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IFRS® Foundation

IFRS Taxonomy Guides

Using the IFRS Taxonomy

Formula linkbase 2020

This Guide has been prepared by IFRS Foundation (Foundation) staff. It has not been approved by the International Accounting Standards Board (Board). The guide is designed to help preparers understand the content of the IFRS Taxonomy formula linkbase.

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Introduction

The aim of this document is to:

- provide a brief introduction to the XBRL formula linkbase;
- describe the types of validation the IFRS Taxonomy formula linkbase provides; and
- give technical details on the implementation of those formulas.

Readers should be familiar with other IFRS Taxonomy supporting materials such as the IFRS Taxonomy Architecture (which can be found on the IFRS website here:

<https://www.ifrs.org/issued-standards/ifrs-taxonomy/#resources>) and the XBRL specifications.

Disclaimer: Please be aware that the IFRS Taxonomy formula linkbase may be subject to change in the future and described formula groups may be either extended or discontinued. The current release of the formula linkbase is not part of the official IFRS Taxonomy set of files.

Introduction to the formula linkbase

What is the formula linkbase?

XBRL formula is an XBRL standard released in 2009 to add business rule validations in the form of an additional XBRL linkbase. The core set of XBRL linkbases includes some validation of calculation style rules, such as aggregation and disaggregation, however, this mechanism does not support many types of business rules, such as cross item validation or dimensional roll-up, and does not support fully the XBRL dimensions specification.

The purpose of the IFRS formula linkbase is to help improve the data quality of XBRL filings based on the IFRS Taxonomy and to provide additional guidance for those working with XBRL filings which are based on the IFRS Taxonomy. This linkbase allows validation of certain business logic rules included in the IFRS Taxonomy, which cannot be validated using the means provided in the base XBRL 2.1 specification or dimensions specification.

There are two groups of formulas, for full IFRS Standards and separately the IFRS for SMEs[®] Standard.

How to use the formula linkbase?

The IFRS Taxonomy formula linkbase can be used with software packages supporting the XBRL formula specification 1.0.

The release includes two entry points which contain links to the IFRS Taxonomy 2020, one entry point with the concepts for full IFRS reporting and another with the concepts related to the IFRS for SMEs.

The IFRS Taxonomy formula linkbase is developed to be as generally applicable as possible, which means it can be used with filings (instance documents) based on:

- the IFRS Taxonomy directly;
- regulatory extensions to the IFRS Taxonomy; or
- entity specific extensions to the IFRS Taxonomy (including with a preparer extension taxonomy).

The implemented rules are intended to act as a guide and there may be differences due to regulatory system or entity-specific circumstances.

The current version of the IFRS formula linkbase release package, as published by XBRL International, Inc., implements the Assertion Severity 1.0 (AS 1.0) specification (19 April 2016). All assertions available in the release package are linked to a 'warning' severity type in accordance with the AS 1.0. We understand that in different reporting scenarios, different severity assertions might be more appropriate. If this is the case, a user may override the severity links, for example, if there is a need to make the formulas more restrictive.

Formula categories

In the initial analysis on real filing data, we identified the following categories, each with its potential quality weakness:

- **Cross period validations**—test the calculation of roll-forwards, whether the beginning balance adjusted by total changes over the period equals the ending balance.
- **Earnings per share validations**—test that the earnings per share calculation (the '*profit (loss)*' divided by the average number of shares) equals the values given in the report.
- **Axis aggregation validations**—test that the summation of the values provided for the members of an axis is equal to the value reported for their parent member (if applicable for a given axis and only if the preparer structured their members in a summation-like hierarchy).
- **Fact equivalence validations**—test that two facts tagged using different IFRS Taxonomy line items or line items and members, that represent the same concept, are equal. This most commonly occurs where one fact is a dimensionally qualified concept and the other one is not (eg '*Aircraft*' = '*Aircraft [member]*' in '*Property, plant and equipment [axis]*' with primary item '*Property, plant and equipment*').

- **Positive / negative fact validations**—test that if a fact is usually expected to be reported as an amount greater or equal zero it is not negative and vice versa.
- **Percentage warnings**—test that the format of a percentage fact is below 100% and above -100%.
- **Technical validations**—test technical aspects of XBRL instance documents not covered by the XBRL specification, which may be confusing for users, for example, the existence of duplicate facts.

Technical details

It is assumed within this document that the technical audience is familiar with the XBRL formula specification 1.0 (22 June 2009, including errata corrections as of 10 March 2011) as published by XBRL International, Inc.

The IFRS formula package does not function as a standalone module, therefore, it needs to be considered in the context of the IFRS Taxonomy 2020 and its documentation.

The IFRS formula linkbase can be included in the Discoverable Taxonomy Set (DTS) of the IFRS Taxonomy 2020. Alternatively, a subset of formulas applicable to the individual scenario may be used. Each category defined above in ‘Formula categories’ is stored in a separate physical formula linkbase file. The category-based file structure is intended to help to improve reusability. In some cases, this reusable approach requires minor adjustments within the formulas. This is particularly true in taxonomies that extend the IFRS Taxonomy.

To help users read and understand the IFRS formula linkbase, the identifier (ID) attribute of the value assertions and the names of the variables relate to the formula category and, where applicable, the specific items tested.

The IFRS Taxonomy formula linkbase consists of the formula type *Value Assertion* as defined in the formula specification. *Existence assertions* are not included in this implementation. The IFRS Standards do require certain disclosures within Standards, however, other considerations, such as materiality, may mean that even if an entity is applying a given Standard the required disclosures may not be present in its financial statements. Therefore, testing the existence of certain IFRS concepts as defined in the IFRS Taxonomy in a financial report is not practical.

In the current version, each formula group is placed in separate Extended Link Roles. This has enabled us to add human readable labels for each formula group using XBRL Generic Label feature.

Cross-period validation

This group of formulas test calculation of roll-forwards. All cross-period validation formulas have the first part of the Value assertion ID attribute set to start with 'crossPeriod_'.

The formulas are stored in the following physical files:

- full IFRS: /formula/full_ifrs/for_ifrs-cro_2020-03-16.xml
- IFRS for SMEs: /formula/ifrs_for_smes/for_ifrs_for_smes-cro_2020-03-16.xml

Business description: The following example uses the IFRS Taxonomy 2020 illustrative example 3, which is available on the IFRS Foundation website, to help explain the basic mechanics of this formula group.

Net increase in cash and cash equivalents	70
Cash and cash equivalents at beginning of period	160
Cash and cash equivalents at end of period	230

The formula group validates all positions in the taxonomy where the following calculation would apply:

$$\text{beginning balance} + \text{change} = \text{ending balance}$$

Technical description: A cross-period validation is implemented when there is a beginning and ending balance in the IFRS presentation linkbase (including their negations). These are indicated through the *preferredLabel* attribute on a presentation arc and have the *preferredLabel* attribute values:

- 'http://www.xbrl.org/2003/role/periodStartLabel',
- 'http://www.xbrl.org/2003/role/periodEndLabel',
- 'http://www.xbrl.org/2009/role/negatedPeriodStartLabel' or
- 'http://www.xbrl.org/2009/role/negatedPeriodEndLabel'.

Beginning and ending balances are always linked through the same parent within the presentation linkbase. The actual change in value over the period is represented via the elements presented in between the beginning and end balance. Those changes may be summarised in an element. This element will have a total label.

In the formula, the beginning balance is stored in the fact variable called '*beginningBalance*'; the changes during the year are stored in the fact variable called '*change*'; and the ending balance is stored in a fact variable called '*endingBalance*'.

The validation returns true if the following condition is met (and false if the condition is unmet):

$$\text{beginning balance} + \text{change} = \text{ending balance}$$

Please note that from a technical perspective, the instant-duration filter in the beginning-/ ending-balance fact variables ensures that only facts with appropriate dates are added up. Additional formulas can be added to this group when similar validations are required on a regulator or company level.

Earnings per share validations

This group of formula tests that the earnings per share (EPS) calculation—the ‘*profit (loss)*’ divided by the average number of shares—equals the values given in the report. All EPS-validation formulas have the first part of the value assertion ID attribute set to start with ‘*eps_*’.

They are stored in the following physical file:

- full IFRS: /formula/full_ifrs /for_ifrs-eps_2020-03-16.xml

There are six EPS validations implemented in the formula linkbase that are derived from the extended link role ‘[838000] *Notes – Earnings per share*’. They are listed in detail below and return true if the formulas add up and are false otherwise.

Business description: The earnings per share formulas provided within this linkbase are based upon the standard label as listed below:

$$\text{Basic earnings (loss) per share from continuing operations} = \frac{\text{Profit (loss) from continuing operations attributable to ordinary equity holders of parent entity}}{\text{Weighted average number of ordinary shares outstanding}}$$

$$\text{Basic earnings (loss) per share from discontinued operations} = \frac{\text{Profit (loss) from discontinued operations attributable to ordinary equity holders of parent entity}}{\text{Weighted average number of ordinary shares outstanding}}$$

$$\text{Basic earnings (loss) per share} = \text{Profit (loss), attributable to ordinary equity holders of}$$

parent entity / Weighted average number of ordinary shares outstanding

Diluted earnings (loss) per share from continuing operations = Profit (loss) from continuing operations attributable to ordinary equity holders of parent entity including dilutive effects / Adjusted weighted average number of ordinary shares outstanding

Diluted earnings (loss) per share from discontinued operations = Profit (loss) from discontinued operations attributable to ordinary equity holders of parent entity including dilutive effects / Adjusted weighted average number of ordinary shares outstanding

Diluted earnings (loss) per share = Profit (loss), attributable to ordinary equity holders of parent entity including dilutive effects / Adjusted weighted average number of ordinary shares outstanding

In some scenarios, the value reported may have been rounded from a more precise calculation result. For example, a preparer may have reported the following:

Basic earnings (loss) per share from continuing operations	0.79
Profit (loss) from continuing operations attributable to ordinary equity holders of parent entity	1,641,000,000
Weighted average number of ordinary shares outstanding	2,069,804,000

The above validation rule would return false based on the fact that

$$\frac{1641000000}{2069804000} = 0.79282869...$$

And therefore is not equal to 0.79.

In this scenario, the formulas have a parameter that indicates the accuracy of the calculation. To achieve this, the above calculations use the following mathematical expression, which is then used in the formula linkbase to perform the above calculations:

$\text{abs}^1((\text{'Profit (loss) from continuing operations attributable to ordinary equity holders of parent entity'} \div \text{'Weighted average number of ordinary shares outstanding'}) - \text{'Basic earnings (loss) per share from continuing operations'}) \leq 0.01$

Technical description: The variables are called 'eps', 'profitLoss' and 'averageShares'. Please note that the unit single measure filter ensures that the correct units are used on all corresponding facts.

In the above example, the threshold is set to 0.01; however, it is possible to change the value before proceeding with the formula validations. Similar precision expressions can be also adopted by other formula groups if required.

Axis aggregation validations

This group of formulas test whether the summation of the values provided for the members of an axis is equal to the value reported for their parent member if applicable for a given axis and only if the preparer structured their members in a summation-like hierarchy. All dimensional aggregation validation formulas have the first part of the Value assertion ID attribute set to start with 'DimAgg_'.

The formulas are stored in the following files:

- full IFRS: /formula/full_ifrs/for_ifrs-axi_2020-03-16.xml
- IFRS for SMEs: /formula/ifrs_for_smes/for_ifrs_for_smes-axi_2020-03-16.xml

The validation adds up all children in a given dimension and compares the value to the parent fact value. The validation returns true if both fact values are equal or false if the values are unequal. This aggregation is performed only on monetary concepts. There is a validation for each Extended Link Roles (ELR) and for each dimension defined in the IFRS taxonomy.

Business description:

For example, the 'Property, plant and equipment [axis]' consists of a certain hierarchy of members:

¹ abs() function returns the absolute value of a number.

Classes of property, plant and equipment [axis]	axis	IAS 16.73 Disclosure
Property, plant and equipment [member]	member[default]	IAS 16.73 Disclosure, IAS 36.127 Example, IFRS 16.53 Example
Land and buildings [member]	member	IAS 16.37 b Example
Land [member]	member	IAS 16.37 a Example
Buildings [member]	member	IAS 16.37 Common practice
Machinery [member]	member	IAS 16.37 c Example
Vehicles [member]	member	IAS 16.37 Common practice
Ships [member]	member	IAS 16.37 d Example
Aircraft [member]	member	IAS 16.37 e Example
Motor vehicles [member]	member	IAS 16.37 f Example
Fixtures and fittings [member]	member	IAS 16.37 g Example
Office equipment [member]	member	IAS 16.37 h Example
Computer equipment [member]	member	IAS 16.37 Common practice

Facts reported for the concept '*Property, plant and equipment*' with dimensional qualification using the members from the '*Property, plant and equipment [axis]*' are generally intended to be totalled up (rolled up) according to the defined hierarchy.

The following scenario would be marked as an error because the '*Land and buildings [member]*' is not reported (see below). The resulting validation would only check the role up '*Property, plant and equipment [member]*' = '*Machinery [member]*' which is not equal.

	<i>Property plant and equipment</i>
Property, plant and equipment [member]	100
Land and buildings [member]	<i>[Not reported]</i>
Land [member]	50
Buildings [member]	25
Machinery [member]	25

Technical description: The parent fact value is stored in the fact variable '*parent*' and all its children are stored in the fact variable '*child*'. In some cases, there are exceptions defined for a dimension where the parent is not the summation of its children. Those exceptions are expressed through an additional explicit dimensional filter in the parent variable, which is flagged as 'complement' (e.g. '*dimAgg_BusinessCombinationsAxis_1*').

Fact equivalence validations

This group of formulas test that two facts tagged using different IFRS Taxonomy line items, or line items and members that conceptually represent the same concept, are equal. This most commonly occurs where one fact is a dimensionally qualified concept and the other one is not (eg '*Aircraft*' = '*Aircraft [member]*' in '*Property, plant and equipment [axis]*' with primary item '*Property, plant and equipment*').

All fact equivalence formulas have the first part of the value assertion ID attribute set to start with 'equ_' within the formula linkbase.

The formulas are stored in the following physical files:

- full IFRS: /formula/full_ifrs/for_ifrs-equ_2020-03-16.xml
- IFRS for SMEs: /formula/ifrs_for_smes/for_ifrs_for_smes-equ_2020-03-16.xml

The purpose of the formulas is to ensure that dimensional and non-dimensional facts with the same accounting meaning contain the same reported value even though they are represented differently.

Business description: In a financial report, the same fact is sometimes tagged at different places; for example, a position called 'Retained earnings' which is used in statement of financial position, is equivalent to a position 'Equity' qualified by 'Retained earnings [member]' on 'Components of equity [axis]' in the statement of changes in equity.

In the IFRS Taxonomy, this is represented by two different facts (one dimensionally qualified and another one which is not dimensionally qualified).

Technical description: The non-dimensional fact is always in the fact variable 'non-dim', whereas the dimensional data point in the corresponding hypercube is stored in the fact variable 'dim'. The formulas will only be evaluated if values are reported for both positions in the taxonomy.

It may be appropriate to adjust the formulas and include rounding or a certain precision parameter. Those mechanisms can be adopted in a similar fashion as described in the section 'EPS validations'.

Positive / negative fact validation

This group of formulas test that if a fact is usually expected to be reported as an amount greater or equal zero it is not negative and vice versa. All positive / negative formulas are identified through the Value assertion ID attribute equal to 'positive' or 'negative' within the formula linkbase.

The formulas are stored in the following physical files:

- full IFRS:
 - /formula/full_ifrs/for_ifrs-pos_2020-03-16.xml
 - /formula/full_ifrs/for_ifrs-neg1_2020-03-16.xml
 - /formula/full_ifrs/for_ifrs-neg2_2020-03-16.xml
- IFRS for SMEs:
 - /formula/ifrs_for_smes/for_ifrs_for_smes-pos_2020-03-16.xml

- /formula/ifrs_for_smes/for_ifrs_for_smes-neg1_2020-03-16.xml

Business description: Many facts reported in IFRS Standards are usually expected to be reported with a positive value or zero. This is related to the credit or debit balance attribute set on a given concept. For example, due to the fact that '*Cost of sales*' has a debit balance attribute it should be reported as a positive number. The formula takes special cases into consideration. For example, Revenue in general should be positive unless reported qualified by the '*Elimination of intersegment amounts [member]*' of the '*Segment consolidation items [axis]*'.

Technical description: The formula will only be validated if stated concepts are non-dimensional or used in combination with an axis defined in the IFRS Taxonomy schema. Certain primary item and member combinations are excluded from this test, which can be found in the '*pos*' / '*neg*' variables. Complementary filters state that this particular primary item or member combination is excluded from the validation. The extensive use of pre-conditions has been avoided wherever possible to maintain performance, and an equivalent complementary filter has been used. Please note that, for the Group 1 negative fact validations (for_ifrs-neg1_YYYY-MM-DD.xml linkbase), the logical 'OR' filter contains multiple explicit dimension filters.

Percentage warning

This formula tests that the data format of a percentage fact is below 100 per cent and above -100 per cent. The percentage-warning formula has the value assertion ID attribute '*percentage*' within the formula linkbase.

All percentage validations are stored in the following physical files:

- full IFRS: /formula/full_ifrs/for_ifrs-per_2020-03-16.xml
- IFRS for SMEs: /formula/ifrs_for_smes/for_ifrs_for_smes-per_2020-03-16.xml

Percentage values are required to be in .xx format as defined in the XBRL 2.1 specification section 4.8.2.

To represent rates, percentages or ratios where the numerator and the denominator would be the same units, the fact MUST have a unitRef attribute identifying a unit element with a single measure element as its only child. The local part of the measure MUST be 'pure' and the namespace prefix MUST resolve to the namespace: "http://www.xbrl.org/2003/instance". Rates, percentages and ratios MUST be reported using decimal or scientific notation rather than in percentages where the value has been multiplied by 100.

Analysis has shown that many preparers incorrectly format percentages to take into account that a value of 1.00 or more is equal to 100 per cent or more rather than 1 per cent.

Some facts might exceed the 100 per cent mark, which would result in a fact value of *1.54*, which is equivalent to 154 per cent. This would not be an error.

Technical description: The type of concept for which the formula is applied is stored in the fact variable called '*percentage*'. This formula is applied to all percentage concepts in the DTS and is not limited to IFRS Taxonomy concepts.

Technical validations

Any formulas included in this category test technical aspects of XBRL instance documents not covered by the XBRL specification that may be confusing for users.

They are stored in the following physical files:

- full IFRS: /full_ifrs/for_ifrs-tech_2020-03-16.xml
- IFRS for SMEs: /ifrs_for_smes/for_ifrs_for_smes-tech_2020-03-16.xml

Duplicate fact validations are included within this category. The validation captures any duplicate facts where non-numeric or numeric values of reported facts are not 'equal within some tolerance defined by the lesser of their respective @precision, implied @precision or @decimals attributes'. For further information regarding XBRL specification terminology for Value-equal facts please see XBRL 2.1 specification Section 1.4, Section 4.10 and definition of: 'xfi:v-equal' function within XBRL Function Registry 1.0.

Appendix 1: Error messages

The current version of the IFRS formula linkbase release provides human readable error messages. The validation messages are triggered when the validation condition of the formula is not fulfilled.

The error messages provided are as follows:

- **Cross period validations**—‘Reported value at end of period is not equal to sum of reported value at beginning of period and changes in that value during period’
- **Earnings per share validations**—‘Calculated EPS is not equal to reported value’
- **Axis aggregation validations**—‘Total of reported values for children members is not equal to reported value for parent member’
- **Fact equivalence validations**—‘Reported values for alternative tagging of same economic concept are not equal’
- **Positive fact validation**—‘Reported value is below 0’
- **Negative fact validation**—‘Reported value exceeds 0’
- **Percentage warnings**—‘Reported value exceeds 100%’
- **Technical validations**—‘Duplicated facts have been reported for: {name of the reported element}, value:{value for fact variable 1} != { value for fact variable 2} please review selected entries’