A Comparative Analysis of Product Classification in Public vs. Private e-Procurement

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Abstract: Product classification is an important tool for automating e-Procurement processes in the private sector, whereas public e-Procurement does not emphasize this function. This paper reports on the methodology and results of a comparative analysis of product classification in public vs. private e-Procurement. We define criteria for assessing the current state of respective standards, such as CPV, eCl@ss, and UNSPSC. The in-depth analysis of two representative standards reveals fundamental differences and shortcomings, which can partly be attributed to different objectives and priorities of public and private sector organizations.

Keywords: CPV, e-Procurement, Interoperability, Standardization

1. Introduction

There is a growing consensus that e-Procurement is the single most important area of development in the B2B e-commerce arena (Neef 2001). Within a public sector context e-Procurement has been widely embraced by governments seeking the administrative and cost reductions experienced in the private sector. As a result a number of 'proven' private sector e-Procurement solutions such as e-marketplaces, desktop purchasing systems, and tendering platforms have been employed by various public sector organizations. However, public e-Procurement differs from the private sector in various aspects mainly because of its economic and social considerations (Maniatopoulos 2004; Tonkin 2003; Zulfiqar et al. 2001). These differences result in a number of specific regulations and standards that have been developed for public e-Procurement. One group of these standards addresses how to classify and describe products and services being the object of all procurement activities. While standards for product classification play an important role for establishing a shared and common understanding of a product domain, there is still no over-arching standard for both public and private e-Procurement nor do competitive standards in these two sectors agree on common concepts, exchange formats, data models, standardization processes, and intellectual property rights that could all contribute to semantic interoperability.

A key instrument for achieving a common product understanding in business-to-business e-Commerce is classification by standard product classification schemes (standard PCS), such as UNSPSC, eCl@ss, and GPC. This major trend, though, is yet not fully reflected in public e-Procurement and its respective European standard, the Common Procurement Vocabulary (CPV). Looking at recent developments in private e-Procurement, we see considerable efforts to automating processes based on aligned, thus standardized descriptions of products and services. These efforts aim also at enhancing the coverage of domains, semantic richness, and formal precision of these schemes. In face of these developments, this paper reports on the methodology and results of a comparative analysis of product classification and respective standards in public vs. private e-Procurement. Based on a literature review, we define criteria for assessing the current state of product classification standards. The in-depth analysis of two representative standards may reveal fundamental differences and shortcomings with private sector standards being more advanced.

Drawing conclusions from the results should bear in mind different objectives and priorities between private and public sector organizations. Product classification in the public sector is primarily an instrument for tendering processes and inter-organizational spend analysis whereas classification in private e-Procurement refers to e-Ordering processes and intra-organizational procurement optimization. The work presented here aims at improving the understanding of product classification with regard to both sectors, and may help standards makers in developing extended, closer integrated, or at least harmonized standards, especially for public e-Procurement.

The remainder of our paper is structured as follows. In Section 2, we discuss related work. Section 3 briefly describes the specific notion of public e-Procurement and its differences to private sector e-Procurement. Section 4 introduces

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product classification, and relates it to the expected benefits of e-Procurement by identifying specific contributions. Based on this, the components of product classification schemes can be reconstructed. In Section 5, we emphasize the importance of standards for product classification, both in public and private e-Procurement. Section 6 incorporates the previously discussed aspects by applying a comprehensive set of criteria for evaluating the status quo of existing standard PCS. Finally, in Section 7 we draw conclusions from our findings and point to future avenues of research and standardization work.

2. Related work

Related work to product classification can be found in several fields such as e-Procurement, product data management, and ontology engineering. Next we provide an overview of closely related work and outline their relevance to the matter of public vs. private e-Procurement.

Early work on basic concepts of product classification evaluates standard PCS from a business perspective. For instance, Fairchild and de Vuyst (2002) examined the role of UNSPSC towards benefits of spend analysis.

Recently, the importance of properties as a cornerstone of product classification has been underlined. For instance, Ondracek and Sander (2003) proposed a “property based product classification” from that several, still different classification hierarchies for specific purposes can be built, though they are based on common, thus standardized properties. Kim et al. (2004) developed a “semantic classification model” based on properties in order to enable an in-depth understanding of product classification. All this work is in support of semantically rich PCS that incorporate well-defined properties. However, it is several steps ahead of the current state of PCS for public e-Procurement.

Assessing the content quality of standard PCS is another important subject. Hepp et al. (2005) proposed a comprehensive set of content metrics that reveal characteristics and shortcomings in existing schemes. Their coverage of relevant standard PCS is limited to those for private e-Procurement (eCl@ss, eOTD, RNTD, and UNSPSC). However, the metrics itself are domain-independent, and we use them for our evaluation in Section 6.2.

Schulten et al. (2001) introduced product classification as a reference domain for ontology engineering and the Semantic Web, and called for concentrated efforts to “design a generic model” for automated mapping between two different PCS. Concerning public e-Procurement, this call and its extensive response in the research community (e.g., Beneventano et al. 2004), is also relevant to CPV, because it may help integrating existing industry schemes into CPV, or provide mappings to it. A wealth of research addresses the ontological modeling of these schemes by employing formal languages, especially ontology languages for representing knowledge about products, (e.g., Lee et al. 2005; Hepp 2005). These models are relevant for both sectors, thus provide important foundations for specifying and integrating schemes. An earlier approach based on XML Schema, thus not focused on formals semantics can be found in Leukel et al. (2002).

While a lot of current approaches, concepts and models are technically oriented, and therefore to some degree independent from domains, we have to state that the field of product classification in public e-Procurement and its specific settings are widely neglected in IS literature.

3. Public vs. Private e-Procurement

3.1 Public e-Procurement

In a public sector context, e-Procurement is a collective term for a range of different technologies that can be used to automate the internal and external processes associated with the sourcing and ordering process of goods and services. Across the EU e-Procurement is very much at an evolutionary stage. However, despite the variations in the adoption of e-Procurement across member states, the trend towards its acceptance is strong, with the majority of national governments developing strategies to expedite the implementation of e-Procurement projects. This diversity of government implementations reflects the variety of commercially available *technologies*, *business models*, and *product coding (classification) schemes* (NECCC 2001).

It has been suggested that the public sector is likely to benefit from the use of e-Procurement solutions (Neef 2001). Those benefits are both tangible and measurable with direct or indirect effect on cash flow such as price savings, and intangible such as cultural change and enabling e-Business into public sector. Heywood et al. (2001) proposes that there are three potentially levels of benefit achievable from e-Procurement: *Transactions*, focusing on e-enabling the purchasing process, *strategic sourcing*, using the newly aggregated control information to enable better and cheaper sources of supply, and *market transparency*, facilitating innovation and collaboration across the supply chain.

However, public sector institutions have different objectives towards the implementation of e-Procurement and those cannot be seen simply as extensions of commercial e-Procurement applications because government institutions pursue a wide variety of goals due to their different nature. Within this context the political and legislative environment that public sector institutions operate requires conformity to a range of requirements that have little or nothing to do with economic output (Maniatopoulos 2004).

3.2 Differences between private and public e-Procurement

Unlike procurement in the private sector, public sector procurement requires a bureaucratic procedure to be followed due to the nature of the institutions (Henriksen et al. 2004). A major characteristic of the public sector is the regulation of the procurement process by local, regional, national and international authorities. Regulation embraces "audit, accountability and compliance with national and international rules ensuring competition for supply and transparency in the award of contracts" (NAO 1999). For example, public procurement in the UK must be consistent with EU procurement directives, which provide a framework of rules for the procurement activities. These rules prevent EU member states from distorting competition in public procurement and discriminating on a geographic or nationality basis. Moreover, they facilitate the achievement of value for money for the taxpayer as well as promoting the single European market. In addition, public procurers in the UK must also adhere to the government's Value for Money (VfM) policy. This requires that procurement decisions must be based on an assessment of whole life cost and quality rather than lowest price alone (OGC 2005).

The second priority of the public e-Procurement adoption refers to that of the social responsibility of government through *sustainable* procurement. Sustainable procurement relates all "policy-through-procurement" issues – where public procurement is seen as a lever to achieve wider policy objectives (OGC 2005). These include environmental or "green" issues; the creation of job places and wealth in regeneration areas; opportunities for Small and Medium Enterprises (SMEs) and Ethnic Minority Businesses (EMBs); fair trade and the inclusion of developing countries; adult basic skills; disability, race and gender equality; innovation; and the promotion of ongoing and contestable supplier markets. Policies aimed at meeting social objectives should be legal, transparent and effective within government (NAO 1999).

Undoubtedly government agendas are typically more extensive and complex than those of private organizations where efficiency, cost reduction and time savings are sufficient justifications for e-Procurement adoption (Coulthard and Castleman 2001). The significance of this reality means that one of the first challenges for an e-Procurement policy and standards framework is to recognize that within a public sector context e-Procurement is more complicated than in the private sector. Public e-Procurement represents an on-line environment involving the complex interactivity of public-private, private-private and public-public sectors rather than just a simple interface between government buyers and private sellers. These considerations have the potential to substantially influence the development of government e-Procurement systems as well as its policies, legislation and standards roles. Within this context a main objective of government policy in relation to its interactions with the business and community sectors should be to seek to promote and enhance efficient and affordable connectivity and interoperability.

4. The role of product classification

4.1 Product-related information

Information on the products (and services) to be procured is essential both in e-Sourcing and e-Ordering. This information is critical to making the right procurement decision that incorporates selecting the right supplier and product as well as determining the conditions for the intended contract and order respectively. Therefore, e-Procurement requires information systems that support these decisions. The term product classification and description refers to two basic concepts of product-related information (CEN 2005): First, classification is an instrument to subdivide markets, industry segments, and its belonging products in classes of products. All products belonging to the same class fulfill similar functions and/or share a set of same attributes, thus they are similar or equivalent to each other. Second, product description underlines the importance of more detailed information that represents specific characteristics or functions of the respective product. Moreover, these two concepts complement each other, since the product class determines many parts of the product description. The latter is implemented by defining class-specific *property lists*. Such a property list contains all properties that should be used to describe a product belonging to the respective class.

Taking in mind that product-related information has to be delivered by suppliers, product classification and description must not be seen from the buyer's perspective only. Often suppliers need to meet buy-side requirements concerning product classification and description; this is especially true for buyer-dominated markets. However, e-Procurement has to consider limitations of suppliers' capabilities in fulfilling these requirements as well as supplier-specific interests in classifying and describing products. Based on the consideration that both buyers and suppliers are stakeholders in the same problem, we extend the focus of the following discussion to e-Sales processes being the supplier's view on e-Procurement processes.

The key responsibility for product-related information belongs to suppliers by nature. This information is created, stored, and maintained in enterprise resource planning (ERP) and product data management (PDM) systems. In addition, the product assortment, its structure and the way of describing products depend heavily on strategic goals, competitive advantages, and addressed markets. In the context of e-Procurement, however, the need for *standardization* becomes evident. Only if suppliers and buyers commit to the same way of classifying and describing products, heterogeneities can be aligned and semantic interoperability achieved (Fensel et al. 2001). In that sense, standard PCS aim at fulfilling this role.

4.2 Contributions to e-Procurement

Standardized product classification supports multiple functions that benefit both e-Procurement and e-Sales processes. These functions can be derived from (i) benefits of e-Procurement, mainly related to buyers, (ii) publications by vendors of standard product classification schemes, and (iii) existing literature. Next, we compile the results of a review of these sources (i.e., CEN 2005; eCl@ss e.V. 2004; Fairchild and de Vuyst 2002) by identifying nine contributions:

Hierarchical search: Searching for products often follows a top-down approach by browsing through a hierarchy that leads to the most specific level and finally to instances, thus actual products which are assigned to leaves of the class tree. Hierarchical search can be implemented due to the definition of product classes forming a class hierarchy.

Direct search: This search strategy works directly on class names in order to find associated products. Since the scope of a product class can often hardly be expressed by a single class name, additional keywords aim at improving the direct search (i.e., synonyms, industry-specific terms, colloquial language).

Property-based search: If similar products are associated to the same class and this class comes with a property list, the search for relevant products can be detailed by specifying requirements on the property values. This search strategy is also called parametric search (e.g., find all screwdrivers with handle insulation corresponding to IEC 900, length between 180 and 200 mm, and blade size of 8 mm).

Product specification: Property lists are templates for the description of products. Therefore, it is predefined how to describe a product. Buyers can rely on this information, when it is expected that suppliers stick to the given template, which ensures a standardized product specification.

Product comparison: Based on the preceding contribution, standardized specifications open the ability to compare multiple offerings by the same supplier, and even more important, products of competitive suppliers (multi-supplier catalogs).

Spend analysis: Due to the subdivision of markets, industry segments and its products, all procurement activities are also segmented into these classes. Statistical analysis of procurement spending can be based on the given class hierarchy, if it reflects markets appropriately. Performing spend analysis is often regarded as the most important benefit of a standard PCS, since it is a critical instrument of strategic procurement and already part of conventional reporting in ERP systems. Due to its standardized structure, benchmarking different procurement organizations is enabled as well (e.g., divisions of a global, diversified enterprise).

Process management: Since procurement and sales processes often depend on the product being subject of these processes, product classes can be used to map products to specific ways of executing the respective process. For instance, the responsibility of each purchaser in an organization can be expressed by referring to the class hierarchy. Another example is adding special process steps required when purchasing hazardous materials. The contributions to process management are of high importance for achieving the benefits of desktop (direct) purchasing systems, which are part of e-Ordering; these systems delegate the order process to the individual employee rather the purchasing department, and at the same time automate these processes by reducing the number of process steps and determining the process type based on the product classification scheme.

Description of contracts: Instead of referring to actual products in a procurement contract, the scope of this contract can be described by naming respective product classes, especially those on higher levels of the class hierarchy. Skeleton agreements can make use of this simplified procedure.

Description of assortments: Analogous to describing contracts, suppliers can provide information on their assortment by referring to standardized classes, especially those on higher levels of the class hierarchy. This information can be forwarded to marketplaces that implement PCS-based tools for searching for suppliers.

The described contributions address various needs of e-Sourcing and e-Ordering. For instance, property-based search is only relevant to e-Ordering systems, because the strategic perspective of e-Sourcing does not include decisions of selecting single products. Table 1 determines the relevance of each contribution to e-Sourcing and e-Ordering.

Table 1: Contributions to e-Sourcing and e-Ordering

Contribution	e-Sourcing	e-Ordering
Hierarchical search	No	Yes, implemented in e-Catalogs.
Direct search	No	Yes, implemented in e-Catalogs.
Property-based search	No	Yes, implemented in e-Catalogs.
Product specification	Yes, properties can be used for describing requirements on items of tenders, and for supplier bids.	Yes, implemented in e-Catalogs.
Product comparison	Yes, properties can be used for comparing supplier bids.	Yes, implemented in e-Catalogs, especially multi-supplier e-Catalogs.
Spend analysis	No	Yes, analysis of all orders.
Process management	No	Yes, management of all catalog-based procurement process.
Description of contracts	Yes, supports searching for tenders.	No
Description of assortments	Yes, supports searching for suppliers.	No

4.3 Basic components

The previous discussion revealed significant differences between the contributions of standard PCS to e-Sourcing and e-Ordering. These differences, however, do not imply that two specific PCS (e-Sourcing and e-Ordering) should be used. Contrary, most standard schemes aim at supporting both types of procurement processes. An important question, however, is what are the requirements on schemes that are truly suitable for these applications? From a practical point of view, this question can only be answered by evaluating the content quality, thus the suitability of classes and properties for the respective purpose. Here, we abstract from these domain-specific criteria by limiting our view to the structure, not the content.

We derive the basic, structural components of standard PCS from the previously determined contributions. For instance, hierarchical search requires the existence of a class hierarchy, while property-based search calls for property lists. This procedure can be seen as a reconstruction of the structure of PCS, and results in four components: class hierarchy, keywords to class names, property lists, and uniqueness (real classification). The latter is also a requirement on the classification process; each product has to be assigned to one product class only. Table 2 contains the results by describing the relation between contributions and components

5. Standards for product classification

As stated before, the benefits of product classification and description can only be achieved when suppliers, buyers and all other market participants commit to the same way of classifying and describing products by adhering to a standard PCS. Here the attribute “standard” does not only cover “real” standards created and maintained by standards development organizations, such as ISO, IEC, ANSI, and DIN. Contrary, countless industry-driven, less formal initiatives and consortia have proposed standard schemes for their respective purpose.

In private e-Procurement, the number of standard PCS is still increasing, and the multiplicity of schemes has lead to confusions among suppliers and buyers, since the competition between standards prevents the diffusion of a single standard, and limits expected network externalities (Dhai and Kauffman 2001). This is especially true for horizontal, international standards on which we focus here. In addition, the organizations behind these standards have seen significant changes in their strategic settings, business models, and services for supporting adopters. For instance, several organizations left the market, or were subject of mergers and acquisitions.

Table 2: Relations between basic components and contributions

Contribution	Class Hierarchy	Keywords	Property Lists	Uniqueness
Hierarchical search	X			
Direct search		X		
Property-based search			X	
Product specification			X	
Product comparison			X	
Spend analysis				X
Process management				X
Description of contracts				X
Description of assortments				X

The two most relevant standards as identified in (CEN 2005) are as follows:

- eCl@ss is being developed by a consortium of mainly German companies since the late 1990s (eCl@ss e.V. 2004). It has gained a significant relevance for e-Procurement in Germany and many European countries. A key characteristic are its property library of about 5,525 properties and class-specific property lists for 10,930 product classes.
- UNPSPC, the United Nations Standard for Product and Service Classification, is the most known standard PCS due to its early start under the UN Development Program (UNDP 2005). Its coverage is very broad with 21% of its classes concerning services. Over the past four years, there were multiple changes in the organization that manages the standard. Due to this uncertainty, and partly because of the missing property lists, UNSPSC has lost some of its market share, especially in Europe.

Looking at recent developments in activities by standards makers, the importance of harmonizing existing schemes, committing to basic components and reference data models as well as integrating horizontal with vertical schemes has been emphasized. Another pathway is marked by adding property lists for product description in order to tap the full potential of standard PCS. This way requires even more resources for creating practical, commonly accepted solutions and maintaining these extended schemes. On the other hand, decision makers face on-going changes in standardization processes, organizations, data models, exchange formats, and content; all these changes may cause uncertainty about the future directions in global standard PCS. For instance, the current adoption of the eCl@ss property lists in e-Catalogs is very low compared to the initial goals; therefore, the contributions that require standardized properties can not be fully realized.

In public e-Procurement, the number of standard PCS is much smaller; actually, there is often one standard for each region only. The reason is that the standard is set by the legislative institution in charge of the respective region. The limitation to a single standard can be attributed to the primary purpose of product classification in public procurement, therefore the subdivision of procurement activities for statistical purposes, especially economic statistics. In the EU, the Common Procurement Vocabulary (CPV) has become mandatory for public e-Procurement by Regulation No 2151/2003 (European Commission 2003). CPV is being managed by DG Internal Market of the European Commission, and consists of about 8,000 entries in the vocabulary.

The NATO Codification System (NCS) is another relevant standard (NATO 2005). It is one of the oldest and largest standard PCS in the world, being used in all NATO organizations, and many other countries. In addition, the NCS forms the basis for a database of more than 31 million parts supplied by 1 million suppliers. NCS is interested in offering its standard for purposes outside the military environment, though it remains to be seen if this can be achieved. Due to its restricted adoption for a specific type of organizations, NCS may be seen as a vertical standard, though its coverage is very broad.

The brief comparison reveals some significant differences in the standard setting process for private and public sector standards. In the private sector, it can be described by *competition*, since those standards will prevail that gain the highest acceptance. Contrary to that, public sector standards are the result of *regulation* that necessarily excludes competition.

6. Evaluation of selected standards

6.1 Criteria

Next, we select two standard PCS for a detailed evaluation. All our criteria will address organizational, structural and technical issues only, since we are not able to evaluate the actual content quality and suitability of these standards. Due to their representative status for private and public e-Procurement in Europe, we select eCl@ss and CPV.

The criteria of our evaluation can be subdivided into the following groups:

- Basic components (analogous to Section 4.3): We check which components are implemented in the standards.
- Contributions to e-Procurement and e-Sales (analogous to Section 4.2): We check which contributions are addressed explicitly, and which can be realized due to existing components.
- Supported languages: We check which European languages are supported.
- Content metrics describing the class hierarchy: We perform a comprehensive set of statistical analysis as introduced by Hepp et al. (2005) concerning the class hierarchy. Specifically, we apply the following metrics: (i) size, (ii) speed of growth, (iii) services ratio, (iv) size of segments, (v) variability of segments size, and (vi) segments domination.
- Data model and exchange format: We check the data models and exchange formats for type and quality of documentation based on criteria described by Leukel (2004).
- Standardization Process: We check the transparency of the standardization process and offered services.

6.2 Findings

6.2.1 Basic components and characterization

The main difference between the two schemes is the absence of property lists in CPV (see table 3). The reason behind this lies in the main purpose of CPV, which is to describe the subject of procurement contracts; hence it is not intended to be used for e-Catalogs (in which products are described on a detailed level). In the CPV, the degree of abstraction is much greater, since its product classes are used for describing item within a contract, whereas eCl@ss aims at describing the characteristics of single products. CPV supports buyers and suppliers in the tendering process only, and buyers in performing spend analysis. From a European point of view, the CPV classification code enables participants to bypass existing language barriers. While CPV is available in all 20 official languages of the EU, eCl@ss is restricted to five European languages plus Chinese.

6.2.2 Content metrics

Size: The mere number of classes is often used for standards marketing, but it obscures the true coverage in the various sections; hence counting the number of classes contributes marginally to assessing the content coverage and quality. Here we use this quantitative approach for identifying the hierarchical structure and its underlying rationale. Both class hierarchies are built upon different principles. eCl@ss defines a hierarchy of 4 levels, with 25 top-level classes (segments). The tree is balanced, since all segments and their sub-trees lead down to the lowest, fourth level; leaves on higher levels are not allowed. If a segment requires a higher degree of specialization, thus a fifth level, then the segment has to be divided into two or more segments (the respective sub-tree on the second or third level has to be promoted to a new segment).

Contrary to eCl@ss, CPV builds a non-balanced hierarchy of 2 to 7 levels. For instance, there are four top-level classes with only 1 sub level (e.g., recovered secondary raw materials); hence the degree of specialization in these segments is very low compared to the other 24 segments with 6 sub levels (e.g., construction work with 796 classes). In addition, the class hierarchy is broader (61 vs. 25 segments) covering more markets and industries.

Table 3: Evaluation – Basic components and characterization

Criteria		eCl@ss 5.1	CPV 2003
Basic components	Class hierarchy	Yes	Yes
	Keywords	Yes	No
	Property lists	Yes	No
	Uniqueness	Yes	Yes
Contributions to e-Procurement and e-Sales	Hierarchical search	Yes	Not intended for e-Catalogs
	Direct search	Yes	Not intended for e-Catalogs
	Property-based search	Yes	No

Criteria		eCl@ss 5.1	CPV 2003
	Product specification	Yes	No
	Product comparison	Yes	No
	Spend analysis	Yes	Yes
	Process management	Yes	No
	Description of contracts	Yes	Yes
	Description of assortments	Yes	Yes
Supported languages	Number	6	20
	Languages	chi, deu, eng, fra, ita, spa	All 20 official languages of the EU

Speed of growth: We determine the amount of new classes in the current version compared to previous versions. For a good coverage, any standard requires timely feedback about missing classes from the user community, and a standardization process that makes new elements available in a timely manner. The major difference here is that CPV is almost static with only 1% growth in 6 years. There are different explanations for that, as for example very good coverage already in CPV 1998, missing resources for maintenance, and lack of comments from standards adopters. However, the most important factor is the standards setting process which requires a legislative initiative up to the Commission. Contrary, eCl@ss shows a tremendous growth in number of classes. A steady growth, however, and significant modifications of the class hierarchy may also harm standards adopters, because re-classification of products becomes necessary.

Table 4: Evaluation – Size and speed of growth

Criteria		eCl@ss 5.1	CPV 2003
Size	Number of levels	4	2 to 7
	Number of classes	25,658	8,323
	Balanced tree	Yes	No
	Number of segments (top-level classes)	25	61
	Number of services segments	1	28
	% of services classes	4.1%	30%
	Segments with 1 sub level	-	4
	Segments with 2 sub levels	-	4
	Segments with 3 sub levels	25	7
	Segments with 4 sub levels	-	11
	Segments with 5 sub levels	-	10
	Segments with 6 sub levels	-	24
Speed of growth	Class growth	93% in 2 years 503 % in 5 years	1% in 6 years

Services ratio: The broad coverage of CPV is being reflected in the high number of segments that represent services. Its 28 segments – ranging from diverse domains such as repair, retail, education, transportation, publishing and cultural services – contain 30% of all CPV classes. Comparing CPV and eCl@ss by applying further metrics should bear in the mind this fact, since eCl@ss provides a single segment for services only. Therefore, we restrict the next steps of our statistical analysis to those segments that contain classes for physical goods; hence we remove all services classes from the raw data. Otherwise, the high percentage of services in CPV and the missing equivalents in eCl@ss could distort the results.

Moreover, service classification differs fundamentally from the classification of tangible goods, although existing service classifications from marketing literature fail to demonstrate the configurable nature of services, which is a key characteristic of services (Baida et al. 2005). With regard to product classification schemes, the one-dimensional hierarchical segmentation of services must be seen as insufficient to reflect the complexity of services classification and services configuration.

Table 5: Evaluation – Services ratio

Criteria	eCl@ss 5.1	CPV 2003
Number of segments (top-level classes)	25	61
Number of services segments	1	28
% of services classes	4.1%	30%

Size of segments: Comparing the sheer number of classes in the entire PCS does not necessarily contribute to assessing the coverage of relevant domains. For instance, representing markets based on classes depends on the degree of abstraction, the principles of the class hierarchy, and the use of properties (i.e. specific classes can be replaced by a generic class that describes characteristics by properties). A first indicator of domain coverage and its representation in the class hierarchy is the size of each segment. Here, we determine the number of classes per segment and summarize the results in a bar chart listing all segments ordered by descending number of classes. The resulting chart for CPV illustrates clearly the uneven population of the segments (figure 1). Very similar are the results for eCl@ss (see Hepp et al. 2005).

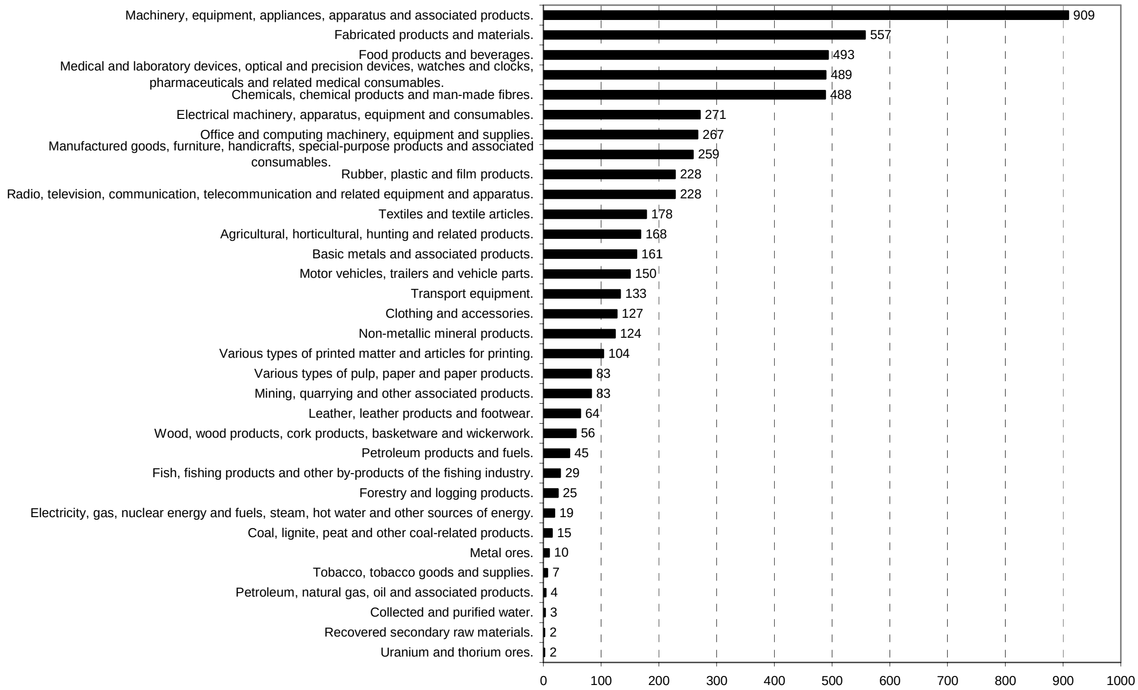

Figure 1: Size of segments in CPV 2003 (without services)

Variability of segments size: The previous metric has revealed that both standard PCS are dominated by a few large segments, whereas other segments are very small. This observation leads to the question whether these schemes are actually balanced standards. We determine the distribution parameters for the data gained in section "size of segments", i.e. the minimal value, maximal value, mean, median, first quartile, third quartile, interquartile range, standard deviation, and the coefficient of variation. The results are shown in table 6.

The schemes show a high variability of segments size with some tiny segments in CPV and huge segments of several thousands of sub-classes in eCl@ss. Therefore, both schemes are actually unbalanced. Comparing the respective metrics for eCl@ss and CPV reveals that the segments in eCl@ss are approximately five times bigger (as indicated primarily by the mean and median as well as by the interquartile range and standard derivation). eCl@ss avoids having very small segments by defining 4 levels with at least two branches for each segment; this would prevent segments of less than 15 classes. Although all absolute metrics show significant differences, the coefficient of variation, which allows comparing distributions that have a different mean, is nearly equal, thus it reveals that the relative variability is quite similar.

Table 6: Evaluation – Variability of segments size

Criteria	**eCl@ss 5.1 without services**	**CPV 2003 without services**
Minimal value	203	2
Maximal value	5,312	909
Mean	1,025	175
Median	673	124
First quartile	412	25
Third quartile	1,244	228
Interquartile range	832	203
Standard derivation	1087	203
Coefficient of variation	106%	116%

Domination of segments: The role of the large segments can be further examined by identifying and quantifying their contribution to the entire scheme. For instance, the percentage of classes in the largest segments indicates whether the standard is a true horizontal one or horizontal just with regard to the existence of top-level classes, but focused quite vertically at the more detailed level. Surprisingly, both schemes are quite unbalanced with regard to the number of classes in the 5 largest segments (eCl@ss: 53.8%, CPV 50.8% of all entries). Looking at these figures (table 7) and the domains of the respective segments, we have to state that eCl@ss is rather focused on the chemical industry. Its five segments covering organic, inorganic chemical products, laboratory supplies, polymers, and additives comprise 40.9% of all classes (CPV: only 9.3%).

In addition, interesting is the order of magnitude between the largest segment and the median. The bigger this ratio, the more the content of the standard is dominated by one single segment; in eCl@ss the largest segment contains nearly eight times more classes than the 'median segment'.

Table 7: Evaluation – Domination of segments

Criteria	**eCl@ss 5.1 without services**	**CPV 2003 without services**
% of classes in the largest segment	21.6%	15.7%
% of classes in the 3 largest segments	40.5%	33.9%
% of classes in the 5 largest segments	53.8%	50.8%
% of classes in segments of the chemical industry	40.9%	9.3%
Largest segment / median of segment size	789%	733%

6.2.3 Data model and exchange format

Both standards do not provide an explicit conceptual data model (table 8), and their underlying data models are not compliant with the ISO 13584 standard for product classification schemes (ISO 2001). The data definitions are supplied in proprietary exchange formats, which are easily processible due to their syntax (comma separated values, Excel spreadsheets). eCl@ss provides a syntax description for its 7 files (needed for property definitions and properties lists). Update information describing modifications in the recent version is available for CPV, while eCl@ss has added this information only recently for the latest release of September 2005 (Service Pack 5.1.1).

Table 8: Evaluation – Data model and exchange format

Criteria		**eCl@ss 5.1**	**CPV 2003**
Data model	Explicit model	(No)	No
	ISO 13584 compliance	No	No
Exchange format	Syntax description	Yes	No
	Format	CSV	XLS
	Number of files	7	1
	Update information	No	Yes

6.2.4 Standardization process

User participation in the standardization process is quite different (table 9). Companies may join the eCl@ss organization formally, a number of industry associations are involved in the definition of consensual classes and properties, and any individual or company is asked to submit change requests. On the other hand, CPV's transparency regarding the standardization process is very low.

Table 9: Evaluation – Standardization process

Criteria	**eCl@ss 5.1**	**CPV 2003**
Transparency: Organization	Yes	No
User participation	Membership, Industry Associations	No
Change requests	Yes	No

7. Conclusions

A driving force for e-Government in general has been the idea of bringing successful private sector ICT solutions and respective business practice to the public sector in order to reduce costs and improve services. This approach was also taken in public e-Procurement by employing e-marketplaces, desktop purchasing systems, and tendering platforms for conducting procurement processes. However, public e-Procurement differs from the private sector in various aspects mainly because of its economic and social responsibilities. These differences result in a number of specific policy and standards frameworks that have been developed for public e-Procurement. This paper provides arguments for the existing gap between private and public e-Procurement concerning product classification. In particular this study reported on the methodology and results of a comparative analysis of product classification in public vs. private e-Procurement. In doing so we developed criteria for comparing the contributions of product classification and description between private and public e-Procurement. For this comparison we choose eCl@ss and CPV as the two most representative schemes. The in-depth analysis of both schemes revealed fundamental differences with regard to basic components, content metrics, and standardization process. Those differences can partly be attributed to the heterogeneity of objectives between private and public e-Procurement. Within a public sector context CPV is still an instrument for spend analysis and tendering processes whereas classification in private e-Procurement is directed at e-Ordering based on e-Catalogs.

Moreover the comparison between eCl@ss and CPV revealed some shortcomings of CPV. Concerning the structural components, eCl@ss must be regarded as a forerunner. Its property library is often regarded as a competitive advantage. However, the current adoption of the eCl@ss property lists in e-Catalogs is rather low, since describing product by standardized properties requires additional efforts, especially for suppliers. Recently, eCl@ss has received a funding by the Federal Ministry of Economy and Labor of Germany towards its wider adoption. The Government has acknowledged the importance of eCl@ss, because it is critical to the success of German companies in conducting e-Business on an international level. In addition, eCl@ss has announced to strengthen its efforts in becoming one of the highly visible standards.

The results of our analysis show that standards for private e-Procurement are moving ahead. The respective industry consortia invest significant resources for creating and maintaining these schemes. Product innovation appears in almost all industries, thus continuous monitoring of markets and adjusting current standards is necessary. Due to these challenges, the need for harmonizing existing standards has become evident. Therefore, several initiatives towards integrated classification standards have been started over the past two years. For instance, a number of consortia and standardization bodies have joined forces in a respective CEN/ISSS project (CEN 2005).

In private e-Procurement, the vision to arrive at a universal PCS, as it is still assumed by CPV, does not exist anymore. Rather standards adopters often participate in private and public e-procurement, thus suppliers, intermediaries and ICT solution providers that act in both markets face another important problem: They need to know public e-Procurement practice and rules for classification in addition to those in private environments. In this context one of the first challenges for an e-procurement policy and standards framework is that of harmonizing the processes for public and private e-Procurement. Government bodies could learn lessons from recent developments in private e-Procurement, and aim at cooperating closer with standards makers in private sector. This collaboration could help standards adopters (government bodies, private organizations) to enhance efficient and affordable connectivity and interoperability, lowering barriers to market entry. The work presented in this paper aims at encouraging this partnership, helping standards makers in developing extended, closer integrated, harmonized standards, between private and public e-procurement.

References

Baida, Z., Akkermans, H. and Gordijn, J. (2005) “Service Classification vs. Service Configuration”, *Proceedings of INFORMATIK 2005,* Vol. 2, Workshop on Product-related Data in Information Systems (PRODIS 2005), GI, pp464-468.

Beneventano, D. et al. (2004) “A Web Service based framework for the semantic mapping amongst product classification”, *Journal of Electronic Commerce Research*, Vol 5, No. 2, pp114-127.

CEN (2005) “CEN Workshop Agreement – Dictionary of Terminology for Product Classification and Description”, Brussels, Belgium, [online], http://www.cenorm.be/cenorm/businessdomains/ businessdomains/isss

Coulthard, D. and Castleman, T. (2001) “Electronic Procurement in Government: More Complicated than Just Good Business”, *Proceedings of the 9th European Conference on Information Systems (ECIS 2001)*, AIS, pp999-1009.

Dhai, Q. and Kauffman, R.J. (2001) “Business Models for Internet based E-Procurement Systems and B2B Electronic Markets: An Exploratory Assessment”, *Proceedings of the 34th Hawaii International Conference on System Sciences (HICSS-34)*, IEEE Computer Society, p7004.

eCl@ss e.V. (2004) "eCl@ss – Standardized Material and Service Classification", Version 5.1, [online], http://www.eclass-online.com

European Commission (2003) "Commission Regulation (EC) No 2151/2003 of 16 December 2003 amending Regulation (EC) No 2195/2002 of the European Parliament and of the Council on the Common Procurement Vocabulary (CPV)", *Official Journal of the European Union*, Vol 46, L 329.

Fairchild, A. M. and de Vuyst, B. (2002) "Coding Standards Benefiting Product and Service Information in ECommerce", *Proceedings of the 35th Hawaii International Conference on System Sciences (HICSS-35)*, IEEE Computer Society, pp258b.

Fensel, D. et al. (2001) "Product Data Integration in B2B E-Commerce", *IEEE Intelligent Systems*, Vol 16, No. 4, pp54-59.

Henriksen, H.Z., Mahnke, V. and Hansen, J.M. (2004) "Public eProcurement adoption: Economic and political rationality", *Proceedings of the 37th Hawaii International Conference on System Sciences (HICSS-37)*, IEEE Computer Society, p50124c.

Hepp, M. (2005) "A Methodology for Deriving OWL Ontologies from Products and Services Categorization Standards", *Proceedings of the 13th European Conference on Information Systems (ECIS 2005)*, AIS, pp1-12.

Hepp, M., Leukel, J. and Schmitz, V. (2005): "A Quantitative Analysis of eCl@ss, UNSPSC, eOTD, and RNTD: Content, Coverage, and Maintenance", *Proceedings of the IEEE International Conference on e-Business Engineering (ICEBE 2005)*, IEEE Computer Society, pp572-581.

Heywood, J.B, Barton, M. and Heywood, C. (2001) *E-Procurement: A Guide to Successful E-Procurement Implementation*, Financial Times Prentice Hall.

ISO (2001) "ISO 13584-1 Industrial automation systems integration – Parts library – Part 1: Overview and fundamental principles", Geneva, Switzerland.

Kim, D., Lee., S., Chun, J. and Lee, J. (2004) "A Semantic Classification Model for e-Catalogs", *Proceedings of the 2004 IEEE International Conference on E-Commerce Technology (CEC 2004)*, IEEE Computer Society, pp88-92.

Lee, H., Shim, J. and Kim, D. (2005) "Ontological Modeling of e-Catalogs using EER and Description Logic", *Proceedings of the International Workshop on Data Engineering Issues in E-Commerce (DEEC 2005)*, IEEE Computer Society, pp125-131.

Leukel, J., Schmitz, V. and Dorloff, F.-D. (2002) "A Modeling Approach for Product Classification Systems", *Proceedings of the 13th International Workshop on Database and Expert Systems Applications (DEXA 2002)*, IEEE Computer Society, pp868-874.

Leukel, J. (2004) "Standardization of Product Ontologies in B2B Relationships – On the Role of ISO 13584", *Proceedings of the 10th Americas Conference on Information Systems (AMCIS 2004)*, AIS, pp4084-4091.

Maniatopoulos, G. (2004) "Enacting E-Procurement Technologies within UK Local Authorities", *Proceedings of the IADIS International Conference e-Society 2004 (ES 2004)*, Vol 2, IADIS Press, pp850-854.

National Audit Office (NAO), (1999) "Modernizing Procurement", HC 808 Session 1998-99: 20 October 1999, [online], http://www.nao.gov.uk/publications

NATO (2005) "NATO Codification System (NCS)", [online], http://www.nato.int/structur/AC/135

NECCC (2001) "Is the Lack of E-Procurement Standards a Barrier to Implementation? A Government and Supplier Perspective", *National Electronic Commerce Coordinating Council Symposium 2001*, Las Vegas, Nevada.

Neef, D. (2001) *E-Procurement: From Strategy to Implementation*, Financial Times Prentice Hall.

OGC (2005) *Sustainable Procurement and Procurement Efficiency Implementation*, Office of Government Commerce, [online], http://www.ogc.gov.uk

Ondracek, N. and Sander, S. (2003) "Concepts and benefits of the german ISO 13584-compliant online dictionary www.DINsml.net", *Proceedings of the 10th ISPE International Conference on Concurrent Engineering (CE 2003)*, Balkema Publishers, pp255-262.

Scholl, H. J. (2003) "E-government: A Special Case of ICT-enabled Business Process Change", *Proceedings of the 36th Hawaii International Conference on System Sciences (HICSS-36)*, IEEE Computer Society, pp136.2

Schulten, E. et al. (2001) "The E-Commerce Product Classification Challenge", *IEEE Intelligent Systems*, Vol 16, No. 4, pp86-89.

Stahl, B. C. (2005) "The Paradigm of E-Commerce in E-Government and E-Democracy" in *Electronic Government Strategies and Implementation*, Wayne Huang, Keng Siau & Kwok Kee Wei (Eds), Idea Group Publishing, Hershey PA, pp1-19.

Tonkin, C. (2003) "e-Procurement in the Public Sector: Story, Myth and Legend", The Policy Institute, Trinity College Dublin.

UNDP (2005) "United Nations Standard Products and Services Code (UNSPSC)", V.8.0401, [online], http://www.unspsc.org

Zulfiqar, K. A. et al. (2001) "E-Government: An Exploratory Study of On-line Electronic Procurement Systems", *Proceedings of the 9th European Conference on Information Systems (ECIS 2001)*, AIS, pp1010-1022.