Toward an Intuitive HS: Addressing Structural and Semantic Impediments to Easy, Accurate HS Classification

Randy Rotchin and Vanessa Girouard

Introduction

Established in 1999, 3CE Technologies is a private, software development company based in Montreal, Canada. We are focused exclusively on solving the problems of HS complexity and unacceptably high error rates in commodity classification.

Our commodity classification assistance tool – eponymously called "3CE" – is recognized for its prodigious ability to read and understand everyday commercial commodity descriptions, intelligently and intuitively interact with users to resolve ambiguity and underspecification, and reason its way through classification process.

3CE has been adopted by a variety of private and public sector organizations worldwide, including the United States Department of Commerce, the European Commission, Canada Post Corporation, Singapore Customs, FedEx, Deloitte, and Walmart.

In 2016, 3CE (marketed commercially by Thomson-Reuters as "Global HS"), was named "Best Content Search and Discovery Solution" by the U.S. Software Information Industry Association.

As software developers, we have approached the Harmonized Commodity Description and Coding System (HS) as a problem (or collection of problems) that need to be solved. Until now, we have devoted little time to imagining how the HS might be improved. Instead, our efforts have been focused on creating software applications that address the Harmonized System's inherent complexity while at the same time, promoting classification accuracy.

We presume that the goal of this conference and the broader endeavour is to democratize the HS by allowing anyone involved in international trade the ability to classify easily and expertly. The ideas presented herein below reflect some of the more challenging aspects of the HS that we have encountered in our effort to develop useful and reliable classification assistance tools, as well as some thoughts on how they might be addressed.

HS-Real World Gap: Structure and Meaning

Perhaps the simplest way of gauging the level of HS complexity is to consider whether or not an HS user needs to have explicit knowledge of where a particular commodity is located in the nomenclature (structure), and/or how it is described in the nomenclature (meaning) in order to easily and accurately classify it. As a general rule, the more the HS reflects a common understanding of the real world, the less explicit HS knowledge is required to classify easily and accurately.

While the current HS offers a kind of representation of the how the real world is organized and expressed, there are many examples of where it diverges considerably.

Examples of structural problems include:

- Juices are not considered beverages (Chapter 22), but as "preparations of vegetables, fruit, nuts or other parts of plants" (Chapter 20);
- Car seats are not parts of a cars (Chapter 87), but articles of furniture (Chapter 94);
- Electric toothbrushes are not actually toothbrushes (Chapter 96), but "Electro-mechanical domestic appliances, with self-contained electric motor, other than vacuum cleaners of heading 85.08. (Chapter 85).

The semantic problem relates to the gap between how products are described by trade and how they are expressed in the HS. The HS's technical expressions are often impenetrable for most people. Examples of the semantic problem include:

Commercial Description	**HS Description**
Computer	Automatic data processing machine
Baby food	Homogenized composite food preparation
Wheelchair	Carriage for disabled persons.
Salad spinner	Centrifuge
Blow drier	Electrothermic hairdressing apparatus

Furthermore, some HS concepts, although explicitly expressed remain vague and are therefore susceptible to subjective interpretation. The expression "for technical uses", for example, is an important qualifier that is used throughout the nomenclature, but is never adequately defined.

Addressing the gaps of common understanding within the HS would help ensure that concepts are clearly defined, mutually exclusive and collectively exhaustive – the ultimate objective of any categorization system. Ideally, HS users should be able to instinctively know which HS section and/or chapter provides for a particular commodity.

<u>Possible Solution: Teasing Apart Designations and Definitions</u>

One approach could involve providing more consistency in defining the various abstract conceptual titles of HS sections, chapters, headings and subheadings. While attributing explicit meanings for such technical terms as "automatic data processing machines" (i.e. definitions - "what they are") seems necessary and self-evident, our cognitive biases allows us take for granted that other, more semantically accessible commodity names such as "juice" and "beverage" (which are more designations of commodities – "what they are called") do not require the same explanatory treatment. It is precisely those *taken-for-granted* commodities that get overlooked and sometimes cause the greatest confusion – either due to insufficient knowledge that such simple concepts can have multiple credible meanings, or because of a lack of a consensus on what semantic boundaries a word may have.

The problem here lies in the inconsistency of HS titles: some HS codes are named after their designation – what they are called in the real world, while others are named after their definition – what they are according to various salient listed characteristics. The consequence is that any HS title that hasn't been endowed with an obvious descriptive indication of what it provides for adds to the likelihood of error.

Ideally, principle definitions should exist for each node of the HS taxonomic tree, and not just for nodes whose nature is not readily evident due to their particularly more conceptual titles.

A possible solution would be to present both the designation and the definition of a concept to the user. For example:

	Designation – "what it is called"	**Definition – "what it is, what characteristics it has"**
Current presentation	(in HS Nomenclature): **84.71 Automatic data processing machines and units thereof; (...)**	(in explanatory notes:) ***automatic data processing machines,*** meaning machines capable of: (i) Storing the processing program or programs and at least the data immediately necessary for the execution of the program; (ii) Being freely programmed in accordance with the requirements of the user; (iii) Performing arithmetical computations specified by the user; and (iv) Executing, without human intervention, a processing program which requires them to modify their execution, by logical decision during the processing run. (B) Automatic data processing machines may be in the form of systems
Suggested presentation (side by side):	**84.71 Computers; (...)**	***84.71 automatic data processing machines,*** meaning machines capable of: (i) Storing the processing program or programs and at least the data immediately necessary for the execution of the program; (ii) Being freely programmed in accordance with the requirements of the user; (iii) Performing arithmetical computations specified by the user; and (iv) Executing, without human intervention, a processing program which requires them to modify their execution, by logical decision during the processing run. (B) Automatic data processing machines may be in the form of systems

This side by side presentation offers a simultaneous view of what the item is called and which commodities count as such item according to a clear, immediately visible list of characteristics. We believe that this could reduce confusion and ambiguity significantly, and thus, raise human understanding and classification accuracy rates.

Cultural Universalization

In a related vein, our ontologists have noted that the HS has a strong Western orientation, particularly North American. This has resulted in an uneven granularity of concepts for certain domains. We have noted that in particular, animals, plants and their products, especially food products, are more affected by this phenomenon. Certain articles of cultural significance, such as ritual, religious and festive items, are also affected by this bias.

Certain fruits, for example, that are wildly popular in several countries outside of, and distant from, North America, are relegated collectively to residual headings and subheadings. Meanwhile, fruits that are more familiar to us in the West, are represented in a more granular and evenly distributed manner. The result is an ensemble view of the fruit commodity inventory that is an uncomfortable demonstration of the Pareto principle: 80% of the Western items are in good view, whereas 80% of the non-Western items are squeezed into 20% of the visual and mental space of the residual codes ("Other").

Figure 1 below shows an extract from the ASEAN Harmonized Tariff Nomenclature (AHTN), which shows that half of the named species of fruit have been relegated to 0810**.90**, and roughly half of those have been relegated to 0810**.90.9_**.

Figure 1 – AHTN Heading 08.10

08.10		**Other fruit, fresh.**	
	0810.10.00	- Strawberries	TNE
	0810.20.00	- Raspberries, blackberries, mulberries and loganberries	TNE
	0810.30.00	- Black, white or red currants and gooseberries	TNE
	0810.40.00	- Cranberries, bilberries and other fruits of the genus *Vaccinium*	TNE
	0810.50.00	- Kiwifruit	TNE
	0810.60.00	- Durians	TNE
	0810.70.00	- Persimmons	TNE
	0810.90	- Other:	
	0810.90.10	- - Longans; Mata Kucing	TNE
	0810.90.20	- - Lychees	TNE
	0810.90.30	- - Rambutan	TNE
	0810.90.40	- - Langsat (Lanzones)	TNE
	0810.90.50	- - Jackfruit (including Cempedak and Nangka)	TNE
	0810.90.60	- - Tamarinds	TNE
	0810.90.70	- - Starfruit	TNE
		- - Other:	
	0810.90.91	- - - Salacca (snake fruit)	TNE
	0810.90.92	- - - Dragon fruit	TNE
	0810.90.93	- - - Sapodilla (ciku fruit)	TNE
	0810.90.94	- - - Pomegranate (*Punica spp.*), soursop or sweetsops (*Annona spp.*), bell fruit (*Syzygium spp., Eugenia spp.*), marian plum (*Bouea spp.*), passion fruit (*Passiflora spp.*), cottonfruit (*Sandoricum spp.*), jujube (*Ziziphus spp.*) and tampoi or rambai (*Baccaurea spp.*)	TNE
	0810.90.99	- - - Other	TNE

Source: Singapore Customs

Some additional consideration could have allowed for a more even distribution of commodities, while at the same time preserving current groupings, ordering of items and granularity at the six-digit level. One possible approach would have been to pre-group all colder-climate berries together under 0810**.0_** as follows:

0810.00 Berries:

- 0810.01 Strawberries
- 0810.02 Raspberries, blackberries, mulberries and loganberries
- 0810.03 Black, white or red currants and gooseberries
- 0810.04 Cranberries, bilberries and other fruit of the genus *Vaccinium*

From a structural perspective, this option liberates subheadings 0810.10, 0810.20, 0810.30, 0810.40, for future, similarly smart grouping of items, freeing up valuable real estate at the fifth- and sixth-digit levels.

Moreover, such changes to the structure of the HS, which leads to a more even repartition of items of variable importance to different economies, will reduce HS complexity.

Multi-dimensionality, Consistency and Exceptions

Addressing Part-Whole Relationships

The current structure of the HS provides for parts in a variety of ways that are not always intuitive. The concept of parts of general use presents particular challenges.

For example, heading 73.20 covers springs and leaves for springs, irrespective of their use, of iron or steel. However, clock or watch springs belong in Heading 91.14, springs for shafts or sticks of umbrellas or sunshades belong in 66.03, springs that are “identifiable parts of machinery” belong in Section XVI, springs that are parts of apparatus and instruments of Chapters 90 or 91 are classified as parts of those articles, etc.

This problem can be attributed in large measure to the fact that the HS is a flat (one-dimensional, or one-faceted) taxonomy, which tries to accommodate articles according to multifaceted criteria (e.g. COMPOSITION and PURPOSE). This happens for any given object-commodity, especially those with a higher level of sophistication such as tools, machines, and parts of machines (and their parts, and the parts of their parts...). As any industrial user of the HS knows all too well, classification becomes more difficult when a specific object's relevance in the human world has the PURPOSE: ASSEMBLE_ANOTHER_OBJECT (as is the case with parts).

Expert systems help manage this complexity by acknowledging and addressing the multi-dimensional structure of commodity classification. Still, the structure of the HS could be made more consistent to reduce complexity and lessen the likelihood of classification error.

Eliminating Exceptions

While acknowledging that commercial considerations and interests have played a major role in determining how commodities should be provided for in the HS, we note that such considerations have often been expressed in the form of crippling exceptions and exclusions.

For instance, articles of cork are provided for under "Chapter 45 – Cork and Articles of Cork". The primary criteria for classification of items in this heading answer the question: "which MATERIAL is this item made of - *cork*" – no secondary criteria asked. While this should be a rather straightforward classification mechanism, not all articles of cork belong to Chapter 45.

Indeed, the chapter notes specify that all items whose PURPOSE is to serve as footwear, headgear, and articles of leisure such as toys, games, sports requisites), should be classified primarily according to the question "which PURPOSE does this item serve?", and then usually according to a set of secondary and additional criteria which may pertain to MATERIAL, or not – sometimes the criteria is a more specialized purpose ("which sport?") or the assembly process (64.01 Waterproof footwear with outer soles and uppers of rubber or of plastics, the uppers of which are neither fixed to the sole nor assembled by stitching, riveting, nailing, screwing, plugging or similar processes.)

We suggest considering an HS taxonomy that attempts to classify all items **primarily** to one unique and unwavering principle, be it MATERIAL ***or*** PURPOSE, the two most common first questions asked when attempting to classify any given commodity. This would make the HS more intuitive and appealing for users, as well as eliminate a significant amount – but not all – of the complexity-augmenting, error-inducing exceptions and exclusions.

HS Application in Practice

There are other impediments to easy and accurate classification. We submit that the following additional topics merit further study and action.

Classification Support - Tools & Training. It is widely accepted that there is no substitute for training and education. However, only a tiny fraction of those involved in cross-border trade get sufficient (if any) HS training. Government training initiatives are constrained by the availability of funding. Private sector stakeholders invest in training only if the return on their investment is both measurable and positive.

It has become widely accepted that wherever training is lacking, technology must fill-in. It is therefore imperative that authoritative bodies play an active role in assessing technology-based HS classification assistance tools for their suitability. In our experience, the single greatest contributor to HS classification errors is a reliance by insufficiently-trained individuals on inappropriate tools. Despite being the first and most important step in the declaratory process, HS classification is almost always an afterthought in Trade Portals, Electronic Single Windows, and Customs Systems.

Tools that adhere to HS principles and are deemed to be reliable should be promoted and endorsed as a complement to training.

Possible Solution: Mapping with Other Taxonomic Standards

Another relatively benign approach would be to establish and expand links between HS concepts and other standards (e.g. Taxonomic Serial Numbers, AISI/Steel Designation System, GHS, UN Numbers,

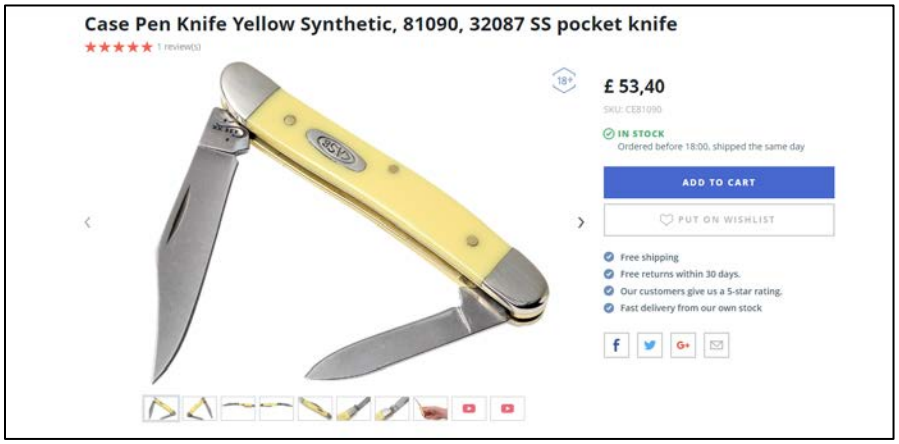
etc.). These documents, while more specific in scope, and of an explanatory span more limited to a particular industry or chapter of the HS, they provide more concrete examples of the very real commodities we are trying to untangle.

Ensuring and Enforcing Consistent Application of the HS.

We often come across instances where a national breakout does not respect the universal HS nomenclature.

For example, the ASEAN Harmonized Tariff Nomenclature explicitly provides for certain folding/moving blade knives under AHTN subheading 8211.92.91. The problem is, its universal HS parent code, 8211.92 clearly provides for "Other knives having fixed blades". Blades with folding/moving blades (i.e. "flick knives and spring knives" and pen knives with blades of 15 cm or more in length") are properly classified under 8211.93, which provides for "Knives having other than fixed blades" (see Figures 2 and 3, below).

Fig. 2 – "Penknife" has "Other than fixed blade".



Source: https://www.knivesandtools.com

Fig. 3 – AHTN heading 82.11

82.11		**Knives with cutting blades, serrated or not (including pruning knives), other than knives of heading 82.08, and blades therefor.**	
	8211.10.00	- Sets of assorted articles	TEN
		- Other:	
	8211.91.00	- - Table knives having fixed blades	TEN
	8211.92	- - Other knives having fixed blades:	
	8211.92.50	- - - Of a kind used for agriculture, horticulture or forestry	TEN
		- - - Other:	
	8211.92.91	- - - - Flick knives or spring knives; hunting knives, diving knives and scouts' knives; penknives with blades of 15 cm or more in length	TEN
	8211.92.99	- - - - Other	TEN
	8211.93	- - Knives having other than fixed blades:	
		- - - Of a kind used for agriculture, horticulture or forestry:	
	8211.93.21	- - - - With handle of base metal	TEN
	8211.93.29	- - - - Other	TEN
	8211.93.90	- - - Other	TEN
	8211.94	- - Blades:	
	8211.94.10	- - - For knives of a kind used for agriculture, horticulture or forestry	TEN
	8211.94.90	- - - Other	TEN
	8211.95.00	- - Handles of base metal	TEN

Source: Singapore Customs

We have found similar problems in the tariff schedules of almost every country we have worked with. In one case, we compared a country's official customs tariff schedule with the tariff tables in the Authority's ASYCUDA System and found more than 1000 discrepancies.

The consequences of divergent nomenclatures have wide ranging negative effects on a host of areas including border and fiscal compliance, targeting and risk assessment and policy development.

It goes without saying that signatories to the HS Convention should be required to ensure that their national nomenclatures align with the universal HS.

Conclusion

We acknowledge that the classification process can be difficult (particularly for non-experts), however, we do not believe there is anything fundamentally wrong with the HS. Some suggestions presented herein above, such as broadening training, promoting advance tools, expanding links with other standards, and ensuring consistent application of the HS globally, should be relatively straight-forward and easy to achieve. The process of addressing the structural and semantic aspects of the HS will require much more dialogue and consideration. We are confident that this project will contribute greatly to a revitalized HS, whose usage will be more accessible to the average user and whose results will be exponentially more accurate.

Contact

For additional information, please contact the authors:

Randy Rotchin
President and CEO
3CE Technologies, Inc.

Vanessa Girouard
Ontologist and Linguist
3CE Technologies, Inc.

T: +1 (514) 737-1500 ext. 235
E: rrotchin@3ce.com