yassa	fathy@speechmorphing.com

## Annex 5 - – AIW and AIM Metadata

### 1 AIW metadata

```
{
  "AIM":{
    "Implementer_ID": "*",
    "Standard": {
      "Name": "CUI",
      "Use_Case": "CPP",
      "Version": "1",
      "Title": "MPAI-CUI"
    },
    "Version": "*",
    "Profile": "",
    "Description": "This AIW implements the MPAI-CUI AI-based Company Performance Prediction (CPP) Use Case",
    "Ports": [
      {
        "Name": "PredictionHorizon",
        "Direction": "InputOutput",
        "Record_Type": "{int8 PredictionHorizon} PredictionHorizon_t",
        "Type": "Software",
        "Protocol": ""
      },
      {
        "Name": "Governance",
        "Direction": "InputOutput",
        "Record_Type": "float32 [] Governance_t",
        "Type": "Software",
        "Protocol": ""
      },
      {
        "Name": "FinancialStatement",
        "Direction": "InputOutput",
        "Record_Type": "float32[] FinancialStatement_t",
        "Type": "Software",
        "Protocol": ""
      },
      {
        "Name": "RiskAssessment",
        "Direction": "InputOutput",
        "Record_Type": "float32[] RiskAssessment_t",
        "Type": "Software",
        "Protocol": ""
      },
      {
        "Name": "OrganisationalModelIndex",
        "Direction": "OutputInput",
        "Record_Type": "{float32 OrganisationalModelIndex} OrganisationalModelIndex_t",
        "Type": "Software",
        "Protocol": ""
      },
      {
        "Name": "DefaultProbability",
        "Direction": "OutputInput",
        "Record_Type": "{float32 DefaultProbability} DefaultProbability_t",
        "Type": "Software",
        "Protocol": ""
      },
      {
        "Name": "BusinessDiscontinuityProbability",
        "Direction": "OutputInput",
        "Record_Type": "{float32 BusinessDiscontinuityProbability} BusinessDiscontinuityProbability_t",
        "Type": "Software",
        "Protocol": ""
      }
    ]
  },
}
```



```

"AIMs": [
  {
    "GovernanceAssessment": "@*:(S:(CUI:CPP:1:GovernanceAssessment))*",
    "FinancialAssessment": "@*:(S:(CUI:CPP:1:FinancialAssessment))*",
    "RiskMatrixGeneration": "@*:(S:(CUI:CPP:1:RiskMatrixGeneration))*",
    "Prediction": "@*:(S:(CUI:CPP:1:Prediction))*",
    "Perturbation": "@*:(S:(CUI:CPP:1:Perturbation))*"
  }
],
"Topology": [
  {
    "PredictionHorizon": {
      "Output": {
        "Module": "",
        "Port": "PredictionHorizon"
      },
      "Input": {
        "Module": "Prediction",
        "Port": "PredictionHorizon"
      }
    },
    "Governance": {
      "Output": {
        "Module": "",
        "Port": "Governance"
      },
      "Input": {
        "Module": "GovernanceAssessment",
        "Port": "Governance"
      }
    },
    "FinancialStatement_1": {
      "Output": {
        "Module": "",
        "Port": "FinancialStatement"
      },
      "Input": {
        "Module": "GovernanceAssessment",
        "Port": "FinancialStatement"
      }
    },
    "FinancialStatement_2": {
      "Output": {
        "Module": "",
        "Port": "FinancialStatement"
      },
      "Input": {
        "Module": "FinancialAssessment",
        "Port": "FinancialStatement"
      }
    },
    "RiskAssessment": {
      "Output": {
        "Module": "",
        "Port": "RiskAssessment"
      },
      "Input": {
        "Module": "RiskMatrixGeneration",
        "Port": "RiskAssessment"
      }
    },
    "GovernanceFeatures": {
      "Output": {
        "Module": "GovernanceAssessment",
        "Port": "GovernanceFeatures"
      },
      "Input": {
        "Module": "Prediction",
        "Port": "GovernanceFeatures"
      }
    },
    "FinancialFeatures": {
      "Output": {

```



```

        "Version": "1",
        "Title": "GovernanceAssessment"
    },
    "Version": "*",
    "Profile": "",
    "Description": "This AIM implements the Governance Assesment AIM of CUI-CPP",
    "Ports": [
        {
            "Name": "Governance",
            "Direction": "InputOutput",
            "Record_Type": "float32 [] Governance_t",
            "Type": "Software",
            "Protocol": ""
        },
        {
            "Name": "FinancialStatement",
            "Direction": "InputOutput",
            "Record_Type": "float32[] FinancialStatement_t",
            "Type": "Software",
            "Protocol": ""
        },
        {
            "Name": "GovernanceFeatures",
            "Direction": "OutputInput",
            "Record_Type": "float32[] GovernanceFeatures_t",
            "Type": "Software",
            "Protocol": ""
        }
    ],
    "AIMs": [ ],
    "Topology": [ ],
}
}

```

## 2.2 Financial Assessment

```

{
  "AIM": {
    "Implementer_ID": ###,
    "Standard": {
      "Name": "CUI",
      "Use_Case": "CPP",
      "Version": "1",
      "Title": "FinancialAssessment"
    },
    "Version": "*",
    "Profile": "",
    "Description": "This AIM computes the Financial Features of CUI-CPP",
    "Ports": [
      {
        "Name": "FinancialStatement",
        "Direction": "InputOutput",
        "Record_Type": "float32[] FinancialStatement_t",
        "Type": "Software",
        "Protocol": ""
      },
      {
        "Name": "FinancialFeatures",
        "Direction": "OutputInput",
        "Record_Type": "float32[] FinancialFeatures_t",
        "Type": "Software",
        "Protocol": ""
      }
    ],
    "AIMs": [ ],
    "Topology": [ ],
  }
}

```

## 2.3 Risk Matrix Generation

```
{
  "AIM": {
    "Implementer_ID": ###,
    "Standard": {
      "Name": "CUI",
      "Use_Case": "CPP",
      "Version": "1",
      "Title": "RiskMatrixGeneration"
    },
    "Version": "*",
    "Profile": "",
    "Description": "This AIM Computes the Risk Matrix of CUI-CPP",
    "Ports": [
      {
        "Name": "RiskAssessment",
        "Direction": "InputOutput",
        "Record_Type": "float32 [] RiskAssessment_t",
        "Type": "Software",
        "Protocol": ""
      },
      {
        "Name": "RiskMatrix",
        "Direction": "OutputInput",
        "Record_Type": "float32 [] RiskMatrix_t",
        "Type": "Software",
        "Protocol": ""
      }
    ],
    "AIMs": [ ],
    "Topology": [ ],
  }
}
```

## 2.4 Prediction

```
{
  "AIM": {
    "Implementer_ID": ###,
    "Standard": {
      "Name": "CUI",
      "Use_Case": "CPP",
      "Version": "1",
      "Title": "Prediction"
    },
    "Version": "*",
    "Profile": "",
    "Description": "This AIM computes Organisational Model Index and Default Probability of CUI-CPP",
    "Ports": [
      {
        "Name": "GovernanceFeatures",
        "Direction": "InputOutput",
        "Record_Type": "float32 [] GovernanceFeatures_t",
        "Type": "Software",
        "Protocol": ""
      },
      {
        "Name": "FinancialFeatures",
        "Direction": "InputOutput",
        "Record_Type": "float32 [] FinancialFeatures_t",
        "Type": "Software",
        "Protocol": ""
      },
      {
        "Name": "OrganisationalModelIndex",
        "Direction": "OutputInput",

```

```

    "Record_Type": "{float32 OrganisationalModelIndex}"
  OrganisationalModelIndex_t",
    "Type": "Software",
    "Protocol": ""
  },
  {
    "Name": "DefaultProbability",
    "Direction": "OutputInput",
    "Record_Type": "{float32 DefaultProbability} DefaultProbability_t",
    "Type": "Software",
    "Protocol": ""
  }
],
"AIMs": [ ],
"Topology": [ ],
}
}

```

## 2.5 Perturbation

```

{
  "AIM": {
    "Implementer_ID": "###",
    "Standard": {
      "Name": "CUI",
      "Use_Case": "CPP",
      "Version": "2",
      "Title": "Perturbation"
    },
    "Version": "*",
    "Profile": "",
    "Description": "This AIM computes the Business Discontinuity Probability of CUI-CPP",
    "Ports": [
      {
        "Name": "DefaultProbability",
        "Direction": "InputOutput",
        "Record_Type": "{float32 DefaultProbability} DefaultProbability_t",
        "Type": "Software",
        "Protocol": ""
      },
      {
        "Name": "RiskMatrix",
        "Direction": "InputOutput",
        "Record_Type": "float32 [ ] RiskMatrix_t",
        "Type": "Software",
        "Protocol": ""
      },
      {
        "Name": "BusinessDiscontinuityProbability",
        "Direction": "OutputInput",
        "Record_Type": "{float32 BusinessDiscontinuityProbability}"
        BusinessDiscontinuityProbability_t",
        "Type": "Software",
        "Protocol": ""
      }
    ],
    "AIMs": [ ],
    "Topology": [ ],
  }
}

```