Fashion Retail Master Data Model and Business Development

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Abstract. Retailing, and particularly fashion retailing, is changing into a much more technology driven business model using omni-channel retailing approaches. Also analytical and data-driven marketing is on the rise. However, there has not been paid a lot of attention to the underlying and underpinning datastructures, the characteristics for fashion retailing, the relationship between static and dynamic data, and the governance of this. This paper is analysing and discussing the data dimension of fashion retailing with focus on data-model development, master data management and the impact of this on business development in the form of increased operational effectiveness, better adaptation the omni-channel environment and improved alignment between the business strategy and the supporting data. The paper presents a case study of a major European fashion retail and wholesale company that is in the process of reorganising its master data model and master data governance to remove silos of data, connect and utilise data across business processes, and design a global product master data database that integrates data for all existing and expected sales channels. As a major finding of this paper is fashion retailing needs more strict master data governance than general retailing as products are plenty, designed products are not necessarily marketed, and product life-cycles generally are short.

Keywords: Retailing, datamodels, fashion retailing, e-commerce, master data management

1. Introduction

To navigate and develop the retail business it should be expected that a consistent insight in the data of the business would be of strong importance (Klena, 2013; Snow, 2008). Insight in retail data includes a persistent and sufficient abstraction of the operating model into the logical model of the data generated by the business (Shaw and Leeming, 1998). Much too often retail data models are at risk of become obscure, when data models no longer can follow the dynamics of the business (Berman and Evans, 2007; Cleven and Wortman, 2010; Smyth, 2013). Or operating models suffer from lack of support from general enterprise resource planning (ERP) systems. In fashion retail data would be expected to be more complex than in general retailing with respect to that products are seasonal, unique to a brand or a chain, must support a short-lived production, customers are not attracted by need but by desire, and multi-channel retailing requires both adaptation but also consistency across channels (Bruce and Daly, 2010; Sundström and Reynolds, 2014).

Traditionally enterprise information systems (EIS) have been addressing business data as either static (master data) or dynamic (transactions) (Dreibelbis et al., 2008). Master data is therefore concerned with permanency and adequate and sufficient data of standardized representations (Haug and Arlbjørn, 2011; Mishra, 2011; Oberhofer and Dreibelbis, 2008). Transactions are derived from business processes and combine master data.

In operating the retail business, especially fashion retail, the master data model (MDM) has often been generic from standard EIS. Generic MDM's rule out product specific characteristics presented that in

turn normally has been expected to be handled in e.g. a product data management (PDM) or product life-cycle management (PLM) system (Fitzpatrick et al., 2012; Otto and Schmidt, 2010; Murphy et al., 2005). As PDM/PLM in many cases only are loosely connected to the EIS (ERP) there is a many risk of loss of meaningfulness between the systems, and the quality and relevance of the MDM is therefore focal to establish coherency between products, business and systems (Silvola et al., 2011; Sammon et al., 2010; Russom, 2006).

A number of industrial standard propositions have been suggested to improve MDM in the fashion retail industry notably NRF ARTS and CEN CWA 16667:2013 (NRF, 2014; CEN, 2013; Otto et al., 2012). Both ARTS and CWA16667 express specifically that the data model must be derived from the business and operating model in line with more strategic frameworks from the theory of Enterprise Architecture (Bernard, 2012; Spewak and Hill, 1993; Magoulas et al., 2012; Kistasamy et al., 2010; Garg et al., 2006). The propositions provide good opportunities for efficient interorganisational transaction exchange (Lankhorst and van Dunen, 2007; Lankhorst, 2004). The standardised data models are, however, not necessarily a final solution, as retailing continue to develop, it is thus assumed that there is a need for further research in the actual implementation in the form of ability to:

- Integrate into existing ERP systems
- Support rich media in especially B2C contexts
- Support concurrent channels i.e. convergence to omni-channel retailing

The problem statement for this paper can thus be formulated as:

What are the key characteristics of design and governance processes related to enhance the master data model in the fashion retail industry?

Theory for this paper consists of theory for fashion retail operations, and for the supply and information exchange within retailing. The accuracy and dynamics of data related to the operating models is provided by the theory of MDM. The theory on data modelling and master data is rich, but the actual requirements for the fashion retailing are less discussed. A general perception is frequently that fashion retail can't differ that much from general retailing and could use generic data models. This view is in most systems replaced with a "minimal subset" of fashion retail related data models. CEN 16667 is a major breakthrough although it still needs to mature and company-specific implementations.

2. Theory

Retailing is the distribution of goods from any supply chain to end-consumers with associated flow of information (Grewal and Levy, 2009; Gereffi, 1999). Fashion retail is the distribution of clothing and accessories with appropriate organisational designs of physical and virtual units of distribution along with ownerships and responsibilities (Reynolds et al., 2007; Heinemann and Schwarzl, 2010; Tambo, 2011). Organisational design, collaboration and innovation is highlighted as a determining factor for

the industry (Tambo, 2014a; De Felice et al., 2013). Fashion retailing is characterised by seasonality (Choi, 2007), assortments (Rajaram, 2001), strong elements of logistical speculation (Vaagen and Wallace, 2008), design, short-lived stock-keeping-units (SKU), and one purchase per product during the life cycle (Battista and Schiraldi, 2013; Brun and Castelli, 2010; Brun et al., 2008; Cillo and Verona, 2008). Fashion retailing embraces the dualism of the product-centered consumer appeal together with a supply chain management that can be decisive for doing successful business (Iannone et al., 2013; Wong and Guo, 2010; Hübner, 2011). Commonly are fashion retail organisations considering the move towards the fast fashion approach (Caro and Martınez-de-Albéniz, 2014; Choi et al., 2014; Zhenxian and Lijie, 2011; Arrigo, 2010), where new products are released for the sales channels from monthly to weekly basis.

Although retailing is often perceived as product and consumer-centric, retailing has become increasingly relying on technology for process innovation as well as process optimisation (Tambo, 2011; Tambo, 2014a). With many scholars regarding information technology as an enabling technology (Ayanso et al., 2010), the technological perspective becomes dominant in switching from physical retailing and e-commerce into complex omni-channel settings (Tambo, 2014b) and highly integrated interorganisational information systems (Caniato, 2014; Goel, 2006).

Information systems (IS) are the technological materialisation of the information dimension of business processes with the emphasis of supporting work (Alter, 2002). Enterprise Architecture (EA) links strategy, business and technology (Bernard, 2012) with emphasis on alignment between operating technologies, business model and transformation (Magoulas et al., 2012; Pulkkinen, 2006). Both Bernard (2012) and Zachman (1987) place data as critical in alignment, and enterprises are both limited to, but can also develop itself by optimal data both when it comes to structure of data and content of data (Loshin, 2010; Menet and Lamolle, 2009; IBM, 2007). As main elements of the corporate IS infrastructure are the ERP system for interacting along the supply chain the suppliers and customers, and the Product Lifecycle/Data Management (PDM or PLM) system for the creation and management of products; within this study there is furthermore the Product Information Management system (PIM) managing the Digital/Media Asset Management (DAM or MAM) database all focused on handling structured and graphical product data (Marcant, 2011; Loshin, 2010; Murphy et al., 2005).

The Master Data Model (MDM) is a structuration of the key operating data entities of the company of which all information systems are built upon (Otto, 2012a; Otto, 2012b; PLATON, 2006). The MDM reflects at an abstract level the data of the business, but it also defines the core of automated (automate-able) information processing (Butler, 2011; Cleven and Wortmann, 2010).

Several contributors discuss MDM from issues of governance related to (1) ongoing development of model and structure (2) governance of content (Berson et al., 2011; Sarsfield, 2009; Newman and Logan, 2006; Thomas, 2006b). Structural development is related to the ability to change and adapt the data model to new business circumstances without obscuring history, reporting, satisficing short-term

needs, or introduce unnecessary complexity. In the case below, it is shown that a structural development can be to go from being able to connect one low-quality picture with a product, to be able to connect several high-quality pictures related to different markets, areas of application, and technical qualities. Governance on content is related to ensure uniformity of data within the given structural model, e.g. that dataset are full, avoid redundancy, conforms with given standards, free from obsolescence, and well in support of the business processes (Cheong and Change, 2007; Cohen, 2006). It is important to distinguish between master data and transactional data. Transactional data relies on the combination of master data, not vice versa. Master data can be e.g. customers, addresses, zip-codes, currencies, products, product features, stores and store features.

Master data without proper governance will normally lose quality over time. The responsibilities of the master data governance are said by Eckerson (2002) to be: *"the formal orchestration of people, processes, and technology to enable an organization to leverage data as an enterprise asset"*. Master data governance is expected to consist of a (1) data governance framework (Cheong and Chang, 2007; Khatri and Brown, 2010) and a (level of) (2) data governance maturity (IBM, 2007). The data governance framework will normally include issues of (1.1) organizational structures and awareness, (1.2) stewardship, (1.3) policy, (1.4) data quality management, (1.5) classification and metadata. The data governance maturity will normally extended over a series of maturity level setting the ability of the enterprise to organize and benefit from data. The data governance framework needs to consider its own organization (Vilminko-Heikkinen and Pekkola, 2013), evaluation and implementation of industry standards (White et al., 2006; Wolter and Haselden, 2006; Wolter, 2007), potential case-based learning (Weber et al., 2008), defining accountability (Wende, 2007), connections between operating systems (ERP) and product development systems (PLM) (William Xu and Liu, 2003). Master data management is also to some degree disputed as governance might contradict the meeting of sound business adaptation (Smith and McKeen, 2008).

Service oriented architectures (SOA) have become widespread during the last 10 years and describes open and uniform interface between data for ensuring low redundancy and high reusability of data (Kistasamy et al., 2010; Loser et al., 2004; He, 2003). CWA16667 (CEN, 2013) presents a wide range of service definitions for SOA for interorganisational integration, and suggests this reference architecture

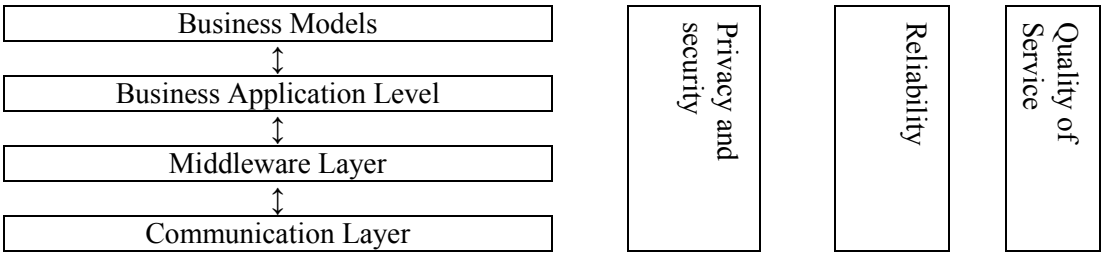

Figure 1. Reference Architecture 2.0 for eBusiness harmonisation in Textile/Clothing and Footwear sectors

High volumes of data, data that become obsolete within short span of time, and a quite recent transition in to a more technology-based business context make master data management challenging to fashion retailing. A low level of maturity might come from rapid introduction of new technologies that have created classical silos.

3. Method

This study is based on a mostly qualitative, case-based, interpretivistic methodology that characterise the technological artefacts as interrelated to and determined by the social context therefore adding elements of social science research (Crotty, 1998). As the study aims at suggesting adaptation and changed practices of work and technology, the methodology largely also is inspired by design science (Peffers et al., 2007; Järvinen, 2007; Cole et al., 2005). Given, that major parts of the study was done within the organisation of the study, there are elements of action research also underlining the authors as insiders within the organisation and the topical area.

The actual approach for data collection was firstly to get insight into the problem area. As the company for several years had accepted a less optimal solution, the main task was to get around the issue of motivations and expectations for a revised and optimised solution. The concept of Yin (2009) of case study methodology was followed in the sense of trying to obtain the fullest set of data on the case and systematically organise these into current state and future state of technology and business processes (Dubois and Gadde, 2002). We have followed Dahlberg et al.'s (2011) suggestion of architecting the master data, expressed as: We suggest that holistic approaches such as enterprise architecture, stakeholder analysis, or business modeling could serve as coherent frameworks in identifying common and specific master data management research themes for global businesses with networked IT environments.

The performed steps of the data collection were observations of (business) processes, especially: Photographic work processes, product creation in the ERP system, B2B e-commerce merchandising, B2C e-commerce transactions, IT-architecture mapping, database and datamodel inspection (from entity-relation diagrams (E/R)), master data evaluation, and mapping of organisational responsibilities. The design artefacts included revised E/R-diagrams, augmented enterprise architecture, revised business processes in Business Process Modelling Notation (BPMN).

4. Case study

TexBrand is a leading European company in fashion wholesale and retail. TexBrand is privately held and operates around 2500 stores under five primary brands and several specialisations or affiliations of these brands. The stores are partially operated and owned by TexBrand and partially by a network of partners. Beside the stores, about 50% of the turnover is generated from wholesale activities to department stores, general chain stores and online retailers. Common to the stores are that they exclusively sell TexBrand brands and that they use point-of-sales (POS) systems supplied by

TexBrand. The POS system enables fast and concise data to the stores and also facilitates retrieval of data for the central datawarehouse reporting system. TexBrand has since 2007 had increasing success with online retailing. Originally, online retailing was organized in a separate entity. Gradually some multi-channel retailing features has been introduced, but not omni-channel retailing.

The organizational separation of the online activities, and organizational distance to some retail partners have led to the identification of insufficiencies in the current master data model. The model was designed to support season and product creation, purchasing and support supply chain management from the manufacturers to the stores. The model was not designed to support high quality marketing material, photos, post-warehouse product lifecycle, and a multi-channel retail business model. Furthermore, the different primary brands have different cultures of data management ranging from loosely structured processes to processes with a high level of governance. Adding to this is that the existing data model has been tree-structured from brands to seasons and categories where the business considers to aim for a more dynamic structure of products combined across seasons and categories to suit the need of more specialised retailers, wholesalers and e-commerce operators.

TexBrand now aims at redesigning the operating master data model. Important positions in the redesign are:

- Extending the data model from supply chain management and in to marketing and a more active product management across channels including both B2C and B2B
- Adding characteristics of PDM/PLM
- Recognising the dynamic character of the sales process ranging from one-off orders for short seasons and up to never-of-out-stock concepts
- Improved support of mixed channel structures
- More distinctive preservation of product history in the in-store phases
- Late phases of the product life cycle is seen as ideal for increasing the sales to wholesale customers, online retailers and partner owned stores

The case highlights the shortcoming of the traditional ERP-inspired master data model mostly servicing the supply chain management needs and to a lesser extent the commercial needs. Commercial needs require a broader understanding, especially considering the rapid growth in the digital channels and an expected slow decline of the physical retailing. Products are distributed and sold differently on the different platforms and this business model must be embedded into the MDM. Images, marketing material, rich media, references to external product referrals, and localisations (country/language adaptations) in the MDM will improve the overall efficiency of the sales process.

Characteristically to the business processes within TexBrand is that even inside relatively small product management teams, there is a separation between work processes that historically have created small “islands” of information:

Role	Work	Master data	Data model insufficiencies
Category planners	Allocate a seasons products in categories and in-season releases	Seasons Categories Store types	Categories not naturally connected to needs of stores and e-commerce
Product developers	Coordinate between designers and manufacturers and produce detailed descriptions designs, patterns, measurement charts, and trimmings	Basic product data Fabrics Measurement charts Production instructions	Technical terms not immediately related to consumer oriented communication
Salesmen	Promote goods at seasonal level to branded stores and wholesale customers generating data such as sales forecasts and preliminary customer orders	Customers Customer types Delivery terms Budgets	Bridging between supply chain, store and wholesale customers: Personal translation of technical systems
Purchasers and logistical supporters	Work with product availability and refine data up to the point of delivery at store level or at e-commerce warehouse	Freight data Customs data Exception handling Campaigns	Limited relation to actual store needs
B2B e-commerce	Enriches data with logistical data and extract professional information from the other team members	Warehouses Product groups and relations	"Guestimating" products available for B2B
B2C e-commerce	Enriches data with graphical content and convert professional information in to data of relevance to e.g. search engines, cultural contexts, consumers and partner B2C outlets	Photos Search metadata Consumer information Enriched "duplicates" of above data	Limited data import from all other systems, enrichment from the start, no return of quality data to other functions
Retail planners	Planning of fit between store stocklevels, store performance, store local characteristics and incoming new collections	Store budgets Store formats	No general cross-store tools for goods in stores
Brand managers	Overall brand position and development Market and cross functional synergies	Aggregate information Cross-channel data Omni-channel initiatives	Too much data, too little precision in data Mostly manual processes

Table 1. Roles, work processes, data model and data model issues

The islands are typically associated with manual activities that convert from data from prior processes and add appropriate value this. The following diagram describes to continuous process of data enrichment using manual activities:

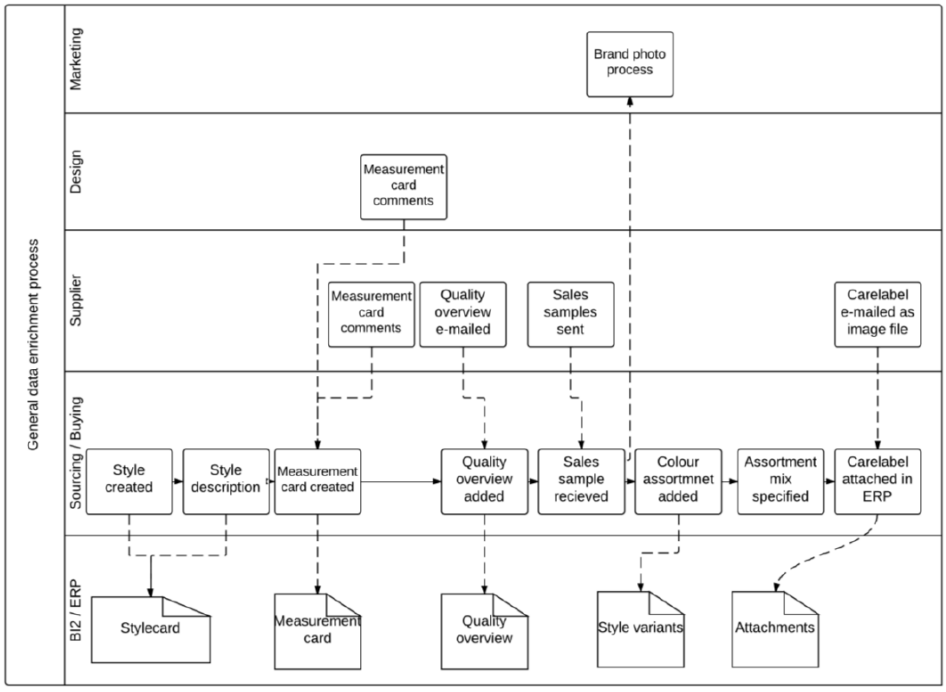

Figure 2. Data enrichment processes between work processes and data entities

By analysing, designing, implementing and operating a more integrated data model, it is expected that TexBrand can more effectiveness of the product management processes significantly, meaning:

- Improved product master data from the product development process can be used throughout subsequent business process and must to a lower degree be stepwise enriched.
- The B2B enrichment process is directly integrated with the earlier product management processes by means of merge of the B2C and the B2B datamodel thus ensuring relevance and availability of graphic, internet metadata and consumer communication at early stages to support stores and omni-channel activities
- Opening up to new B2C segments using B2B data
- Support of rapid changes in brand development and composition, potentially including brands not owned by TexBrand

With an already complex master data model, the changes are complex, but can be introduced incrementally

5. Discussion

To analyse the current situation TexBrand, the theoretical review and the empirical data from the case setting was compared. The analysis was structured using the EA cube as an analysis framework, with the aim of establishing an overview of the current state and identify the gaps between the EA levels. The analysis demonstrated that TexBrand is currently experiencing strategic challenges that relates to

the state of their product master data. Furthermore it was described how the product master data enrichment process is inefficient and it was highlighted how missing product master data are increasing the time to market and thereby negatively affecting profit. In addition the study demonstrated that the current product master data model was not designed to meet business requirements in a world increasingly relying on digital sales channels. The insufficient data model is contributing to an IT architecture that is not scalable and makes it difficult to expand in to new digital channels or improve existing channels. Furthermore the current IT systems do not possess the necessary functionalities to actively manage product master data. In addition the data model is not capable of holding the necessary business information for analytical purposes, which naturally leads to poor data quality. The current data governance is limited and data is not treated as a company asset, which contributes to the poor data quality.

Main findings of this paper are related to the case-based character of the fashion retail MDM, the considerations of the distributed type of master data, the aiming at consolidating distributed data, and the necessary adaptation to the omni-channel future on both the B2B and the B2C level. Below is an example of expected changes, where the existing data model is augmented with four tables for subcategory name, product lifecycle status, carelabel attributes, and sales object/channel orientation.

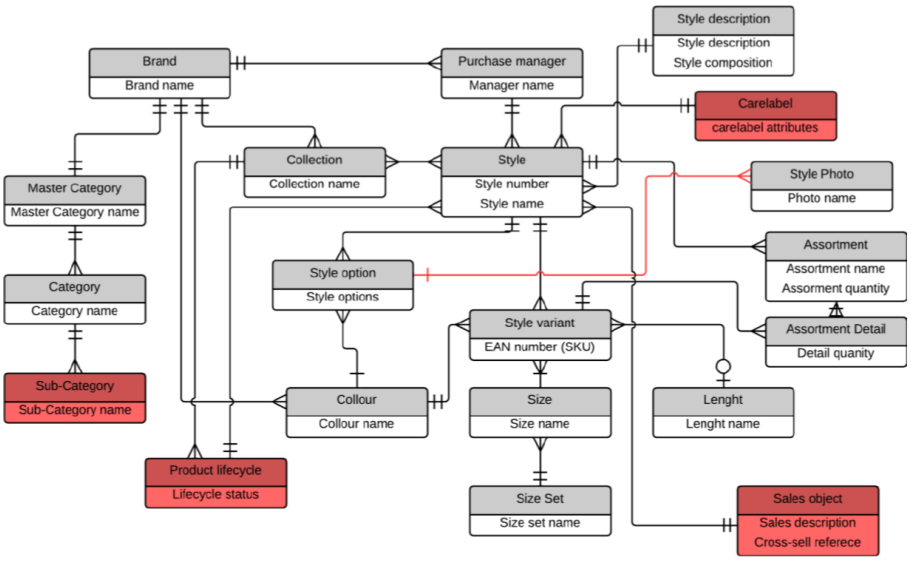

Figure 3. Conceptual augmentation of the operating data model

The diagram is expression entities and relations (E/R-diagram) of the operating datamodel. The model contrasts the CWA16667 model by looking beyond purchasing and ordering, and is designated for a deeper degree of complexity in the customer perspective of fashion retailing than found in CWA16667. The can also be found in the following breakdown structure of categories, where classical categories and formal (customs code Combined Nomenclatura) are changed to a multi-tier taxonomy supported by generic attributes and category dependent attributes.

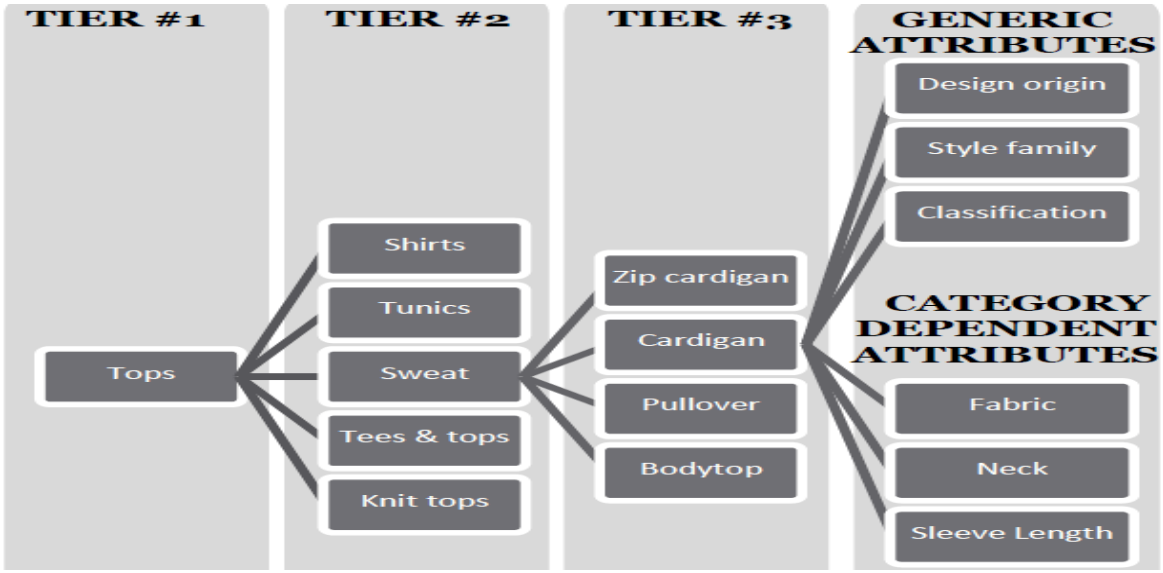

Figure 3. Extended category master data model

The EA3 enterprise architecture framework is setting requirements for architectural transitions governed by a management plan from current to future state. The table below summarises the observations and the operational context of the existing business, and the intended future state.

Current state summary – Information level	Future state summary – Information level
• Product images not on style option level	• Product images on style option level
• Static product data	• PLM object
• No sales oriented data	• Sales entity
• Too much data in the name field	• Additional category specific attributes
• Caralabel as attachment	• Carelabel as part of the data model
• Categories not sufficient	• 3 tier category structure
• Attributes not category depending	• Category depending attributes
• Current data model not supporting rich media	• Supporting rich media

Table 2. Enterprise architecture management plan

The business rationale of changing the datamodel is related to secure earlier availability of high quality data. By this, large online retailers, multi-channel retailers, and smaller multi-brand retailers can all be better serviced in the future than in the current state, e.g. by having access to rich media weeks before goods arrive instead of having rich media after TexBrand themselves have floated the data in their corporate website. Below is the other dimension of the data model management summarised: The discussion above is on the structure and purpose of the datamodel. Below is the issue on how data is

governed, and how improved principles and practices of governance can change quality and reliability of data and thereby engage costumers more positively.

Current state – data governance	Future state – data governance
• Data enrichment aimed at internal and upstream needs	• Data enrichment including downstream business requirements
• Data ownership not clearly defined for photos	• Clearly defined ownerships
• No metrics to measure data quality	• Establish metrics for data quality
• Reference data not up to date	• Implementing new category structure
• Product category definitions not clearly defined	• Agreeing on product category definitions

Table 3. Master data governance transition

In analysing the capability of TexBrand to make the suggested transition, it is relevant to look at the stipulated master data maturity assessment suggested in (IBM, 2007). The five most relevant criteria of the 13 suggested were picked.

Category	Motivation	Level 1..5, 5 being best
Organisational structures and awareness	(Too) many parties involved in data enrichment	1
Stewardship	A certain degree of technical management and monitoring	2
Policy	Policies have been implemented on a test basis but are still ad hoc	2
Classification and metadata	(Too) strong differences in individuals data entry	1
Data quality management	No metrics or routines are implemented	1

Table 4. Master data management maturity assessment

The maturity is thus at a quite low level. The suggested changes connected with the expected business benefits are expected to create a momentum towards a significantly higher level. Importantly for this discussion is the narrow relationship between the technology and the organisation. The organisational ownership of data is fundamental to the definition of the governance (Vilminko-Heikkinen and Pekkola, 2013; Haug and Arlbjørn, 2011). The organisational dependency of the data is much wider and relate to the awareness of the owner on the impact of data quality and lack of quality in the full downstream supply chain. The organisational design and architecture is present today in the form of the islands of data stewardship, but to harvest the anticipated benefits responsibilities, awareness and "sense of urgency" most be paired with the technologies opportunities so the datamodel and the

Enterprise architecture has been suggested above as an approach to support the improvements in the master data management processes by pinpointing the relationship between systems, data, business processes and business strategy. Enterprise Architecture makes a frame to analyse and design a master data solution as outlined in table 2 and table 3. Furthermore it highlights possible issues when implementing MDM in the fashion industry and describes how MDM can contribute to solve some of the critical challenges currently faced within the industry.

To summarise, technologies in fashion retailing is connecting data related to individual business processes along the value chain and the product life cycle. What separates retailing from other industries is the end-to-end supply chain with the direct consumer interaction and the physical artefact as the key focal point in the transaction between seller and buyer. What separates fashion retailing that consumer spending is so more based on desire, sentiments and impulse inspired by incessant movements in society, this pattern of consumer attitudes is best handled by a deep and ongoing insight that only can be created and maintained by strong and distinct datamodels.

6. Conclusions

Considering the contribution from Sundström and Reynolds (2014) and the CWA16667 (CEN, 2013) there are strong potentials for further research as the fashion retail sector just recently has taken up technology as a critical paradigm of innovation. When talking big data, consumer-centered approaches, and (smart) supply chains, both master data, the data models and the management paradigms must improve. This applies to relevance and adequacy of the data models, both inside the companies and between companies, and the governance principles of data.

The purpose of this study was to identify meaning, importance and development potentials of master data management principles in the fashion retailing industry. The transitional process of TexBrand has served as a case for the study. The TexBrand case has demonstrated that the process is based on conditions of strategic commitment, identifiable maturity metrics, organisational change and a deep insight in the relationship between data and business. The study was conducted using a design science methodology with the objective of solving the problem and through this contribute to research and illustration of business development opportunities.

References

Alter, S., 2002. The work system method for understanding information systems and information systems research. Communications of the Association for Information Systems 9(6), pp. 90-104.

Arrigo, E., 2010. Innovation and Market-Driven Management in Fast Fashion Companies. Symphonya. Emerging Issues in Management, (2 Intangible Assets & Global Competition).

Ayanso, A., Lertwachara, K., Thongpapanl, N., 2010. Technology-Enabled Retail Services and Online Sales Performance. Journal of Computer Information Systems, 50(3).

Battista, C., Schiraldi, M.M., 2013. The Logistic Maturity Model: Application to a Fashion Company. International Journal of Engineering Business Management, 5, 1-11.

Berman, B., Evans, J.R., 2007. Retail Management: A Strategic Approch, 11th ed. Prentice Hall.
Bernard, S.A., 2012. An introduction to enterprise architecture. AuthorHouse.
Berson, A., Dubov, L., Plagman, B.K., Raskas, P., 2011. Master data management and data governance. McGraw-Hill.
Bruce, M., Daly, L., 2010. Innovative process in E-commerce fashion supply chains. In: Innovative Quick Response Programs in Logistics and Supply Chain Management (pp. 227-242). Heidelberg: Springer Verlag.
Castelli, C. M., Brun, A. (2010). Alignment of retail channels in the fashion supply chain: an empirical study of Italian fashion retailers. International Journal of Retail & Distribution Management, 38(1), 24-44.
Brun, A., Caniato, F., Caridi, M., Castelli, C., Miragliotta, G., Ronchi, S., Spina, G. (2008). Logistics and supply chain management in luxury fashion retail: Empirical investigation of Italian firms. International Journal of Production Economics, 114(2), 554-570.
Butler, D., 2011. Master Data Management - An Oracle White Paper, September 2011.
Caniato, F., Caridi, M., Moretto, A., Sianesi, A., Spina, G. (2014). Integrating international fashion retail into new product development. International Journal of Production Economics, 147, 294-306.
Caro, F., Martınez-de-Albéniz, V. (2014). Fast Fashion: Business Model Overview and Research Opportunities.
CEN, 2013. CWA 16667 Reference architecture 2.0 for ebusiness harmonization in textile/clothing and footwear sector. The European Standards Organization.
Cheong, L.K., Chang, V., 2007. The need for data governance: a case study, 18th Australasian Conference on Information Systems. The University of Southern Queensland, Toowoomba, Australia, 999-1008.
Choi, T. M., Hui, C. L., Liu, N., Ng, S. F., Yu, Y., 2014. Fast fashion sales forecasting with limited data and time. Decision Support Systems 59, 84-92.
Choi, T.M., 2007. Pre-season stocking and pricing decisions for fashion retailers with multiple information updating. International Journal of Production Economics, 106(1), 146-170.
Cillo, P., Verona, G., 2008 . Search styles in style searching: exploring innovation strategies in fashion firms. Long Range Planning, 41(6), 650-671.
Cleven, A., Wortmann, F., 2010. Uncovering four strategies to approach master data management, System Sciences (HICSS), 2010 43rd Hawaii International Conference on 2010, IEEE, 1-10.
Cohen, R., 2006. What's in a Name? Data governance roles, responsibilities and results factors. DM Review, 8.
Cole, R., Purao, S., Rossi, M., Sein, M.K., 2005. Being Proactive: Where Action Research Meets Design Research. ICIS 2005.
Crotty, M., 1998. The foundations of social research: Meaning and perspective in the research process. Sage Publications Limited.
Dahlberg, T., Heikkilä, J., Heikkilä, M., 2011. Framework and Research Agenda for Master Data Management in Distributed Environments.
De Felice, F., Petrillo, A., Autorino, C., 2013. Key success factors for organizational innovation in the fashion industry. International Journal of Engineering Business Management, 5(27), 1-11.
Dreibelbis, A., Hechler, E., Milman, I., Oberhofer, M., Van Run, P., Wolfson, D., 2008. Enterprise master data management: an SOA approach to managing core information. Pearson Education.
Dubois, A., Gadde, L., 2002. Systematic combining: an abductive approach to case research. Journal of business research, 55(7), 553-560.

Eckerson, W.W., 2002. Data quality and the bottom line: Achieving business success through a commitment to high quality data. The Data Warehousing Institute, 1-36.

Fitzpatrick, D., Coallier, F, Ratté, S., 2012. A holistic approach for the architecture and design of an ontology-based data integration capability in product master data management. Product Lifecycle Management. Towards Knowledge-Rich Enterprises. Springer, pp. 559-568.

Garg, A., Kazman, R., Chen, H., 2006. Interface descriptions for enterprise architecture. Science of Computer Programming, 61(1), pp. 4-15.

Gereffi, G., 1999. International trade and industrial upgrading in the apparel commodity chain. Journal of international economics, 48(1), 37-70.

Grewal, Levy, 2009. Emerging Issues in Retailing Research. Journal of Retailing, 85(4), 522–526.

Goel, A., 2006. Enterprise integration EAI vs. SOA vs. ESB. Infosys Technologies White Paper, 87.

Haug, A., Arlbjørn, J.S., 2011. Barriers to master data quality. Journal of Enterprise Information Management, 24(3), 288-303.

He, H., 2003. What is service-oriented architecture. Publicação eletrônica em, 30, 1-5.

Heinemann, G., Schwarzl, C., 2010. Eight Success Factors in New Online Retailing. In New Online Retailing (pp. 92-186). Gabler.

Hübner, A., 2011. Framework for Retail Demand and Supply Chain Planning. In Retail Category Management (pp. 15-41). Springer Berlin Heidelberg.

Iannone, R., Ingenito, A., Martino, G., Miranda, S., Pepe, C., Riemma, S., 2013. Merchandise and replenishment planning optimization for fashion retail. International Journal of Engineering Business Management 5, 1-14.

IBM, 2007. The IBM Data Governance Council Maturity Model: Building a roadmap for effective data governance. IBM software group.

Järvinen, P., 2007. Action research is similar to design science. Quality & Quantity, 41(1), 37-54.

Khatri, V., Brown, C.V., 2010. Designing data governance. Communications of the ACM, 53(1), 148-152.

Kistasamy, C., Van Der Merwe, A., De La Harpe, A., 2010. The relationship between service oriented architecture and enterprise architecture, Enterprise Distributed Object Computing Conference Workshops (EDOCW), 2010 14th IEEE International 2010, IEEE, 129-137.

Klena (2013) From transactions to relationships - Connecting with a transitioning shopper. IBM

Lankhorst, M.M., 2004. Enterprise architecture modelling—the issue of integration. Advanced Engineering Informatics, 18(4), 205-216.

Lankhorst, M., Van Drunen, H., 2007. Enterprise Architecture Development and Modelling. Combining TOGAF and ArchiMate.

Loser, C., Legner, C., Gizanis, D., 2004. Master data management for collaborative service processes, International Conference on Service Systems and Service Management, Research Center for Contemporary Management, Tsinghua University.

Loshin, D., 2010. MDM Components and the Maturity Model. A DataFlux White Paper.

Magoulas, T., Hadzic, A., Saarikko, T., Pessi, K., 2012. Alignment in Enterprise Architecture: A Comparative Analysis of Four Architectural Approaches. Electronic Journal of Information Systems Evaluation, 15(1).

Marcant, C., 2011. Product Information Management: Definition, Purpose, and Offering. SapientNitro.

Menet, L., Lamolle, M., 2009. A Model Driven Engineering Approach Applied to Master Data Management, On the Move to Meaningful Internet Systems: OTM 2009 Workshops 2009, Springer, 19-28.

Mishra, M.R., 2011. A Study on Challenges and Opportunities in Master Data Management. International Journal of Database Management Systems, 3(2).

Murphy, J., Bois, R., Newmark, E., 2005. Taking the PIM Path on the MDM Journey. AMR Research Report.

Newman, D., Logan, D., 2006. Governance is an Essential Building Block for Enterprise Information Management. Gartner Research, Stamford, CT, 4.

NRF, (2014). Operational Data Model and Data Warehouse Model. National Retail Federation. https://nrf.com/resources/retail-technology-standards/data-models

Oberhofer, M., Dreibelbis, A., 2008. An introduction to the master data management Reference Architecture. Online (http://www.ibm.com/developerworks/data/library/techarticle/dm-0804oberhofer/)

Otto, B., 2012a. How to design the master data architecture: Findings from a case study at Bosch. International Journal of Information Management, 32(4), 337-346.

Otto, B., 2012b. Managing the business benefits of product data management: the case of Festo. Journal of Enterprise Information Management, 25(3), 272-297.

Otto, B., Hüner, K.M., Österle, H., 2012. Toward a functional reference model for master data quality management. Information Systems and e-Business Management, 10(3), 395-425.

Otto, B., Schmidt, A., 2010. Enterprise master data architecture: Design decisions and options, 15th International Conference on Information Quality (ICIQ 2010), Little Rock 2010.

Peffers, K., Tuunanen, T., Rothenberger, M.A., Chatterjee, S., 2007. A design science research methodology for information systems research. Journal of Management Information Systems, 24(3), 45-77.

PLATON, 2006. Arla Foods - Master Data Management - whitepaper. (http://www.platon.dk/files/pdfs/kundecase_arla_mdm_dk.pdf)

Pulkkinen, M., 2006. Systemic management of architectural decisions in enterprise architecture planning. four dimensions and three abstraction levels, System Sciences, 2006. HICSS'06. Proceedings of the 39th Annual Hawaii International Conference on 2006, IEEE.

Rajaram, K., 2001. Assortment planning in fashion retailing: methodology, application and analysis. European Journal of Operational Research, 129(1), 186-208.

Reynolds, J., Howard, E., Cuthbertson, C., Hristov, L. (2007). Perspectives on retail format innovation: relating theory and practice. International Journal of Retail & Distribution Management, 35(8), 647-660.

Russom, P., 2006. Taking data quality to the enterprise through data governance. The Data Warehousing Institute, Seattle.

Sammon, D., Adam, F., Nagle, T., Carlsson, S.A., 2010. Making Sense of the Master Data Management (MDM) Concept: Old Wine in New Bottles or New Wine in Old Bottles? DSS 2010, 175-186.

Sarsfield, S., 2009. The data governance imperative. IT Governance Ltd.

Shaw, D., Leeming, A., 1998. The Retail Industry and Information Technology. In Modelling for Added Value, 139-154. Springer London.

Silvola, R., Jaaskelainen, O., Kropsu-Vehkapera, H., Haapasalo, H., 2011. Managing one master data–challenges and preconditions. Industrial Management & Data Systems, 111(1), 146-162.

Smith, H.A., McKeen, J.D., 2008. Developments in practice XXX: master data management: salvation or snake oil? Communications of the Association for Information Systems, 23.

Smyth, G., 2013. Transforming an organization from fragile to agile with EA, SOA & BPM. (http://fragiletoagile.com.au/wp-content/uploads/2013/11/Transforming-an-Organisation-from-Fragile-to-Agile-with-EA-SOA-and-BPM.pdf)

Snow, C., 2008. Embrace the role and value of master data. Manufacturing Business Technology, 26(2), 38-40.

Spewak, S.H., Hill, S.C., 1993. Enterprise architecture planning: developing a blueprint for data, applications and technology. QED Information Sciences, Inc.

Sundström, M., Reynolds, J., 2014. Final Report from the Expert Group on Retail Sector Innovation. (http://ec.europa.eu/research/innovation-union/pdf/Report_from_EG_on_Retail_Sector_Innovation_A4_FINAL_2.pdf)

Tambo, T., 2011. International Fashion Retailing from an Enterprise Architecture Perspective. In: Pantano, E., Timmermanns, H. (eds), Advanced Technologies Management for Retailing: Frameworks and Cases. IGI global, PA: Hershey, 105-120.

Tambo T. 2014a. Collaboration on technological innovation in Danish fashion chains: A network perspective. Journal of Retailing and Consumer Services. 21(5), 827-835.

Tambo T. 2014b. Omni-channel Retail Information Systems. Khosrow-Pour M, editor. In Encyclopedia of Information Science and Technology (3rd Edition). 3 ed. Hershey, USA: Idea Group Publishing. pp. 874-882

Thomas, G., 2006b. The DGI data governance framework. The Data Governance Institute, Orlando.

Vaagen, H., Wallace, S.W., 2008. Product variety arising from hedging in the fashion supply chains. International Journal of Production Economics,114(2), 431-455.

Vilminko-Heikkinen, R., Pekkola, S., 2013. Establishing an Organization's Master Data Management Function: A Stepwise Approach, System Sciences (HICSS), 2013 46th Hawaii International Conference on 2013, IEEE, 4719-4728.

Weber, K., Ofner, M., Hsg, B., Cdq, C., Back, A., Brenner, W., Österle, H., Winter, R., 2008. Case study Ciba–organizing master data management. BE HSG/CC CDQ/11, Institute of Information Management, University of St.Gallen, .

Wende, K., 2007. A model for data governance–Organising accountabilities for data quality management, 18th Australasian Conference on Information Systems. The University of Southern Queensland, Toowoomba, Australia 2007, 417-425.

White, A., Newman, D., Logan, D., Radcliffe, J., 2006. Mastering master data management. Gartner Group, Stamford.

William Xu, X., Liu, T., 2003. A web-enabled PDM system in a collaborative design environment. Robotics and Computer-Integrated Manufacturing, 19(4), 315-328.

Wolter, R., 2007. Master Data Management (MDM) Hub Architecture.

Wolter, R., Haselden, K., 2006. The what, why, and how of master data management. Seattle: Microsoft Corporation.

Wong, W. K., Guo, Z. X., 2010. A hybrid intelligent model for medium-term sales forecasting in fashion retail supply chains using extreme learning machine and harmony search algorithm. International Journal of Production Economics,128(2), 614-624.

Yin, R.K., 2009. Case study research: Design and methods. Sage.

Zachman, J.A., 1987. A framework for information systems architecture. IBM Systems Journal, 26(3), 276-292.

Zhenxiang, W., Lijie, Z., 2011. Case study of online retailing fast fashion industry. International Journal of e-Education, e-Business, e-Management and e-Learning, 1(3), 195-200.