Understanding Block Semantics

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“It must be remembered that there is nothing more difficult to plan, more doubtful of success, nor more dangerous to manage than a new system. For the initiator has the enmity of all who would profit by the preservation of the old institution and merely lukewarm defenders in those who gain by the new ones.” Niccolò Machiavelli

Executive summary:

- A Block is a useful notion created out of convenience that enables software to interact with the fragments of an XBRL-based financial report with increased effectiveness.
- The notion of a Block can be leveraged to tightly and correctly bind the primitive objects that make up a Block together.
- The notion of Disclosures, Templates, Exemplars, Topics and other such metadata enhance the experience of professional accountants using software to create financial reports.
- There are alternatives to the painful, gruesome, grueling, barbaric practices, processes, and procedures that are used to create financial reports today.
- Blocks enable the creation of modern approaches to creating financial reports.

1 Good Reads, https://www.goodreads.com/quotes/88687-it-must-be-remembered-that-there-is-nothing-more-difficult
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Irreducible complexity\textsuperscript{2} is explained as follows: a single system which is composed of several interacting parts that contribute to the basic function, and where the removal of any one of the parts causes the system to effectively cease functioning.

So for example, consider a simple mechanism such as a mousetrap. That mousetrap is composed of several different parts each of which is essential to the proper functioning of the mousetrap: a flat wooden base, a spring, a horizontal bar, a catch bar, the catch, and staples that hold the parts to the wooden base. If you have all the parts and the parts are assembled together properly, the mousetrap works as it was designed to work.

But say you remove one of the parts of the mousetrap. The mousetrap will no longer function as it was designed, it simply will not work. That is irreducible complexity: the complexity of the design requires that it can’t be reduced any farther without losing functionality.

Similarly, an XBRL-based digital financial report has irreducible complexity, certain pieces that if missing cause errors, problems using the information, and other quality issues. Errors and quality issues in financial reports causes the entire report to be considered untrustworthy.

Blocks are designed to prevent such errors, problems using information, and other quality issues. Further, Blocks enable increased functionality to be provided to software users by software engineers.

You have used a conceptual model if you are an accountant and probably don’t even realize it. Electronic spreadsheets are broken down into the rows, columns, cells, sheets, and workbooks that make up the pieces of an electronic version of a spreadsheet.

\textsuperscript{2} Understanding the Law of Conservation of Complexity, \url{http://xbrl.squarespace.com/journal/2015/5/24/understanding-the-law-of-conservation-of-complexity.html}
Those ideas came from the paper-based spreadsheet that likewise had rows, columns, cells, and sheets.

Similarly, a financial report has a conceptual model. There is one very important difference to understand between the spreadsheet model and the financial report conceptual model. The spreadsheet model is presentation oriented. You can put anything into the rows, columns, cells, and sheets of a spreadsheet. But you only understand that there are rows, columns, cells, and spreadsheets; you do not know anything about what is contained in the spreadsheets.

The financial report conceptual model is different in that the financial report conceptual model (a) includes a layer that relates to the general business report model and (b) includes a layer that relates to the accounting items reported within a financial report. While you can present information contained within a financial report by leveraging the information in the report; the actual focus on the conceptual model of a financial report is on the representation of information within the report, not presentation of the information.

As Barnet Sherman points out in his Forbes article, *The Four Letters Transforming The Municipal Bond Market And Government Finance*:

> “With accurate data comes extensive data functionality. There are nearly an endless number of applications for data to be used in. Software engineers can develop automated, repeatable processes so data can be analyzed, measured, ranked, benchmarked, managed, modeled, tested, shared, exchanged, outlined, mapped, sorted, templatized, searched, queried, predicted, charted, animated, mined, validated, machine-read, machine-learned, compared, reused, verified, categorized, structured, tracked, screened, referenced, stored and retrieved. Just for starters.”

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The objective of Blocks is simple: The creation of accurate data so that this extensive functionality can be released by software engineers to those using XBRL-based digital financial reports. The notion of a Block and the functionality that having Blocks enables is explained in this document.

**Primitive Objects**

As was explained in the document *Putting the Expertise into an XBRL-based Knowledge Based System for Creating Financial Reports*, compound objects are created from a set of primitive objects. For example a line is a primitive object and a square, which is made up of four lines, is a compound object:

![Diagram of a line and a square]

**Implementation Layer**

An XBRL-based financial report has two layers of primitive objects. The first set of primitive objects relates to XBRL modeling or *implementation layer*. Those primitive objects include:

- **Network**: A Network is a technical artifact that really has no meaning by itself because those creating XBRL-based digital financial reports use networks in different ways.
- **Table (Hypercube)**: A Table is the same thing that XBRL calls a hypercube. A Table or hypercube simply groups some set of Axes, Members, Line Items, Abstracts, and Concepts together. Again, because Table’s are used inconsistently, they really have no meaning by themselves.
- **Axis (Dimension)**: An Axis is one approach to representing a characteristic or aspect. Entity and period core aspects are also in essence axes.
- **Member**: A Member is a value of a Characteristic.
- **Line Items (Primary items)**: A Line Items is in essence a type of dimension or Axis.
- **Abstract**: An Abstract is simply used to organize, they provide no real meaning.
- **Concept**: A Concept is a type of Member. A Concept is special in that it can be used to represent a Fact Value. Therefore, Concepts have data types.

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4 *Putting the Expertise into an XBRL-based Knowledge Based System for Creating Financial Reports*, [http://pesseract.azurewebsites.net/PuttingTheExpertiseIntoKnowledgeBasedSystem.pdf](http://pesseract.azurewebsites.net/PuttingTheExpertiseIntoKnowledgeBasedSystem.pdf)

The implementation model primitive objects can be related in very specific ways. The following table shows the allowed relationships between the different categories of primitive objects within an XBRL taxonomy:

<table>
<thead>
<tr>
<th>Parent</th>
<th>Network</th>
<th>Table</th>
<th>Axis</th>
<th>Member</th>
<th>LineItems</th>
<th>Abstract</th>
<th>Concept</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network</td>
<td>Illegal XBRL</td>
<td>Illegal XBRL</td>
<td>Illegal XBRL</td>
<td>Illegal XBRL</td>
<td>Illegal XBRL</td>
<td>Illegal XBRL</td>
<td>Illegal XBRL</td>
</tr>
<tr>
<td>Table</td>
<td>OK</td>
<td>Disallowed</td>
<td>Disallowed</td>
<td>Disallowed</td>
<td>Disallowed</td>
<td>OK</td>
<td>Disallowed</td>
</tr>
<tr>
<td>Axis</td>
<td>Disallowed</td>
<td>OK</td>
<td>Disallowed</td>
<td>Disallowed</td>
<td>Disallowed</td>
<td>Disallowed</td>
<td>Disallowed</td>
</tr>
<tr>
<td>Member</td>
<td>Disallowed</td>
<td>Disallowed</td>
<td>OK</td>
<td>Disallowed</td>
<td>Disallowed</td>
<td>Disallowed</td>
<td>Disallowed</td>
</tr>
<tr>
<td>LineItems</td>
<td>Disallowed</td>
<td>OK</td>
<td>Disallowed</td>
<td>Disallowed</td>
<td>Disallowed</td>
<td>Disallowed</td>
<td>Disallowed</td>
</tr>
<tr>
<td>Abstract</td>
<td>OK</td>
<td>Disallowed</td>
<td>Disallowed</td>
<td>Disallowed</td>
<td>OK</td>
<td>OK</td>
<td>Not advised</td>
</tr>
</tbody>
</table>

**Business Report Logical Layer**

The second set of primitive objects is related to the meaning of the objects that comprise a business report. Because a financial report is a type of business report, financial reports are likewise comprised of the following primitive objects:

- **Report**: Report\(^6\) which communicates financial and nonfinancial information about an economic or accounting entity to users of that report. Financial reports contain facts, characteristics which describe those facts, parenthetical explanations of facts, relations between facts.

- **Component**: A component (or report fragment) is a set of facts which go together (tend to be cohesive and share a certain common nature) for some specific purpose within a financial report. For example, a "balance sheet" is a report component. The "Maturities of long-term debt" disclosure is a report component.

- **Fact**: A fact is a piece of information that is reported\(^7\). A fact defines a single, observable, reportable piece of information contained within a financial report, or fact value, contextualized for unambiguous interpretation or analysis by one or more distinguishing characteristics\(^8\). A fact value is one property of a fact; every fact has exactly one fact value. The set of characteristics of a fact is a property of the fact. For example, *Cash and cash equivalents* of 100,000 for the *consolidated entity*

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\(^6\) A report as defined in this model is a combination of a set of one or more XBRL instances, the XBRL taxonomy schemas associated with the XBRL instance(s), the XBRL linkbase(s) associated with the XBRL instance(s) or XBRL taxonomy schemas; in the XBRL International Open Information Model 1.0, a report is essentially the set of facts in an XBRL instance, [http://www.xbrl.org/Specification/oim/CR-2017-05-02/oim-CR-2017-05-02.html#component-report](http://www.xbrl.org/Specification/oim/CR-2017-05-02/oim-CR-2017-05-02.html#component-report)


\(^8\) A characteristic in this model is identical to an aspect in the XBRL International Open Information Model 1.0; [http://www.xbrl.org/Specification/oim/CR-2017-05-02/oim-CR-2017-05-02.html#term-aspect](http://www.xbrl.org/Specification/oim/CR-2017-05-02/oim-CR-2017-05-02.html#term-aspect), an aspect could be a core aspect or a non-core aspect. Entity and period are core aspects. Units is defined as an aspect by the OIM, but we are defining units as a property of a numeric fact.
current balance sheet date of December 31, 2014 which is reported in US Dollars is a fact.

- **Characteristic**: A characteristic describes a fact. A characteristic or distinguishing aspect provides information necessary to describe a fact or distinguish one fact from another fact. A fact may have one or many distinguishing characteristics. For example, line item concept Cash and cash equivalents is a characteristic and the calendar period December 31, 2014 are characteristics which describe a fact.

- **Parenthetical explanation**: Facts may have parenthetical explanations⁹ which provide additional descriptive information about the fact.

- **Relation**: A relation¹⁰ is some interaction between the pieces which make up a financial report. Report components can be related to other report components. Reported facts can be related to other reported facts. Characteristics can be related to other characteristics. Business rules are a type of relation which describes computation type and logic-based relations. Classes or sets of concepts are relations.

- **Property**: A property is a trait, quality, feature, attribute, or peculiarity which is used to define its possessor and is therefore dependent on the possessor. A property belongs to something. For example, the color of a ball belongs to and is therefore is dependent on (is a property of) the ball. Financial reports have a set of properties. Components have a set of properties. Facts have a set of properties. Characteristics have a set of properties. Blocks have a set of properties. Parenthetical explanations have a set of properties. Relations have a set of properties. Exemplars and Templates have a set of properties. A Topic has a set of properties. A Disclosure has a set of properties.

- **Block**: A block¹¹ is a part of a component that participates in the same concept arrangement pattern. A Block is a set of facts which go together (tend to be cohesive and share a certain common nature) for some specific purpose within a financial report. Simply think about a block as a useful fragment used for referencing a fragment of a financial report.

- **Slot**: A slot is simply the idea of an allotted place where something can be logically and sensibly placed in a fragment of a financial report, or Block.

- **Disclosure**: A Disclosure is simply a set of facts that is disclosed. A Disclosure is comprised of one to many Blocks.

- **Topic**: A Topic is simply a set of Disclosures that are grouped together for some specific reason. A Disclosure could belong to one or many Topics. (Best practice is for a Disclosure to be associated with only one Topic.)

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• **Exemplar**: An Exemplar is an example of a Disclosure from some other existing financial report. A Disclosure may have zero to many exemplars. An Exemplar is a fragment of an existing Report.

• **Template**: A Template is a starting point or sample used to create a complete Disclosure. A Templated may have zero to many Templates. A Template is an XBRL instance and all related XBRL taxonomy schemas and XBRL linkbases.

Note that the business report logical layer is both consistent with the *XBRL International Open Information Model 1.0*\(^\text{12}\) and the *XBRL International Abstract Model 2.0*\(^\text{13}\) and builds upon those two efforts to clearly articulate the semantics or logic of a business report. The business report semantics layer is actually very well understood by those who created XBRL; however, this information is not particularly well articulated by XBRL International or by those creating reporting schemes which leverage the XBRL technical syntax.

Finally, the model represented in this document supplements the business report model specifically for metadata necessary and useful for financial reporting.

**Poka-yoke (Mistake proofing)**

Poka-yoke is a technique used to prevent mistakes through smarter design. Poka-yoke\(^\text{14}\) is a Japanese term that means "mistake-proofing". A poka-yoke is any mechanism consciously added to a process that helps an equipment operator avoid mistakes. Its purpose is to eliminate defects by preventing, correcting, or drawing attention to human errors as the errors occur.

For example, consider the graphic\(^\text{15}\) below. You want someone to plug the plug into the receptacle such that positive and negative match up; inadvertently reversing this would have catastrophic consequences. In the top graphic notice that it is possible to make a mistake but in the bottom a mistake would be impossible because of the size differences in the positive and negative receptacle and plug.

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Smart design means less user errors. Blocks are a mechanism for implementing poka-yoke, or mistake proofing XBRL-based information. Primitive object structure, mechanical relations, mathematical relations, logical relations, and even some accounting relations must make sense relative to other primitive objects. Blocks and the structured nature of XBRL make implementing these mistake proofing techniques possible with financial report creation software.

**Compound or Composite Objects**

A compound or composite object is an object that has some set of primitive objects. Using the previous example of a square; the square is a compound object made up of the primitive object line. An example of leveraging a compound object would be to, say, resize the object which is a square. If you know the rule “all sides of a square are equal” and “all angles in a square are always 90 degrees”; then resizing the square can be made easier for the user if the user can interact with the compound object square rather than have to interact with each primitive object line.

Further, categorizing compound objects makes working with them even easier. For example, if you distinguish four sided objects from three sided objects you can interact with the objects in a richer way.

Further, within the category of four sides objects which we give the name quadrilateral, we name the different objects you can also refer to each different object by its name if given a name or by the characteristics of the object using prototype theory.
Basically, consistency causes patterns and patterns are leveragable.

The two most confusing and therefore challenging objects to understand in an XBRL-based report are the Network and the Component\(^\text{16}\). The Block was created to mitigate this inconsistency, creating consistency. There are two primary reasons for the inconsistency and resulting confusion.

First, base taxonomies such as the US GAAP and IFRS XBRL Taxonomies can be confusing to understand because of the ways the taxonomies are created. Both the US GAAP and IFRS XBRL Taxonomies are essentially modeled as “picklists”. Additional confusion is caused by important relations are not represented and the cumbersome size of the Networks used to represent information. At a technical syntax lever, the Network is very consistent within the US GAAP and IFRS XBRL taxonomies. But, within a Network, the things that are represented are irregular and therefore impossible to address and use consistently. Some information is represented within a Table, other information is not. Some Tables share names, some Tables have unique names. Neither the US GAAP nor the IFRS XBRL taxonomies follow XBRL International best practices which specifies that dimensional and non-dimensional models should not be mixed\(^\text{17}\). Both mix dimensional and non-dimensional models. This make is literally impossible for a software application to work effectively with the US GAAP or IFRS XBRL taxonomies to perform higher-level tasks such as identify a Disclosure and in particular identify and work with specific Disclosures.

Second, XBRL-based reports are represented favoring some notion of presentation of report information rather than representation of the meaning which the report information conveys. Further, little though is put into representing disclosures by some reporting entities. As such, an untrained observer can be very confused as to the meaning of different XBRL representations of information and the meaning that information conveys.

However, if you consider the group of approximately 500,000 report fragments of approximately 6,000 economic entities which report using US GAAP to the SEC and approximately 40,000 report fragments of approximately 400 entities which report using IFRS to the SEC for annual financial reports (i.e. 10-K, 20-F, 40-F); patterns are very apparent to humans and can be discovered by machines provided with the right information. Further, if a knowledgeable observer leverages the consistent patterns and avoids the obviously incorrect (i.e. illogical) patterns, inconsistent representations of the same information, and other irregularities; then useful information emerges.

\(^{16}\) Understanding Networks, Components, and Blocks; [http://xbrlsite.azurewebsites.net/2018/Pesseract/12-NetworksComponentsAndBlocks.pdf](http://xbrlsite.azurewebsites.net/2018/Pesseract/12-NetworksComponentsAndBlocks.pdf)

Blocks contribute to unraveling information, identifying what that information is, and leveraging known structural, mechanical, mathematical, logical, and accounting relations within each Block. Knowing and leveraging that information enables the creation of high-quality, mathematically and logically rock-solid Blocks\(^\text{18}\). This feature has use to those both creating financial report information and consuming that same information.

**Understanding Blocks**

A Block\(^\text{19}\) is a unit of a report that was created in order to make interacting with and otherwise working with a report easier. Individual facts are many times too small working sets to be useful. Networks tend to be too large to work with. A Block is a useful unit of a report that makes doing certain things significantly easier and other things which were simply impossible; possible.

Essentially, a Block is a fragment of a report that has the same *concept arrangement pattern*\(^\text{20}\). For example, there is a simple basic Block\(^\text{21}\):

<table>
<thead>
<tr>
<th>Inventory [Line Items]</th>
<th>Period [Axis]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2017-06-30</td>
</tr>
<tr>
<td>Raw materials</td>
<td>797,000,000</td>
</tr>
<tr>
<td>Work in process</td>
<td>145,000,000</td>
</tr>
<tr>
<td>Finished goods</td>
<td>1,239,000,000</td>
</tr>
<tr>
<td>Total</td>
<td>2,181,000,000</td>
</tr>
</tbody>
</table>

The Block above has the concept arrangement pattern “roll up”. I will explain more of the traits of a Block as we go along. Blocks are very consistent structures and makes working with an XBRL-based report at a logical level possible as contrast to working at the XBRL technical syntax level. Blocks make many, many things possible.

Blocks are driven by the information represented by a Disclosure itself, not by how someone might choose to present that Disclosure information. For example, if you look at a set of 339\(^\text{22}\)

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\(^{19}\) Charles Hoffman and Hamed Mousavi, *Putting the Expertise into an XBRL-based Knowledge Based System for Creating Financial Reports*, [http://pesseract.azurewebsites.net/PuttingTheExpertiseIntoKnowledgeBasedSystem.pdf](http://pesseract.azurewebsites.net/PuttingTheExpertiseIntoKnowledgeBasedSystem.pdf)

\(^{20}\) Charles Hoffman and Rene van Egmond, *Understanding Concept Arrangement Patterns, Member Arrangement Patterns, and Report Fragment Arrangement Patterns*, [http://xbrlsite.azurewebsites.net/2017/IntelligentDigitalFinancialReporting/Part02_Chapter05.7_UnderstandingConceptArrangementPatternsMemberArrangementPatterns.pdf](http://xbrlsite.azurewebsites.net/2017/IntelligentDigitalFinancialReporting/Part02_Chapter05.7_UnderstandingConceptArrangementPatternsMemberArrangementPatterns.pdf)

\(^{21}\) Microsoft, [http://www.xbrlsite.com/2017/Prototypes/Microsoft/evidence-package/#Rendering-DisclosureComponentsOfInventoriesDetail-us_gaap_InventoryCurrentTable.html](http://www.xbrlsite.com/2017/Prototypes/Microsoft/evidence-package/#Rendering-DisclosureComponentsOfInventoriesDetail-us_gaap_InventoryCurrentTable.html)

Disclosures of the components of property, plant, and equipment there are similarities between each of those Disclosures.

A Block is a part of a Component whose line items all participates in the same concept arrangement pattern\(^{23}\). A roll up, roll forward, adjustment, and hierarchy are all types of concept arrangement patterns. Every XBRL-based public company financial report is essentially a set of Blocks. I estimate that there are about 754,430 blocks in the set of 5,734 public company reports that I analyzed. Of that total, 16% are roll ups, 5% are roll forwards, 24% are hierarchies, and 54% are text blocks\(^{24}\).

### Blocks and Extensibility

XBRL has a predictable shape. What you put into that predictable shape is up to you. However, what you represent using that predictable shape must be logical by some definition. But how do you define what is logical per your definition of logical? How do you explain to creators of XBRL-based reports what is allowed and what is not allowed via an extension XBRL taxonomy so that reports based on that extension and its base XBRL taxonomy are logical?

Here is a simple case to help you understand the issue. The accounting equation establishes that “Assets = Liabilities and Equity”\(^{25}\). That rule is nowhere to be found in either the US GAAP XBRL Taxonomy. Per my last measurement, there were 53 economic entities out of about 5,734 where their reported assets did not equal liabilities and equity. Per investigation, all 53 inconsistencies with the accounting equation were verified to be errors in the XBRL-based report of the economic entity.

As was pointed out in the document Leveraging XBRL Extensibility Effectively\(^{26}\), when XBRL’s extensibility feature is employed, the flexibility introduced in terms of extensibility means responsibility to control that extensibility using rules. Rules prevent anarchy\(^{27}\). The judicious use of rules is necessary to control the structure, mechanics, mathematical relations, logical relations, and general consistency of the information provided within a report.

Blocks help you control mechanisms that assure that extensibility is used how the extensibility is intended to be used. Things like the US GAAP and IFRS XBRL Taxonomy architecture guidelines provide some guidance as does the Edger Filer Manual or the European Single Electronic Format. But, while this guidance is necessary, it is not sufficient. Proof that the


\(^{24}\) I have a document that summarizes this information.


\(^{26}\) Leveraging XBRL Extensibility Effectively, [http://xbrlsite.azurewebsites.net/2018/Library/LeveragingXBRLExtensibilityEffectively.pdf](http://xbrlsite.azurewebsites.net/2018/Library/LeveragingXBRLExtensibilityEffectively.pdf)

guidance is not sufficient is the clearly identifiable filer errors in the XBRL-based reports of public companies\textsuperscript{28} financial reports. Again, rules prevent anarchy. But exactly what rules?

\textit{Universally Applicable Automatable Rules}

There are two types of logical rules that are enforced within Blocks. The first category is \textit{universally applicable rules} that apply to every Block of every report. For example, consider the figure on page 5 which I will repeat here except rather than simply indicating allowed and disallowed relations between the parent and child report elements I am showing the count of the number of relations for each relation in addition to the color coding of what is allowed and what is not allowed. This information is from a set of 5,734 reports that were analyzed to examine the nature of these relations between different categories of report elements:

<table>
<thead>
<tr>
<th>Parent</th>
<th>Network</th>
<th>Table 232,230</th>
<th>Axis 386,912</th>
<th>Member 1,216,391</th>
<th>Lineltems 232,690</th>
<th>Abstract 732,409</th>
<th>Concept 3,155,249</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Table</td>
<td>1,261</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>45</td>
<td>230,899</td>
<td>24</td>
</tr>
<tr>
<td>Axis</td>
<td>1</td>
<td>386,888</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>Member</td>
<td>3</td>
<td>0</td>
<td>450,091</td>
<td>766,221</td>
<td>4</td>
<td>72</td>
<td>0</td>
</tr>
<tr>
<td>Lineltems</td>
<td>183</td>
<td>232,161</td>
<td>0</td>
<td>0</td>
<td>107</td>
<td>217</td>
<td>2</td>
</tr>
<tr>
<td>Abstract</td>
<td>474,310</td>
<td>22</td>
<td>0</td>
<td>1</td>
<td>113,069</td>
<td>144,471</td>
<td>546</td>
</tr>
<tr>
<td>Concept</td>
<td>45</td>
<td>26</td>
<td>11</td>
<td>137</td>
<td>1,222,427</td>
<td>1,929,257</td>
<td>13,346</td>
</tr>
</tbody>
</table>

These rules are universally applicable to every report. While XBRL validation is required to enforce certain relations related to expressing XBRL calculation relations and XBRL definition relations; financial report creators are free, per the XBRL technical specification, to represent XBRL presentation relations pretty much however they might want. For example, there is nothing that says you cannot have an “Axis” as part of a set of “Line Items” in the set a set of presentation relations. Even more pathological representations could be created. While most software does not let you do things like this, other software does. Blocks enforce these rules without you having to provide any metadata what-so-ever. These sorts of rules are hard coded into the business report processor.

Another universally applicable rule is the requirement for XBRL calculation relations when a roll up mathematical computation in a Block of information.

Another universally applicable rule is the XBRL technical syntax rules. There is no need for accounting professionals to provide universally applicable rules; software can, and should, enforce all of these rules.

Other Automatable Logical Rules (i.e. not universally applicable)

If a rule is not universally applicable, then the rule must be enforced using metadata provided by someone, generally a business professional who understands these reports and the information conveyed by the reports.

For example, the SEC does not require XBRL formula rules to be provided for roll forward type mathematical relations in an XBRL-based report. Does this mean that roll forwards don’t need to roll forward? Certainly not. What it means is that professional accountants need to be very careful and either (a) make sure they are using other automated processes to be sure this type of mathematical relation is checked by their software, or (b) check roll forward computations manually. The second alternative, manually checking roll forward computations, is proving not to work very well in XBRL-based reports submitted to the SEC. This is provable by simply observing all the errors that exist in those reports.

There are other types of mathematical computations which the SEC does not mandate that business rules be provided: adjustments, variance, member aggregations to name a few.

However, a tool that enforces Block structural, mechanical, mathematical, and other logical rules frees the user of the application from the burden of having to prove that the basic math of a financial report is working correctly.

Class or Type Relations Rules

Consider the balance sheet fragment below. What would prevent someone creating an XBRL-based report from using the concept “us-gaap:DeferredTaxLiabilitiesNoncurrent” as part of the
line item “Total current liabilities”? 

Based on the concept name, it is rather obvious that the concept relates to noncurrent liabilities and not to current liabilities. But errors such as this occur all the time in the XBRL-based financial reports submitted to the SEC by public companies. 

Again, I will point out, that hundreds and sometimes even thousands of concepts are used to create XBRL-based financial reports. It is not effective to manually check each and every concept used to make sure the financial report has been represented correctly. While manual effort is required, minimizing that effort will maximize quality. 

If rules exist which explicitly state that the concept “us-gaap:DeferredTaxLiabilitiesNoncurrent” should be a part of noncurrent liabilities and never be part of current liabilities, then that task can be automated. This is the role of class or type relations rules. 

**Reporting Checklist Rules**

Financial reports have certain disclosures that are always required. For example, a balance sheet is always required. Same for an income statement, cash flow statement, and statement of changes in equity. A statement of comprehensive income might be required. Certain
disclosures are always required such as the nature of operations, basis of reporting, significant accounting policies, and revenue recognition policy.

If certain line items are reported; then certain disclosures are required. For example, if the line item “Inventories” appears on the balance sheet, the a disclosure of inventory components and the inventory policy is required.

These statements and disclosures are instantiated within a report in the form of a Block. If machine-readable metadata is provided, then automated machine-based processes can augment the manual effort of professional accountants to check to be sure statutory and regulatory disclosure rules are being complied with.

**Disclosure Mechanics Rules**

Blocks have rules that must be followed depending on the nature of the Block. If a Block is a roll up; you would certainly expect XBRL calculation relations to exist.

If you know what a Block of information is representing, you would understand even more about the character that the Block must take. For example, if you knew that a Block represented an inventory components disclosure; then you would know that:

- The Block is a roll up because an inventory components disclosure is a roll up.
- That roll up should, in fact, roll up correctly.
- The Block, being a roll up, has a total concept and that total concept is most probably going to be the concept “us-gaap:InventoryNet” should you be reporting using US GAAP or “ifrs-full:Inventories” if you are reporting using IFRS. There may be other alternative concepts but those alternatives should be knowable to you.
- The Block, being an inventory components disclosure, will likely be accompanied by an inventory policy disclosure, a Level 2 Policy Text Block. Further, it is highly likely, but not necessarily the case, that a Level 1 Note Text Block for the full inventory disclosure will be somewhere in the report.

It is these sorts of relations that disclosure mechanics rules automatically verifies to be correct or incorrect based on the machine-readable rules that are available to assist the software application.

**Consistency Cross Check Rules**

Consider the following situation. A report was created and the concept “us-gaap:OperatingExpenses” which relates to indirect operating expenses was used erroneously to represent the line item “Total cost of revenues”. How would an automated software process find that error?
If consistency cross check rules are implemented by software applications and the metadata is provided that states what the consistency rules are; then automated software processes can find this inconsistency. This is in essence how the quarterly quality checks\textsuperscript{29} that I run work.

Relying on manual checks to make sure this sort error does not exist in a report is obviously not going to work. Today, about 10\% of all reports have such an error.

A similar type of error\textsuperscript{30} is when a concept is use within one Block to represent a line item and then that concept contradicts or conflicts with another Block of a report that contains information.

**Complex Structures are Really Groups of Simple Structures**

Consider the set of three Blocks below which make up an income statement\textsuperscript{31}:


\textsuperscript{30} If you want to better understand these types of errors, see these high-quality examples of errors that exist in XBRL-based reports submitted to the SEC, http://xbrl.squarespace.com/journal/2017/4/29/high-quality-examples-of-errors-in-xbrl-based-financial-repo.html

\textsuperscript{31} Microsoft, Income statement, http://www.xbrlsite.com/2017/Prototypes/Microsoft/evidence-package/#Rendering-StatementINCOMESTATMENTS-us_gaap_StatementTable.html
There are three Blocks. The first Block is a roll up of “Net income”. The second Block is a hierarchy (or set) that represents a summary of earnings per share. The third Block is a hierarchy (or set) that represents a summary of weighted average shares outstanding.

Could have this information been presented in different manners? Sure. Could this information been represented in a different manner? Could the meaning of the information have been different simply based on the preferences of the creator of the representation? Certainly not.

Blocks are about the objective representation of information, not about subjective and perhaps even arbitrary presentation choices which are consciously or sometimes even unconsciously made by accountants. Blocks are about structural rules, mechanical rules, mathematical rules, logical rules, and certain accounting rules that are all objective and not open for debate. That leaves the judgement to the professional accountants, hiding the technical details that they do
not care about and should not have to concern themselves with to the software application to deal with.

If these ideas are discussed with a professional accountant, care needs to be taken to be sure that you are having the right discussion. The typical professional account will make the statement that everything within a financial report is subject to professional judgement which is simply not true. Professional accountants get no latitude as to whether a roll up should roll up, if a roll forward should roll forward or if a balance sheet balances. This logic is universal and to which all domains, even the domain of accounting, must subscribe. If explained to professional accountants correctly, the vast majority will concur with these ideas. Proof of this is that the vast majority of information reported within an XBRL-based report subscribes to these ideas.

**Blocks have Slots**

Blocks have “slots”. A Slot is simply a place in a Block where it makes logical sense for new objects to be added to the Block. Different types of Blocks have different slots. Below you can see one Block, showing two Slots for that Block. One Slot is that a new Line Item can be added within the roll up total. Or, a second Slot is that a new period can be added to the Block.

![Blocks have Slots](image)

This is not a comprehensive discussion of Slots, it only provides the general ideas of what a Slot is, and that a financial report can be broken down into a set of Blocks each of which has specific Slots.

**Types of Blocks**

The following is a list of commonly occurring Block patterns.
**Text Block**

The most common form of Block is the Text Block which makes up over half of the reported facts within an XBRL instance. This is a Text Block:

<table>
<thead>
<tr>
<th>Components of Inventories</th>
<th>Period (Acs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2016-07-01 - 2017-06-30</td>
</tr>
<tr>
<td>Raw materials</td>
<td>$797</td>
</tr>
<tr>
<td>Work in process</td>
<td>145</td>
</tr>
<tr>
<td>Finished goods</td>
<td>1,239</td>
</tr>
<tr>
<td>Total</td>
<td>$2,181</td>
</tr>
</tbody>
</table>

There are three categories of Text Blocks: Level 1 Note Text Block, Level 2 Policy Text Block, and Level 3 Disclosure Text Block. All Text Blocks are similar in that they contain prose, essentially formatted text.

Essentially, a Text Block or any kind is a Block that has exactly one concept, the Text Block concept.

**Hierarchy or Set**

The Hierarchy or Set is simply some set of one to many concepts, other than Text Blocks, that conveys information that goes together for some reason or other.

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33 Text Blocks in reports submitted to the SEC are a specifically prescribed form of escaped HTML.


35 I don’t like the term “Hierarchy”, because essentially all of the Block patterns are hierarchies of some sort. The term “Set” is a better term. But, there is a lot of legacy information that uses the term Hierarchy. So, the term Set and Hierarchy are basically interchangeable and mean the same thing.
**Roll Up**

The Roll Up is similar to a Set in that it is a set of concepts. What makes a roll up different is that the Set of concepts participates within a roll up relation that is represented by XBRL calculations relations.

<table>
<thead>
<tr>
<th>Inventory [Line Items]</th>
<th>Period [Axis]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2017-06-30</td>
</tr>
<tr>
<td>Raw materials</td>
<td>797,000,000</td>
</tr>
<tr>
<td>Work in process</td>
<td>145,000,000</td>
</tr>
<tr>
<td>Finished goods</td>
<td>1,239,000,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2,181,000,000</td>
</tr>
</tbody>
</table>

A roll up always has exactly one total. A roll up always has XBRL calculation relations. A roll up always has numeric concepts that are of the same period type (i.e. either all instant or all duration). A roll up could aggregate a set of stocks (i.e. balance sheet accounts) or a set of flows (i.e. income statement, net cash flow, etc.).

**Roll Up, Nested**

A nested roll up is exactly the same as a roll up except that the roll up includes one or more subtotals.

<table>
<thead>
<tr>
<th>Property, Plant and Equipment [Line Items]</th>
<th>Period [Axis]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2016-06-30</td>
</tr>
<tr>
<td>Land</td>
<td>824,000,000</td>
</tr>
<tr>
<td>Buildings and improvements</td>
<td>12,393,000,000</td>
</tr>
<tr>
<td>Leasehold improvements</td>
<td>3,659,000,000</td>
</tr>
<tr>
<td>Computer equipment and software</td>
<td>17,391,000,000</td>
</tr>
<tr>
<td>Furniture and equipment</td>
<td>3,889,000,000</td>
</tr>
<tr>
<td><strong>Total, at cost</strong></td>
<td>38,136,000,000</td>
</tr>
<tr>
<td>Accumulated depreciation</td>
<td>(19,800,000,000)</td>
</tr>
<tr>
<td><strong>Total, net</strong></td>
<td>18,356,000,000</td>
</tr>
</tbody>
</table>

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36 Roll up, Microsoft, [http://www.xbrlsite.com/2017/Prototypes/Microsoft/evidence-package/#Rendering-DisclosureComponentsOfInventoriesDetail-us_gaap_InventoryCurrentTable.html](http://www.xbrlsite.com/2017/Prototypes/Microsoft/evidence-package/#Rendering-DisclosureComponentsOfInventoriesDetail-us_gaap_InventoryCurrentTable.html)

37 Roll up, Nested, Microsoft, [http://www.xbrlsite.com/2017/Prototypes/Microsoft/evidence-package/#Rendering-DisclosureComponentsOfPropertyAndEquipmentDetail-us_gaap_ScheduleOfPropertyPlantAndEquipmentTable.html](http://www.xbrlsite.com/2017/Prototypes/Microsoft/evidence-package/#Rendering-DisclosureComponentsOfPropertyAndEquipmentDetail-us_gaap_ScheduleOfPropertyPlantAndEquipmentTable.html)
**Roll Forward**

A roll forward seems similar to a roll up, however they are not the same. A roll forward represents the flows between a stock at two different calendar periods in time. The formula is: **Beginning balance + Changes = Ending Balance.**

<table>
<thead>
<tr>
<th>Income Tax Contingency [Line Items]</th>
<th>Period [Axis]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balance, beginning of year</td>
<td>10,164,000,000</td>
</tr>
<tr>
<td>Decreases related to settlements</td>
<td>(4,000,000)</td>
</tr>
<tr>
<td>Increases for tax positions related to the current year</td>
<td>1,277,000,000</td>
</tr>
<tr>
<td>Increases for tax positions related to prior years</td>
<td>357,000,000</td>
</tr>
<tr>
<td>Decreases for tax positions related to prior years</td>
<td>(49,000,000)</td>
</tr>
<tr>
<td>Decreases due to lapsed statutes of limitations</td>
<td>(48,000,000)</td>
</tr>
<tr>
<td>Balance, end of year</td>
<td>11,727,000,000</td>
</tr>
</tbody>
</table>

Roll forwards always have an instant concept with a period start preferred label role, the same instant concept at some future point in time with a period end preferred label role, and then some set of one to many changes. Another term for roll forward is “movements” or “movements analysis”.

**Member Aggregation**

A member aggregation is exactly the same logically as a roll up. However, a member aggregation is different than a roll up in that the syntax used to represent the roll up is different. In a roll up, the line items being rolled up are a set of concepts. In a member aggregation, however, there is one concept that is used to represent all of the members and members are differentiated from one another using an Axis.

**Roll Up + Member Aggregation**

A roll up can be combined with a member aggregation which then has the roll up + member aggregation pattern as is shown here:

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40 Roll up + Member aggregation, comparison, [http://www.xbrlsite.com/site1/2017/Prototypes/DisclosureAnalysis/All/Index_1271_Consistent.html](http://www.xbrlsite.com/site1/2017/Prototypes/DisclosureAnalysis/All/Index_1271_Consistent.html)
Roll Forward + Member Aggregation

A roll forward can likewise be combined with a member aggregation which then has a roll forward + member aggregation pattern which is shown here:

Adjustment

An adjustment looks similar to a roll up or a roll forward, however, the logic of the mathematical computation is completely different. An adjustment has the formula logic: Originally stated balance + changes = Restated balance. The following shows an example.

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41 Roll forward + member aggregation, comparison, http://www.xbrlsite.com/site1/2017/Prototypes/DisclosureAnalysis/All/Index_225_Consistent.html

Adjustments are relatively rare in financial reports. They can typically occur when there is a correction of an error or a change in equity related to an accounting policy change.

**Variance**

A variance looks similar to a member aggregation, however the business logic is different. The formula logic for a variance is: Budgeted amount + Variance = Actual. There can be other members used besides budgeted; what is common is the use of a reporting scheme.

**Hierarchy + Members But Without Aggregation**

Below you see a disclosure of payments to benefit plans. Members are used to distinguish one category of plans from another however there is no aggregation involved in the representation.

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44 Hierarchy + Members but without aggregation, comparison, [http://www.xbrlsite.com/site1/2017/Prototypes/DisclosureAnalysis/All/Index_285_Consistent.html](http://www.xbrlsite.com/site1/2017/Prototypes/DisclosureAnalysis/All/Index_285_Consistent.html)
**Roll Forward Info**

A roll forward info might look similar to a roll forward, but there is a difference. A roll forward actually has a roll forward computation. A roll forward info has no roll forward computation, it only conveys information about a roll forward. A good example is the roll forward of shares for a share based payment award with supplemental information provided for the weighted average stock price for each flow.

**Other Block Patterns**

As mentioned, testing of the approximately 754,430 Blocks in the set of 5,734 public company financial reports that have been submitted to the SEC, 100% of those Blocks fit into this model. However, errors could exist in the model. The error that could be occurring is that there is some other identifiable pattern or patterns which are not listed in this set of identified Block patterns. The resolution to this error would simply be to add a new Block pattern or patterns.

This is not a matter of opinion, this is 100% provable using the evidence of the financial reports themselves. When the new Block patterns are added, then the model becomes 100% correct once again.

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45 Roll forward info, Microsoft, [http://www.xbrlsite.com/2017/Prototypes/Microsoft/evidence-package/#Rendering-DisclosureStockPlanActivityDetail-us_gaap_ScheduleOfShareBasedCompensationArrangementsByShareBasedPaymentAwardTable.html](http://www.xbrlsite.com/2017/Prototypes/Microsoft/evidence-package/#Rendering-DisclosureStockPlanActivityDetail-us_gaap_ScheduleOfShareBasedCompensationArrangementsByShareBasedPaymentAwardTable.html)
Disclosures
A disclosure is simply some set of information that is disclosed within a report. A disclosure is made up of one or many Blocks.

For example, a balance sheet is made up of two blocks:

1. A roll up of “Assets”
2. A roll up of “Liabilities and Equity”

Similarly, every other disclosure can be explained using that idea that disclosures are made up of sets of Blocks. The document Disclosure Best Practices\(^{46}\) provides detailed information related to about 65 disclosures.

Note that an important idea here is that each Disclosure is given a name\(^{47}\). Providing names allows for specific disclosures to be referred to, things to be connected to disclosures, and other such benefits.

Templates
A Template is an instance of a Disclosure that can be used for creating a report. Similar to how a template might be used in PowerPoint to create a presentation; Templates can be used to create financial reports\(^{48}\).


Exemplars

What does the term CPA stand for? Some say that the term stands for “Copy, Paste, Adjust” meaning that the way an accountant creates a report is by taking a piece from another report that is similar, adjusting that report, essentially using that existing report as a template or model for a disclosure which you might need to create.

Given that XBRL-based reports are machine readable, that means that any of the, say, approximately 6,000 10-Ks submitted by companies to the SEC can be automatically read, you find the disclosure that you want to borrow (i.e. use as a starting point for your disclosure), and then automatically imported into your software application that is used to create financial reports.

I created a prototype of breaking the Microsoft 10-K for 2017 into the approximately 127 Networks that made up that report 49. I used the same software code to extract information across reports, grabbing about 38 balance sheets 50.

Exemplars provide both human readable versions 51 that can be scanned to help you find the disclosure that you desire manually; or using machine readable 52 versions of pointers to the Exemplars and the Exemplar itself so that it can be imported into your software application.

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49 Microsoft Report Components, [http://xbrlsite.azurewebsites.net/2016/Prototype/msft/rss.xml](http://xbrlsite.azurewebsites.net/2016/Prototype/msft/rss.xml)
50 Balance sheet Components, [http://xbrlsite.azurewebsites.net/2016/Prototype/BalanceSheet/rss.xml](http://xbrlsite.azurewebsites.net/2016/Prototype/BalanceSheet/rss.xml)
Topics
Because there are lots and lots of possible disclosures, probably between 1,000 and maybe up to perhaps 5,000, you will want a way of organizing the Disclosures. That is where Topics come in. You can organize disclosures into whatever hierarchy you might find desirable. Every company could have their own organization, including or excluding whatever disclosures they want or including/excluding entire libraries of disclosures.
Framework for Creating Metadata for Any Reporting Scheme

While it may be interesting to see the human-readable and machine-readable organizations for US GAAP\textsuperscript{53}, IFRS\textsuperscript{54}, and what I call the XASB\textsuperscript{55} reporting scheme even though the entire set of disclosures is not provided as of yet; what is more interesting is to recognize that this is really a framework for organizing information to make automating work possible. To get a fuller appreciation for what you see, try the human-readable examples\textsuperscript{56} for most all of what can be

\textsuperscript{54} IFRS machine readable metadata, http://xbrlsite.azurewebsites.net/2018/Prototypes/ModernFinancePlatform/ModernFinancePlatform_Web_IFRS.pdf
\textsuperscript{55} XASB machine readable metadata, http://xbrlsite.azurewebsites.net/2018/Prototypes/ModernFinancePlatform/ModernFinancePlatform_Web_XASB.pdf
Quality

Engineer and statistician W. Edwards Deming defined quality as “predictability,” and called variance “the enemy of quality.” To achieve an intended outcome, Deming thought it was important to plan for common-cause variation, which can be predicted, and special-cause variation, which cannot be predicted.

Harold F. Dodge, one of the principal architects of the science of statistical quality control, said, “You cannot inspect quality into a product.” In other words, once the inspection takes place, it’s

too late. Rather, data from the quality inspection needs to be utilized to continually improve the process.

Management consultant Joseph Juran, who focused on management training and the human element of quality control for a variety of businesses, stated that quality is “a fitness for use.” Businessman Philip B. Crosby, who developed the concept of Zero Defects while working as senior quality engineer at aircraft manufacturer The Martin Company, defined quality as “a conformance to requirements.” He warned against the high cost of nonconformance and said that the desired performance standard of zero defects could only be achieved through the proper management system.

The philosophies, processes, and techniques of Lean Six Sigma can be effectively applied to controlling the quality of XBRL-based financial reports. Lean Six Sigma is a discipline that combines the problem solving methodologies and quality enhancement techniques of Six Sigma with the process improvement tools and efficiency concepts of Lean Manufacturing. Born in the manufacturing sector, Lean Six Sigma works to produce products and services in a way that meets consumer demand without creating wasted time, money and resources.

Conclusion
Microsoft Word, supplemented by Microsoft Excel, is used to create 85% of all financial reports as I understand it. That is a problem because neither of those applications understands anything about financial reports. This is part of the reason that the last mile of finance is so inefficient.

There are alternatives. The painful, gruesome, grueling, barbaric practices, processes, and procedures that are used to create financial reports can be modernized.

Acknowledgements
Most of the ideas in this document come from discussions and feedback that I received over the past 15 or so years from many, many colleagues who are too numerous to list here. That input was critical to shaping the thoughts expressed in this document. Thank you to the entire XBRL community!

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