
Basic Product Data in E-Commerce: Specifications and Problems of Data Exchange

Submitted 30/09/21, 1st revision 16/10/21, 2nd revision 10/11/21, accepted 13/12/21

Maciej Niemir¹, Beata Mrugalska²

Abstract:

Purpose: This paper summarizes and compares the types and interpretations of the basic attributes necessary to enter product data in selected e-commerce platforms.

Design/Methodology/Approach: The research methodology was based on an analysis and selection of a reference group of basic product attributes and identification of appropriate market representatives, platforms and tools commonly used in e-commerce. Furthermore, for each of the selected basic attributes of the product, an analysis was made in terms of the presence, mandatory field, and data input validators. The best practices indicated by the platform developers were also reviewed.

Findings: The research results indicate discrepancies in the understanding of the basic attributes of the product. A lack of commonly available, standardized, consistent data describing products for which the manufacturer would take responsibility lead to creating own solutions for the e-commerce market and development of their own meanings of some data.

Practical implications: It is necessary to clearly understand e-product data as e-commerce market is relatively young and for which product data has a much greater and often completely different meaning than in a traditional trade.

Originality: It provides recommendations for e-commerce platforms for managing e-product core/ basic product data while using a single standard for product master data and common product identifier.

Keywords: E-commerce, attribute, master data, global unique product ID, unique name.

JEL Classification: L87.

Research type: Research article.

¹Faculty of Engineering Management, Poznan University of Technology, Poland,
magdalena.niemir@put.poznan.pl;

²Faculty of Engineering Management, Poznan University of Technology, Poland,
magdalena.mrugalska@put.poznan.pl;

1. Introduction

Currently, the practices of sharing and exchanging data about products through IT systems have become an indispensable part of the business, demonstrating the high maturity of the supply chain of companies (Frederico *et al.*, 2017). It is well known that the exchange of good quality and complete information is the key to the develop enterprises and increase their operational efficiency (Cao and Zhang 2011; Hole *et al.*, 2018). On the other hand, it is shown that poor data quality can have a significant impact on increasing costs in the company (Haug *et al.*, 2011; Appelbaum *et al.*, 2017).

However, the problem arises when the data is not completely standardized (Tagliabue 2021) or when each partner in the supply chain expects something different (Whitehead *et al.*, 2019). Such a situation is observed in e-commerce where data are not only used for electronic document exchange EDI (Electronic Data Interchange), production management in ERP (Enterprise Resource Planning) systems or inventory in WMS (Warehouse Management System), but they are a very important element of sales process (Liu *et al.*, 2019). Just as logistics in traditional trade requires data quality mainly in identifiers and dictionary values, omnichannel trade, mainly e-commerce, needs special quality in product descriptive data, which significantly contribute to the overall quality of data on e-shop websites. Research shows that data quality is of great importance to the final results of online sales (Putri and Pujani 2019).

The subject of this study is the electronic representation of any product that can be used for commercial transactions over the Internet. The aim of the study is to verify the technical capabilities and recommendations of e-commerce solutions in the field of core/basic product data management to find out if the market:

- uses a single standard for product master data?
- uses a common product identifier?

The area of e-commerce solutions included in the study covered selected e-commerce platforms, global data catalogs dedicated to e-commerce, as well as global standards of structured data in this area.

2. Basic Product Data

In the literature there can be found many definitions of basic product data. For example, Schäffer and Stelzer (2017) defines them as a set of data representing a product but more often you can meet terms such as product master data, core product data (Popa *et al.*, 2011), core product attributes, basic product data, or item master data (Madlberger, 2011). Such data set can describe different kinds of features or properties of a product - both physical, structural, and compositional (Schäffer and Stelzer, 2017). For ordinary products, physical product data is usually divided into product, environmental, customer and interactive data (Tao *et al.*, 2019) whereas structural ones refer to the attributes of the settings and compositional ones to its quantitative descriptions (Greenacre, 2018).

Moreover, product data can be divided to such areas as identification, classification and description (Legner and Schemm 2008; Vandic *et al.*, 2018). Undoubtedly, the key attributes of product data are:

- 1) name of the product that clearly and fully identifies a specific product, taking into account its variant and brand, without the need-to-know other product attributes, without the need to browse photos or physically see the product.
- 2) unique identifier - uniquely representing the product in the supply chain, created in one standard, and interpreted equally by all computer systems. A well-known and globally widespread number that meets these requirements is the GTIN (Global Trade Item Number) issued by the GS1 organization, which associates over 2 million companies around the world (GS1 2020a), and the codes of which are currently on 100 million different products.

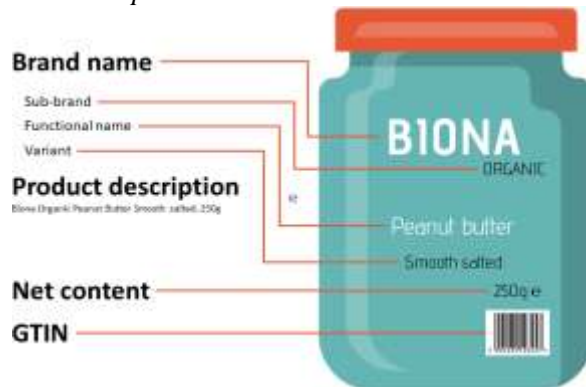
Apart from the attributes listed above, others largely depend on the industry, market needs, purpose of use, internal regulations of entrepreneurs and legal regulations of countries. For example, Regulation (EU) No 1169/2011 of the European Parliament and of the Council of 25 October 2011 on the provision of food information to consumers European Commission (2011) strictly indicates what product data should be placed in online stores selling food which automatically translates into the need for them to maintain a database of necessary product attributes. From 2019, all Participants of the GS1 System, and therefore all entrepreneurs who use GTINs, are required to fill in basic information about products to register them in the global register of products called "Global Registry Platform" (GRP). This is the process necessary for them to obtain a new GTIN. GRP in the near future will contain all product data with a GTIN.

One of the GRP client systems will be the "Verified by GS1" service that verifies basic product data using APIs online. The idea to create such a service in GS1 arose as a result of meetings of a group of companies associated in the Consumer Group Forum (CGF) with GS1, which, after conducting pilot projects, indicated the absolute need to validate unique numbers and key attributes of products in order to achieve higher data quality, greater completeness and easier ways to share information (GS1 US 2019).

The basic attributes that each manufacturer must submit to the Register are:

- GTIN (Global Trade Item Number)
- Product description (repeatable by language code)
- Brand name (repeatable by language code)
- Product image URL (repeatable by language code)
- Net content and Unit of measure (repeatable by unit)
- GPC (Global Product Classification)
- Countries of sale / Target market (list)

Figure 1 visualizes the concept and scope of data, especially regarding the product description, where you can see how it should be built. A more detailed description of the structure and assumptions will be presented in the following paragraphs.

Figure 1. Product description

Source: Own study.

The GS1 organization, when creating GRP, drew on the wealth of proven existing standards, including the solutions adopted in GS1 GDSN (Global Data Synchronization Network), therefore the GRP attributes are similar, while the data model is significantly simplified. The Global Data Synchronization Network is a web-based, interconnected network of interoperable data pools subject to GS1 standards. GDSN enables companies all over the world to exchange standard product master data with their trading partners. GDSN has been operating since 2004.

The scope of product data available in the GDSN network itself is incomparably greater, but decentralized, stored in the so-called Data Pool, of which there are currently 44 in the world and operated by external companies. Only data references are stored centrally (in the so-called GDSN Global Registry). Hundreds of product attributes stored in data pools are assigned to specific product groups, and industry-specific data models are created so that individual partners in the supply chain can communicate efficiently and in a single standard. However, due to the similarity of names, it should be made clear that GRP is not part of the GDSN solution and the roles of the GDSN Global Registry and Global Registry Platform are different. A simplified GDSN model is presented in Figure 2 where the exchange of product data takes place between partners and data pools.

The solutions of the GS1 Organization are widely used in logistics and trade. In view of the situation when GRP will be, or is already, the largest product register in the world, the attributes it requires can be taken as reference for further consideration. This is not the same as making these attributes primary in all cases, but the fact that they are required to obtain a GTIN makes them a minimum of the scope.

Simplifying the GRP data model and making it more universal, it was assumed that the basic product data adapted for further considerations will be:

- Global unique product ID
- Unique name that describes the product
- Brand name

- Product image
- Net content
- Product Classification
- Countries of sale.

Figure 2. GS1 Simple schema



Source: gs1.org.

3. Materials and Methods

In order to achieve the assumed goal, apart from selecting a reference group of basic product attributes, it was necessary to select appropriate market representatives as well as platforms and tools commonly used in e-commerce. This was done on the basis of:

- analysis of internet traffic statistics in the world and in Poland in the e-commerce category, based on Internet traffic ranking Similarweb (2021) (statistics of March 01, 2021),
- analysis of the popularity of using e-Commerce platforms, based on data from BuiltWith (2021) (results published on 16th April 2021),
- own experience of commonly used tools in e-commerce (Google Merchant, Schema.org).

For each of the selected basic attributes of the product, an analysis was made in terms of the presence, mandatory field, and data input validators. The best practices indicated by the platform developers were also reviewed, and the results were placed in separate tables. The representatives of the e-commerce industry as, Schema.org, Google Merchant Center, Amazon, eBay, Allegro, Ceneo, WooCommerce, Shopify and Magento.

4. Results and Discussion

The results of the comparison of the occurrence of the basic attributes of the product on selected e-commerce platforms and tools are presented below, broken down into each attribute with a reference to the "Verified by GS1" solution. The tables are for reference only, and the descriptions explaining the meaning and limitations of the attributes in many places have been shortened to emphasize the most important differences in implementations while maintaining readability. Materials available on the websites of the developers of the solutions were used.

In the case of GS1 "Verified by GS1" solutions, these were the GS1 Global Office websites (GS1 2021) and GS1 UK national organization websites (GS1 UK 2021), as well as the GS1 web Vocabulary Standard (GS1 2015), which lists all the attributes used by GS1 in its web solutions and GS1 Global Data Dictionary (GDD) - a repository of the data elements defined across all GS1 Standards (GS1 2021). In the case of Schema.org, his vocabulary (W3C Schema.org Community Group 2021) was used. It should be emphasized that the analysis of structured data did not include the product schema extension called "GS1 SmartSearch", whose attributes are derived from the GS1 dictionary.

The main reason was that the extension does not replace but adds attributes to a product type that should still have basic data. This extension structures data well, but it is not disseminated enough on the Internet. More information on the GS1 SmartSearch extension can be found on both Schema.org and GS1 websites. To analyze the Google Merchant documentation, a very well-prepared online guide was used (Google 2021), which very precisely, along with examples, presents all the restrictions on the use of fields.

Likewise, the Amazon documentation (Amazon.com, Inc. or its affiliates 2021) used for the analysis contained many examples and information regarding data quality. In order to analyze eBay documentation (eBay Inc. (2018)) and Allegro documentation (Allegro 2021) were used in a similar way, while the missing elements were supplemented directly by reviewing the functionalities of the platforms.

In the case of e-commerce platforms used to build online stores, their documentation: Magento (Magento 2020), WooCommerce (WooCommerce 2021), Shopify (Shopify 2021) contained few implementation details in the context of basic master data. It should also be noted that when collecting information on basic product data, the possibility of interfering with the program code, installing plug-ins, extensions, etc. was not taken into account. In the case of the Ceneo price comparison engine, API documentation was used (Ceneo.pl sp. z o.o. 2021).

Table 1 summarizes the capabilities of the platforms / tools in the field of product identification data management. Separately - for global identifiers and identifiers with limited use in the supply chain. The table does not include the platform's own identifiers, e.g., internal ID, ASIN (Amazon Standard Identification Number), ePID (eBay), etc.

It is worth mentioning that GTIN standard has incorporated the International Standard Book Number (ISBN), International Standard Serial Number (ISSN), International Standard Music Number (ISMN), International Article Number (which includes the European Article Number and Japanese Article Number) and some Universal Product Codes (UPCs), into a universal number space, therefore, unless otherwise indicated, the GTIN field in the table contains the standards listed. GTINs may be 8, 12, 13, or 14 digits long. Short numbers can be encoded as GTIN-14 by adding initial padding zeroes. SKU – Stock Keeping Unit number, is a unique number assigned to a product for, amongst other things, the purpose of keeping track of inventory. MPN - Manufacturer Part Number is a series of unique numbers and/or letters assigned to the item or part by the manufacturer.

Table 1. Comparison of product identifiers

Platform & tools	Global unique Product ID	Comments	Other IDs
Verified by GS1	GTIN*	GTIN in 14-digit format, there are no product variants with the same GTIN, the number is verified in terms of the check digit, country prefix, company prefix - it is certain that the product belongs to the company.	
Product Schema.org. Type	– GTIN ISBN GTIN8 GTIN12 GTIN13 GTIN14	One or more IDs can be used at once and multiple times. All fields are text fields of any length. In the case of the GTIN field, it can take not only a numerical value, but also comply with the GS1 Digital Link specification and be expressed in the form of a URL with additional values.	SKU MPN
Google Merchant Center	GTIN+	Required (For all new products with a GTIN assigned by the manufacturer). Optional (strongly recommended) for all other products. Max 50 numeric characters (max 14 per value). The number is verified in terms of the check digit, and country prefix. Repeated field up to 10 times.	SKU* (id) max 50 characters MPN+ Max 70 characters. Required (Only if your new product does not have a manufacturer assigned GTIN).
Amazon	GTIN+	Required in most cases as a product identifier when creating new product pages or matching to existing pages in the catalog. Verifies the GTIN, but it does not specify to what extent.	SKU* Max 40 characters
eBay	GTIN+	Needs to be entered, but you can enter "Does not apply". Verifies the GTIN, but it does not specify to	MPN+ Max 65 characters. Needs to be entered, but

		what extent.	you can enter "Does not apply".
Allegro	GTIN+	Mandatory in selected categories	
Ceneo	GTIN* ISBN	Mandatory, but for ISBN the data should be entered in a separate field	MPN
WooCommerce	[configurable]	You can install an appropriate plug-in that allows you to enter GTIN codes.	SKU max 255 characters
Shopify	barcode	Text field with no quality control. There are add-ons that allow you to fill in the GTIN field.	SKU max 16 characters
Magento	[configurable]	There are tips on how to set an additional field to enter a GTIN, but it will be a regular field with no quality control.	SKU* max 64 characters

Note: *Required field; + required field with exceptions

Source: Own study.

Table 1 shows that while the GTIN standard is recognizable, it is not always required and is certainly not verified in most cases in terms of structure (number length, check digit) and numerical correctness (country prefix, company prefix). Additionally, the possibility of multiple entry of GTIN numbers for one product in some solutions may lead to problems in data synchronization. You can also notice the lack of standardization in the field of SKU or MPN fields.

"Product name" is undoubtedly one of the main attributes, next to the identifier, of each product database. It enables quick identification of a record in the database by an operator (human) in the management process, because in a few words it describes what the product really is. There are different definitions of "product name" which affect how the field is filled in the database. In GDD Data Models, consequently, there are many attributes that define the "product name" that should be filled in depending on the needs and requirements of the business partners. The attributes and description are presented in Table 2.

Table 2. Comparison of GDD attributes for product names

Attribute name	Length	Description
Label Description	500	A literal reproduction of the text featured on a product's label in the same word-by-word order in which it appears on the front of the product's packaging. This may not necessarily match the GTIN description as loaded by the supplier into the GTIN description field in GDSN.
Functional Name	35	Describes use of the product or service by the consumer. Should help clarify the product classification associated with the GTIN.
Regulated Product Name	500	The prescribed, regulated or generic product name or denomination that describes the true nature of the food and is sufficiently precise to distinguish it from other foods according to country specific regulation.
Trade Item Description	200	An understandable and useable description of a trade item using brand and other descriptors. This attribute is filled

		with as little abbreviation as possible while keeping to a reasonable length. This should be a meaningful description of the trade item with full spelling to facilitate message processing. Retailers can use this description as the base to fully understand the brand, flavour, scent etc. of the specific GTIN in order to accurately create a product description as needed for their internal systems. Examples: GS1 Brand Base Invisible Solid Deodorant AP Stick Spring Breeze GS1 Brand Laundry Detergent Liquid Compact Regular Instant Stain 1 GS1 Brand Hair Colour Liquid Light to Medium Blonde.
Description Short	35	A free form short length description of the trade item that can be used to identify the trade item at point of sale.

In e-commerce, the name of the product is much more important than in traditional trade. In the real world, the customer can be encouraged to buy a product by its nice appearance and packaging. In the virtual world, there is no physical product, but its reflection in the form of digital data: name, photo, and description. Therefore, it is a good name of a product that may determine its search and purchase by the customer. Table 3 shows a comparison of the attributes related to the name of products in the tested e-commerce solutions.

Table 3. Comparison of product names

Platform tools	Max length	Definition
Verified by GS1	70	„Product description”. An understandable, unique and useable description of a product using a combination of key elements such as brand name, sub-brand (if applicable), functional name, variant, and net content. Repeatable by language.
Product -Schema.org. Type	Not specified	„Product name”. The name of the item. The documentation does not specify this value.
Google Merchant Center	150	“Title”. Accurately describe your product and match the title from your landing page. Titles should not include promotional text like "free shipping," all capital letters, or gimmicky foreign characters. Titles should include a <u>distinguishing feature</u> such as color or size for variants.
Amazon	200 (80 re-commended)	“Title”. Each word in the title should start with a capital letter, except conjunctions (and, or, for), articles (the, a, an), or prepositions with fewer than five letters (in, on, over, with). For product bundles, titles should contain the number of items. Titles should not include special characters or symbols like ©, all capital letters, information about yourself or your company, price and quantity, promotional messages, such as “sale” or “free ship.”, subjective commentary, such as “Hot Item,” or “Best Seller”.
eBay	80	“Title”. Titles should not include special, foreign, or gimmicky characters, unless the symbol is a part of the factual data for the product. Titles should not include superlative adjectives, promotional text, conditions,

		prices, shipping options, or irrelevant search keywords, special formatting, phone numbers, hyphenated cut-offs, extra white spaces, abbreviations used to condense text, should not contain foreign language words, should not contain plurals. Titles must not contain duplicate tokens, multiple synonyms, or fitment information, must not include HTML Titles should include only the brand name that the manufacturer (or brand) uses to identify the specific product being referenced.
Allegro	50	“Name of the item”. Disallowed practices: repeating keywords repeatedly, using fashionable phrases, inadequate to the displayed product, words such as "recommend", "must see!", "new", "promotion", "hit", etc., including additional information in the title, for example your login, city, in which can be picked up in person, information about the invoice or fast shipping, placing stock numbers or your internal markings in the title, placing special characters in the title (for example @,!, []) as decorations.
Ceneo	150	“Name”. There is no documentation of best practice or information about field validations
WooCommerce	Not specified	“Name”. There is no documentation of best practice or information about field validations.
Shopify	150	“Title”. There is no documentation of best practice or information about field validations.
Magento	Not specified	“Product name“. There is no documentation of best practice or information about field validations

Source: Own study.

Table 3 clearly shows that there is no standardization here. However, it should be noted that the fields that clearly refer to the product name have been compared with those that can only potentially be. The name of the "title" field in some of the platforms discussed is ambiguous - it refers to an offer regarding the sale of a product or the title of an auction, while the evolution of auction services towards marketplaces, and then "productization", understood as aggregation of offers around correct product data, changed the original meaning "bid title" to "product title".

Additionally, such a title may be replaced by the name of the product stored in the central product catalog of the platform (for example, this is how Amazon works). In other words, what results from the analysis of the descriptions for those fields that are presented by the researched platforms (applies to those that provided such descriptions), in the context of the content, we refer to the name of the product.

First, what draws attention is the maximum character length of this field - there are 400% discrepancy. As regards the description of the field, great importance is attached to the case of letters, double spaces, special characters, the prohibition of the use of "keyword spamming" techniques (popular phrases not related to the product) and these are common requirements of the analyzed solutions.

The exception is Amazon's requirement "each word in the title should start with a capital letter" which is not present in others. Little attention has been paid to the construction of the product name itself, which unfortunately may lead to discrepancies in the description of the same product and ambiguity. Best practices are provided by Google Merchant Center (all not included in the table), where it provides examples of correctly described names of various products, and Additional guidelines for meeting legal requirements in different countries. The meaning of this field and its components is also well described in the "Verified by GS1" service.

5. Conclusion

The research results presented in this document indicate that the authors of e-commerce solutions do not use one common standard for the unique identification of products, both in the form of descriptive text and ID. Due to the lack of commonly available, standardized, consistent data supervised by manufacturers, the developers of solutions for the e-commerce market imposed their own solutions and developed their own meanings of some data. Harmonizing this process can be tedious, if possible. On the other hand, a good example of the market maturation process is the start of using the GTIN number, however, as research has shown, in some cases it is still optional and not validated, and therefore does not ensure quality, data integrity and data compliance with the GS1 standard.

As mentioned earlier, GS1 aims to launch the Global Registry Platform as a global database of products overseen by manufacturers who will ensure quality, completeness and up to date of data. If this happens, and if product data will be publicly available for download, such action can effectively improve the quality of data in e-commerce, as it will not only help to disseminate standards, but also to make product data more consistent. However, this will only happen if the manufacturers know how to enter data correctly, and the system will be equipped with special modules ensuring data quality.

In conclusion, to improve the current data quality in e-commerce, there is a need to create a proposal for a common standard for an attribute representing a unique product name in terms of its technical parameters (such as e.g., field length) and of its content. Also, clear guidelines on how to validate for both attributes should be crafted.

References:

- Appelbaum, D., Kogan, A., Vasarhelyi, M., Yan, Z. 2017. Impact of business analytics and enterprise systems on managerial accounting. *International Journal of Accounting Information Systems*, 25, 29-44.
- Allegro. 2021. Wystawianie i edycja oferty - pomoc allegro. <https://allegro.pl/pomoc/dla-sprzedajacych/wystawianie-i-edycja-oferty>.
- Amazon.com, Inc. or its affiliates. 2021. Amazon seller central. <https://sellercentral.amazon.com/>.
- BuiltWith. 2021. Distribution for websites using ecommerce technologies. <https://trends.builtwith.com/shop>.
- Cao, M., Zhang, Q. 2011. Supply chain collaboration: Impact on collaborative advantage and firm performance. *Journal of Operations Management* 29(3), 163-180.

- Ceneo.pl sp. z o.o. 2021. Ceneo - porównanie cen, sklepy, perfumy, agd, rtv, komputery. <https://www.ceneo.pl/poradniki/Instrukcja-tworzenia-pliku-XML>.
- eBay Inc. 2018. Catalog best practices guide. <https://developer.ebay.com/devzone/merchant-products/catalog-best-practices/content/index.html>.
- European Commission, 2011. Regulation (EU) no 1169/2011. <https://eur-lex.europa.eu/eli/reg/2011/1169/oj>.
- Greenacre, M. 2018. Compositional data analysis in practice. Boca Raton, CRC Press.
- Frederico, G. et al. 2017. Supply chain management maturity: A comprehensive framework proposal for literature review and case studies. *International Business Research*, 10(1), 68-77.
- Google, 2021. Product data specification - google merchant center help. https://support.google.com/merchants/answer/7052112?hl=en&ref_topic=6324338.
- GS1 2015. GS1 webvocabulary standard. https://www.gs1.org/docs/gs1-smartsearch/GS1_Vocabulary_Standard.pdf.
- GS1. 2020a. GS1 annual report. <https://www.gs1.org/sites/gs1/files/2020-11/gs1-annual-report-2019-2020.pdf>.
- GS1. 2020b. GS1 product image specification standard. https://www.gs1.org/docs/gdsn/Product_Image_Specification.pdf.
- GS1. 2021a. GS1 global data dictionary. <http://apps.gs1.org/GDD/>.
- GS1. 2021b. GS1 package measurement rules standard. https://www.gs1.org/docs/gdsn/3.1/GS1_Package_Measurement_Rules.pdf.
- GS1. 2021c. Trust and efficiency start with a valid id. get product identity right with verified by gs1. <https://www.gs1.org/services/verified-by-gs1>.
- GS1, UK. 2021. Building trust and efficiency. <https://www.gs1uk.org/our-services/data-services/verified-by-gs1>.
- GS1, US. 2019. Verified by GS1 frequently asked questions. <https://www.gs1us.org/industries/emerging-topics/verified-by-gs1>.
- Haug, A., Zachariassen, F., Van Liempd, D. 2011. The costs of poor data quality. *Journal of Industrial Engineering and Management (JIEM)*, 4(2), 168-193.
- Hole, Y., Pawar, S., Bhaskar, M.P. 2018. Service marketing and quality strategies. *Periodicals of Engineering and Natural Sciences (PEN)*, 6(1), 182-196.
- Legner, C., Schemm, J. 2008. Toward the inter-organizational product information supply chain. evidence from the retail and consumer goods industries. *Journal of the Association for Information Systems*, 9(4), 120-152.
- Liu, A., Zhang, Y., Lu, H., Tsai, S.B., Hsu, C.F., Lee, C.H. 2019. An innovative model to choose e-commerce suppliers. *IEEE Access*, 7, 53956-53976.
- Madlberger, M. 2011. Can data quality help overcome the penguin effect? the case of item master data pools. In *ECIS*.
- Magento 2020. Magento user guide. <https://docs.magento.com/user-guide/catalog/product-create.html>.
- Popa, V., Duica M., Gonzales, A. 2011. Supply chain information alignment in the consumer goods and retail industry: global standards and best practices. *Electronic Journal of Information Systems Evaluation*, 14(1), 134.
- Putri, W.K., Pujani, V. 2019. The influence of system quality, information quality, e-service quality, and perceived value on Shopee consumer loyalty in Padang city. *The International Technology Management Review*, 8, 10-15.
- Schäffer, T., Stelzer, D. 2017. Assessing tools for coordinating quality of master data in inter-organizational product information sharing. In *WI2017*.
- Shopify. 2021. Shopify help center. <https://help.shopify.com/en/manual/products/details>.
- Similarweb. 2021. Top sites ranking for e-commerce and shopping in the world. <https://www.similarweb.com/top-websites/category/e-commerce-and-shopping/>.

- Tagliabue, J. 2021. You do not need a bigger boat: recommendations at reasonable scale in a (mostly) serverless and open stack. In Fifteenth ACM Conference on Recommender Systems, 598-600.
- Tao, F., Sui, F., Liu, A., Qi, Q., Zhang, M., Song, B., Guo, Z., Lu, S.C.Y., Nee, A.Y. 2019. Digital twin-driven product design framework. *International Journal of Production Research*, 57(12), 3935-3953.
- Whitehead, K., Zacharia, Z., Prater, E. 2019. Investigating the role of knowledge transfer in supply chain collaboration. *The International Journal of Logistics Management*, 30(1), 284-302.
- W3C Schema.org Community Group. 2021. Product - schema.org type. <https://schema.org/Product>.
- WooCommerce. 2021. Adding and managing products - woocommerce docs. <https://docs.woocommerce.com/document/managing-products/>.
- Vandic, D., Frasincar, F., Kaymak, U. 2018. A framework for product description classification in e-commerce. *Journal of Web Engineering*, 001-027.