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City character and standardisation – A historical perspective – The case of Delft

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Abstract: This paper explores the relation between a city's character and standardisation activities in that city, taking the case of the Dutch city of Delft. In Delft's 2000 years of history, and in the current situation, many cases of standards development and use can be found. The analysis shows that these show a huge variety. Several cases go beyond 'normal,' and had or have substantial impact. This strong standardisation profile is in line with the city's character expressed in its branding. However, causal relationships cannot be found. The paper seeks for alternative explanations for the correlations. Future research may deepen this study and replicate it in other cities.

Keywords: Standardisation, City character, Case study research, History, Theology, Delft.

Highlights:

1. 39 current and historical standardisation cases from the Dutch city of Delft show an enormous variety.
2. Causal relationships between the cases hardly occur.
3. Empirical evidence for the relation between city character and standardisation initiatives is absent as well.
4. Bos' theology of cities provides an explanation.
5. A city's character may provide fertile ground for standards use or standards development

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1 Introduction

In their paper *The Necessity for a Local Level of Gastronomic Tourism Standardization: The Case of Torino's City Branding*, de Vries *et al*. (2017) connect standardisation in a city to the character of this city. They use the case of the Italian city of Torino. By analysing this city's history, de Vries *et al*. (2017) found a common denominator for the city: quality, or even excellence. They proposed to strengthen this quality character by means of standardisation at the local level by developing local quality standards for restaurants in the city. This initiative

would relate to the 'slow food'[1] movement in the Piedmont province, of which Torino is the capital. By defining characteristics of 'slow food', people in this province already use a form of local standardisation. In this way there would be a mutually enforcing relationship between city character (in the Torino case: quality) and standardisation (in this case: standardisation for sustainable agriculture, food, and restaurant services). However, this is what they propose in their paper, they do not provide empirical evidence of causal relationship.

This paper aims to explore the relationship between city character and standardisation in another way, by studying a case of a city with a clearly defined character in which quite some standardisation activities did and do occur: the city of Delft, the Netherlands. It does so by first tracing the city character. Next, an inventory is made of historical and current cases of standards and standardisation in the city. Then these are analysed, the analysis reveals a huge variety. The findings show hardly any causal relations between the cases, nor empirical evidence of a link between city character and standardisation. Surprisingly, an explanation of the link between city character and standardisation can be found in theology.

2 Research approach

Cities differ in their character, so for exploring the mutual relationship between city character and standardisation, case study research is an appropriate method (Yin, 2014). In the ideal case multiple cities are studied but in this paper a single case study is used as this allows to go more in-depth. In follow-up research, more cities can be studied.

The city chosen is the Dutch city of Delft. This is a convenience choice. The trigger for this study was the location of the 2024 conference of the European Academy for Standardisation EURAS: Delft. Moreover, the author of this paper lives in Delft, knows the city, knows its 'brand', can relate this brand to standardisation, and is – to a certain extent – familiar with both its history and the present situation.

For defining the city character he makes use of written documents about its character and branding. Delft's branding effort, though done for city marketing purposes, aimed to position the city by characterising it. See Chapter 3.

For the standardisation side, a definition of standardisation is needed. Unfortunately, academic researchers differ in how they define this concept. Here the author relies on the only academic paper on this topic available, written by De Vries (1997). He defines standardisation as "the activity of establishing and recording a limited set of solutions to actual or potential matching problems, directed at benefits for the party or parties involved, balancing their need, and intending and expecting that these solutions will be repeatedly or continuously used, during a certain period, by a substantial number of the parties for whom they are meant". This definition covers all forms of standardisation, including standardisation within companies.

This study discusses not only standards development ('standardisation') but also implementation and use of standards. ISO and IEC define standards as 'documents, established by consensus and approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context' (ISO/IEC, 2004, Clause 3.2). Probably the authors had the practices of ISO and IEC in mind when they agreed on this definition. Standardisation researchers tend to use the term in a broader sense. For instance, 'consensus' may not be essential, and a 'standard' may also result from a battle between competing specifications, or even competing 'designs' – then massive adoption is decisive rather than the process of

[1] See https://www.slowfood.com.

development. Literature lacks a common definition of this broad concept (see the chaotic diversity of definitions collected by Grillo et al. (2024, supplementary materials, table D1. For the purpose of this study the city's involvement in standardisation, in one way or another, is important. Therefore no categories of 'standard' are excluded beforehand so that the discussion can be based on a variety of empirical data. Because of the study's purpose, it also includes cases on, for instance, education about standardisation, standardisation research, and input from people in Delft to international standardisation. The author knows both historical and current cases of standards and standardisation in the city. In order to mitigate the inevitable personal bias, its history is investigated using a book that provides 50 'windows' to view the history (Bult et al., 2017)[2]. This book takes main events, persons or characteristics to describe highlights in the city's history, instead of describing the history in a chronological or thematic story line. Some of these relate to one moment in time (e.g., a fire), other ones to a certain period (e.g., the city's involvement in international trade companies).

The historical findings are presented in Chapter 4. The link to standardisation is the author's personal interpretation of the historical data, making use of his expertise in standardisation. For the description of several cases he adds additional sources: his personal archive of historical standardisation documents (these have a focus on company standardisation), books about the history of Delft, and case-specific books, articles, and Internet sources. References to such sources are included in the text, the parts of the text without references are based on the descriptions in the book by Bult *et al*. (2017).

Chapter 5 describes cases of current activities, companies and other organisations in Delft, all involved in standardisation or standards use in one way or another. An overview of standards use and standardisation activities in the city is not available but having lived in Delft for fifty years the author knows many of them, the selection is based on the author's knowledge about both the city and the standardisation field. The descriptions are mainly based on data at the websites of the organisation, where possible with supplementary data from other sources. Again, the link to standardisation is the author's personal interpretation.

Chapter 6 presents a cross-case analysis: are there any common patterns within and between the two sets of historical and current cases? For doing so a classification of cases is needed. Here the main paper devoted to classification in the field is used (De Vries, 1998).

Finally, Section 7 links the cases to the city character, discusses the findings and provides the conclusion.

3 Delft's city Character

A former mayor described its character as follows: 'Delft is […] a town with two characters. Here past and future are inextricably bound. Delft is steeped in culture, but also reveals an enterprising and innovative character' (van Walsum, 1991, p. 4). The municipal authorities combined these two sides of the city's character in defining a branding for Delft, namely 'Creating history' (de Vries, 2017). This refers to the city's history, still visible in its old city centre, but also in its historical heritage such as the world-famous Delft-Blue pottery, the paintings by Johannes Vermeer and the invention of the microscope by Anthony van Leeuwenhoek (Verhoeven, 2015, pp. 418 – 421). Currently, Delft University of Technology tops global rankings for Architecture, Civil & Structural Engineering, Mechanical, Aeronautical & Manufacturing Engineering, Water Resources, Transportational Sciences,

[2] See for an English-language website about this canon and the windows: https://www.canonvannederland.nl/en/page/107966/canon-van-delft.

Marine/Ocean Engineering and Chemical engineering,[3] so it has global relevance. The motto 'creating history' can be linked to standardisation: in the development stage of standardisation a solution to a matching problem is created, with the intention and expectation that this is going to be used, during a certain period (de Vries, 1997). So there is a time dimension as well and this links to history, but the real historical contribution should stem from the standard's impact. Delft is the city of the Netherlands Standardization institute NEN – the world's first independent national standardisation institute, founded in 1916 (Vermij, 2010). Also Delft's history shows several cases of standardisation. For instance, rules for international shipping stem from this city, and the expertise in optics influenced standards in that field.

4 Historical cases of standards and standardisation in Delft

This section describes historical cases for those windows in the canon of Delft for which the author sees a link to standardisation or standards use – the other ones have been omitted. The left-hand columns provides a window description, the numbers between brackets refer to the numbers of windows in the book by Bult *et al*. (2013). The right-hand column describes the link to standardisation.

Table 1: 'Windows' in Delft's history and the related standardisation dimension.

Window	**Standardisation dimension**
1. (2). 12 before Christ – 450. Period of Roman occupation. **Farmers delve small canals**.	Fields were surrounded by canals. The sizes of these rectangular fields were standardised: They met the 'golden ratio': their ratio is the same as the ratio of their sum to the larger of the two sizes, so a/b = (a+b)/a = 1.618. Within the Roman Empire this was a conscious choice (Poortenaar, 1947). It was Delft's first case of standards use. Many centuries later, a similar form of standardisation was used in the urban environment: in the 12th century, the width of lots in the city had was standardized – 1,5 rods (≈ 5.5 meters) (Verhoeven, 2015, p. 23).
2. (4). 1246. The Earl of Holland William II grants Delft **city rights**. The city becomes more independent but has to obey a set of rules set by the earl. These rules concern rights and duties of citizens, public administration and legal organisation, and rules of court. The municipal administration got permission to set additional rules. And they did – 62 articles, thousands of pages (Verhoeven, 2015).	City rules included rules for business for the sake of consumer protection, for instance food safety requirements. Only weights and measures approved by the city board were allowed. 'Market surveillance' was arranged to ensure the rules were really met (Verhoeven, 2015). Initially, standard sizes for, for instance, distances, butter packaging and grain packaging, were granted by Earl William II and his aunt Rikarde, in 1243. Delft had to pay for the use of these standards. In 1329 the city managed to get the right on setting butter packaging sizes themselves, and in 1342 also to give penalties for nonconformities (Verhoeven, 2015, p. 44). The freedom to set standards enabled the development of industry. Delft's textile production and -trade was mentioned first in 1317. The sector distinguished five

[3] https://www.tudelft.nl/en/about-tu-delft/facts-and-figures/tu-delft-in-international-rankings

	levels of textile quality. Quality control was in the hands of the city board, they employed six people for this purpose (Verhoeven, 2015, p. 46).
3. (6). 1342. The Earl of Henegovia and Holland William IV grants Delft **more rights**.	Rules included metrology standards and rules for trade in textile, grain, butter and fish.
4. (9). 1389. Albrecht of Bavaria, Earl of Holland, grants Delft the right to **delve a canal to the river Nieuwe Maas**. At that river, a settlement was built: Delfshaven ('harbour of Delft'). This gave the city the possibility to become active in international shipping. Its size should remain limited so that Delfshaven could not become an independent city.	The rules given to the city of Delft got into force in the new settlement Delfshaven as well.
5. (12). 1417. Duchess Jacoba of Bavaria grants **more independency to the city**.	Delft receives the right to set its own rules.
6. (13). 1450. **Clean water for breweries**. Local circumstances (availability of clean water and turf) allowed the city to become the main producer of beer in the country – during the period 1351 – 1358 around 50,000 barrels per year (one barrel = ca. 130 liter, so 6,500,000 liters, increasing to 203,000 – 252,000 barrels per year around in 1495 – 1510); 80% was exported, in the last period even 93% (van der Gaag, 2015, pp. 100-101, 163). Delft had its own fleet for the transport of beer and for getting the grain needed for the beer from other parts of the Netherlands, France and Great Britain.	The production process of the more than 200 breweries had to meet strict standards, for instance to protect quality (e.g. by sealing beer kegs for at least two weeks) (Verhoeven, 2015, p. 48). Not meeting the standards resulted in financial penalties. The enormous number of 200 breweries is caused by a municipal standard setting a cap on the maximum beer production per brewery: no more than 24 barrels per week. In the 15th century, withdrawal of this standard allowed the further increase of production (Verhoeven, 2015, p. 49, 165). In 1423 Duke Jan van Beieren ordered national standardisation of the sizes of barrels – three sizes: full, half and quarter. The city of origin would be indicated in a standardised way (Welleman, 1950). At that time citizens of Delft on average consumed more than one liter of beer per day. The breweries delivered the beer at home but in absence of a deposit system they faced problems in getting empty barrels back. Therefore they decided to attach a unique code on each barrel. One common employee had a full-time job for crossing the city to find empty barrels. The standardised coding system allowed him to bring each barrel back to the right brewery (Stolk, 2024). In the grain trade Delft's units for volumes of grain were used to measure volumes of grain: 'hoeden' (ca. 1000 liters) and 'achels' (12.5 liters). These standard units found wider application: they were used as the basis for calculations between the variety of different local volume sizes of cities in the Netherlands plus

	some cities in Great Britain and France (Verhoeven, 2015, p. 99).
7. (14). 1477. **The Delft Bible**. The first book ever printed in the Dutch language.	The spread of printed copies of this book contributed to the standardisation of the Dutch language via the linguistic choices made for this book.
8. (16). 1536. **City fire**. An enormous fire destroyed almost the entire city.	The fire urged the local government to set standards for fire safety, and to arrange inspection.
9. (17). 1558. **Pieter van Foreest**. This medical expert became city-physician. His role was to combat plagues.	Measures such as criteria for doctors, requirements to improve water quality, and quarantine measures for patients with infectious diseases can be seen as a form of standardisation for the sake of citizens' health.
10. (22). 1602. **The Chamber of Delft**. Delft hosted one of the six Chambers of the United East-Indian Company (VOC): the company that was granted a monopoly for trade with Asian countries. In 1672 Delft opened a yard in Delfshaven to build its own ships – 111 in total (van der Gaag, 2015).	Ships were built in a modular way. This allowed re-assembly once certain parts had been broken. Component communality was used as well, allowing a multitude of small suppliers to produce standard components. The VOC adhered to strict own rules, not only for the trade itself but also for slavery and warfare.
11. (23). 1618. **Hugo Grotius** in disgrace. Grotius was legal advisor of the Government of Holland and became an expert in both civil and church law. Because of religious conviction he was put in prison but escaped and moved to France. He became Swedish ambassador. Meanwhile he published hundreds of studies on law, political theory, philosophy and theology and their interrelations.	For Grotius, ethics, politics and law are not separate fields. 'Natural law' applies to these: defined by men rather than God-given. This is undisputed and taken for granted in current standardisation practice and research but at that time this idea was new (Stanford, 2017). Grotius (1609) wrote the famous book *Mare Liberum* (or *The Freedom of the Seas*) on international sea law. It is the basis for current law of the sea (United Nations Convention on the Law of the Sea UNCLOS). In former ages, there were no supranational entities like the UN so no legislator for the 'free sea'. This makes the rules Grotius formulated for international shipping the – probably – first case of international standardisation at a global scale. Also the rules Grotius (1625) formulated for warfare can be seen in this way.[4]
12. (25). 1645. **Gemeenland's building**. Seat of Hoogheemraadschap Delfland. This water management board, established in 1289, has a governmental status and takes care of water management in Delft and the surrounding area.	Since more than seven centuries ago, the water management board issues rules and inspects if the requirements are being met. Their policies are based on data. The map of the area, made in the period 1701 – 1713, was the most detailed large-area map in the world at that time. Nicolaas Cruquius started collecting meteorological data in 1705. In absence of recognised units of measurements he developed his own set of units including the

[4] For the latter he was not the first one. In 762, the Persian Islamic theologian and legal theorist Abu Hanifa already defined rules, for instance no killing of non-combatants, no sexual violence (Lindqvist, 2001).

	'cruquius' for temperatures. It became the world's oldest set of meteorological data (Verhoeven, p. 421)
13. (26). 1653. **De Porceleyne Fles**. Delft is famous for its Delft-Blue pottery, De Porceleyne Fles is the only remaining factory. In-between 1600 and 1850 Delft dominated the European pottery industry.	The more than 40 potteries had to meet strict standards. The Saint Luke Guild was in charge of conformity assessment, they supervised the quality. The Blue-white design served as a benchmark for potteries elsewhere. Archeologists coin it as standardisation (Kotsonas, 2014). Delft Blue can be seen as a dominant design as well.
14. (40). 1884. **Agnetapark**. Still visible in Delft: a part of the city with nice cottages in a green environment. This was an initiative by the entrepreneur Jacques van Marken. He founded the Netherlands Yeast and Spirits Factory, one of the first modern companies in the country. He was a forerunner in terms of occupational health and safety, fair wages, a pension fund and good living conditions for the workers (van der Mast, 2019). His wife Agneta supported him in this. Motto for the company was: 'The company for all, all for the company' (Jonckers, Boelen & Raaijmakers, 2009). The factory was first in the Netherlands in having an industrial research lab (van der Vlis, 2016, p. 153).	'The company was founded to pursue large-scale production based on scientifically defined procedures.' (Vermij, 2010, p. 181). This included the use of standards. In absence of regulations, van Marken developed his own standards for occupational health and safety. The Agnetapark is the first Dutch 'garden city' and served as a benchmark for other garden cities nationally and internationally. This comes close to the concept of 'dominant design'.
15. (46). 1945. **Secret term Bacinol**. The first company founded by van Marken was the Yeast and Spirits Factory. During the Second World War they did research on penicillin, in close cooperation with one of the local hospitals. They found out how to upscale the production. After the war the factory became the world's main producer of penicillin.	The factory developed many internal standards setting requirements for components of its production facilities. For these components the company operated a systematic article classification and coding system, resulting in unique 9-digit article numbers for similar components (Gist Brocades NV – CTS-Normalisatie, 1982). Standardisation had the attention of the company's management. For example, in 1954 CEO Van Leeuwen did the introduction speech at a national conference on the benefits of standardisation (Van Leeuwen, 1954).
16. (48). 1945-1970. **Delft seeks higher ground**. Scarcity of space and increase of the number of inhabitants made the city decide for high-rise buildings.	Around 1950, houses and apartment buildings were built at the East side of the city (Bomenwijk) for which prefab concrete components were used (van der Vlis, 2016, p. 313). Sizes were standardised. Since 1960 tall apartment buildings were built south-west of the city centre. These were highly standardised for the sake of cost reduction – at the level of components, modules,

	apartments and entire buildings: all the same, allowing replication and thus economies of scale.
17. (50). 1986. **Delft University of Technology**. Technical education and research in Delft formally started in 1842 but in 1986 the 'Hogeschool' became a university. Nowadays it has 28,000 students (for comparison: the city has 110,000 inhabitants). Scientific research in the city is much older. For instance, in 1586 or slightly before, Simon Stevin and Jan de Groot falsified Arestoteles' theory that heavy objects fall with higher speed than light ones. For their experiment they dropped objects from the tower of the New Church (Verhoeven, 2015, p. 419). In 1815 military higher education started in Delft. Because of misbehaviour of students it was decided they should no longer live in the city but in a barracks. Because of lack of space for building the barracks, this education moved to another city, Breda, in 1826 (van der Vlist, 2016, pp. 64-65).	From the outset, the university and its forerunners were involved in standardisation. The first decades of formal standardisation in the Netherlands were dominated by engineers, most of them educated in Delft (Vermij, 2010). The university was and is involved in pre-normative research. Dozens of professors did and do participate in standardisation committees. Some researchers also were involved in teaching about standardisation. Zuithoff (1962) suggests that at that time it was common practice to pay attention to standards. However, standardisation got some attention as well – university professor Van Emden (1953) presented a method to calculate benefits of standardisation at company level. More recently, teaching materials were developed for mechanical engineering and for materials science, in cooperation with the chair on standardisation in the neighbouring city of Rotterdam (e.g., Simons & de Vries, 2002; van Mourik, van der Hoek & de Vries, 2012). For many years, Tineke Egyedi did research on standardisation at the faculty Technology, Policy and Management, and she was President of the European Academy for Standardisation (EURAS) as well. Currently, Geerten van de Kaa and direct colleagues form a standardisation research and education unit. Last but not least, Geerten is also editor of this journal, the *Journal of Standardisation*, and Delft University of Technology is its publisher.[5]

5 Current cases of standards and standardisation

The last window in Section 3 brings us from Delft's history to the current situation. This section lists several other cases, in alphabetical order.

Table 2. Current organisations and areas in Delft and their link to standardisation.

Company / organisation / area	Standardisation dimension
18. **Bieslandhoeve**.[6] Biological farm. They sell their products in their own shop and via restaurants and shops in Delft.	This farm adheres to the principles of Slow Food. Some of their products are Demeter-certified.[7] Demeter is a global movement of farmers, manufacturers, and researchers that practice and value biodynamic farming methods. This community has developed common standards together. The Demeter trademark signals adherence to these standards.

[5] https://journals.open.tudelft.nl/jos.

[6] https://hoevebiesland.nl.

[7] https://demeter.net.

19. **BPO**.[8] Design office. From initial idea to functional and manufacturable product.	BPO includes the use of standards and conformity assessment in their service package. They are active in additive manufacturing – this provides additional challenges for the standardisation and conformity assessment part. The company investigated this in cooperation with the chair on standardisation at the Rotterdam School of Management, Erasmus University (Peeters, 2011).
20. **Delft Convention Bureau**.[9] Municipal agency that supports organising conferences in Delft.	They provide a unique service package by assembling the offers from many companies in Delft (e.g., different forms of transportation, conference rooms, technical equipment for these rooms, catering, hotels, restaurants). This can be seen as company standardisation. Literature on that topic focuses on product standardisation and standardisation of (components of) installations (e.g., Nakamura, 1991). This is a service example (Shamsuzzoha, Blomqvist & Takala, 2023).
21. **Deltares**.[10] The independent knowledge institute Deltares works on innovative solutions in the field of water and subsurface, in the Netherlands and abroad.	Deltares is actively involved in developing standards (including pre-normative research) and in using standards (including standards for testing).
22. **European Patent Office**.[11] Not in Delft but just 4 km. cycling from Delft city centre, in Rijswijk.	Standards and patents may get combined in the form of standard-essential patents (SEPs) (Bekkers, 2021).
23. **Exact**.[12] Producer of business software, with focus on SMEs.	Modular design of the software.
24. **Festo**.[13] Family business active in industrial automation, process automation, lifetech automation, and digital engineering tools.	Festo needs many technical standards. On top of that they have a policy in sustainability and make sure they comply to applicable standards.
25. **Honeywell**.[14] A former Dutch company, now part of an American multinational. Focus on building automation.	Honeywell's office in Delft is very active in ensuring that the company's products meet the applicable standards in Europe. So it is active both in standards and in conformity assessment. The company participates in standardisation committees and used to be member of the Dutch standards users association NKN.
26. **Ikea**.[15] Ikea is known to be Swedish but actually its	Ikea's product standardisation is well-known. They consistently apply the four main principles of product

[8] https://bpo.nl/en.

[9] https://www.delft.com/about-delft-marketing.

[10] https://www.deltares.nl/en.

[11] https://www.epo.org/en.

[12] https://www.exact.com.

[13] https://www.festo.com/gb/en.

[14] https://www.honeywell.com/us/en.

[15] https://www.ikea.com.

headquarter is in Delft. This is not just a P.O Box for tax reasons. Ikea uses franchising for its shops, but the shop in Delft is the only one owned by Ikea. It is the biggest Ikea shop in the world. Next-door, Ikea has its headquarter and its shop design centre. They use the shop in Delft to showcase and experiment with new shop designs and the allocation of the products.	variety management: component commonality, modularity, platforms and postponement. It is less known that they also apply standardisation in their shops. First, the product portfolio is similar all over the world, no matter local preferences. Second, the way the shop is shaped is standardised – based on the design of the shop in Delft. In that sense, this shop design in Delft services as a company-internal dominant design.
27. **Improve**.[16] Audiovisual support for events including 3D recording.	The company not only applies standards for the equipment they use for supporting the events, they also invested in service standardisation for the event business: their director became chair woman of the Dutch standardisation committee in this field. This committee developed 13 national standards for events, with a focus on safety.[17]
28. **Mojo Concerts**.[18] The company organises approximately 200 shows per year, for 4000 concerts in the Netherlands and abroad, and they arrange bookings for 100 Dutch artists. They are market leader in the Netherlands.	National or even international standardisation for events is hindered by leading companies in organising events: they have their own set of superior standards. Sharing this knowledge by making it available in formal standardisation might affect their market share. Mojo indeed has a strength in having their own set of standards.
29. **NMi**. 'Independent specialist for testing, certification and training in the field of metrology.'[19] NMi is a Notified Body for the European regulations for measuring instruments, the Measuring Instruments Directive (MID 2014/32/EU) and the Non-Automatic Weighing Instruments Directive (NAWI 2014/31/EU), and certifies most measuring equipment.	Both the metrology field and the activity of certification rely on standards.
30. **Octatube**. 'Octatube brings bold, complex and challenging designs of facades, roofs and other architectural structures to life with innovative bespoke solutions.'[20]	Octatube uses standards not only for the constructions they design but also for, for instance, management systems and sustainability. They obtained certifications based on these standards.

[16] https://www.improve.nl.

[17] https://vvem.nl/kennisbank/nen-normalisatie-voor-evenementen.

[18] https://www.mojo.nl.

[19] https://nmi.nl.

[20] https://octatube.nl/en_GB.

31. **Prysmian Group Netherlands**.[21] Cable company. The former Dutch company Nederlandse Kabelfabriek (NKF), founded in 1913, is now part of the multinational company Prysmian Cables and Systems. They produce cables for electricity, from low to high voltage.	For more than a century now, the company is actively involved in using standards and in involvement in standardisation. Standards are extremely important for cables and the systems in which these are being used.
32. **Royal Netherlands Standardization Institute NEN**.[22] The Royal Netherlands Standardization Institute (NEN) 'is a private, non-profit organisation, founded in 1916 by the Netherlands Society for Industry and Trade, in cooperation with the Royal Institute of Engineers.'[23]	NEN's mission is threefold: (1) assuring active involvement of all stakeholders in the Netherlands in the development of international and European standards, and where still appropriate, of national standards; (2) promotion of the use of standards and standardisation within the Netherlands; (3) operating as the central point in the Netherlands for information on standards and standards development.'[24] During most periods of its history, NEN was one of the most active national standards bodies in the world. They took a substantial number of international and European committee secretariats, and they played an important role in the governance of international and European standardisation as well. NEN played a leading role in fields like chemistry, electrotechnology, oil and gas, and management systems, and in more specific areas such as accreditation, green houses and soil quality.
33. **Samsung Electronics Logistic Services (SELS)**. Samsung has its headquarter for European logistics in Delft.	Samsung's involvement in standardisation is up to the Korean mother company. However, they apply standardisation for logistic operations as well. And they employed the 2022 winner of the European Standards and Innovation award, Ivan Navarro González (Navarro González, 2022).[25]
34. **Tanthof East**. Quarter in the South of Delft, built in the 1970s. It consists mainly of low-rise houses.	Like the Agnetapark and Voorhof, this area serves as an 'extreme case' of a certain style of architecture, in the Tanthof case informally called 'cauliflower area'. This may be seen as a dominant design for that period. More in general, Delft is known for its architecture in many different styles (Boekraad *et al*. 2009) but also in 'Unity in variety' at the level of neighbourhoods (Boekraad et al., 2009, p. 113). This term stems from the famous architect and urban designer Berlage who designed a part of Delft in 1920 – the city as a piece of art for the benefit of all its citizens, no matter social

[21] https://www.prysmian.com/en.

[22] https://www.nen.nl/en/

[23] https://www.iso.org/member/2027.html

[24] https://www.iso.org/member/2027.html

[25] https://www.cencenelec.eu/news-and-events/news/2023/brief-news/2023-10-02-2022-standards-innovation-awards-winners. See for the paper Navarro González (2022).

	class. Balancing between unity and variety is a central theme in standardisation research (Simons, 1994).
35. **The Green Village**. Field lab for sustainable innovation in the urban environment. 'At The Green Village, knowledge- and educational institutions, entrepreneurs, government bodies and civilians can research, experiment, validate and demonstrate their sustainable innovations.' It allows to 'test on neighbourhood-, street- and building level.'[26]	The Green Village is exempted of standard rules and regulations. This allows to experiment, not being hindered by current standards. But of course, in order to make inventions a market success, standards may be needed; existing ones and sometimes also modifications of these standards or new ones. The Green Village cooperates with NEN and with the chair on standardisation at the Rotterdam School of Management, Erasmus University (RSM) to support them in this sense: in 2023 and 2024, groups of RSM students provide the entrepreneurs with operational and strategic standardisation advice.
36. **The Hague University of Applied Sciences – Campus Delft**.[27] The name may suggest it is a university but this school offers higher vocational education. At Campus Delft the technical education is concentrated, 7000 students.	Standards are relevant for most if not all of the technical areas. Students have access to NEN's standards database.
37. **TNO**.[28] Applied science and technology organisation. The biggest research organisation in the Netherlands. Their headquarter used to be in Delft, close to the university, but they decided to move to the nearby city of The Hague, at walking distance of the political centre where most of their money comes from. But some of their research labs are still in Delft (van der Vlis, 2016, pp. 333-334).	TNO not only uses standards for their research, they also participate in standardisation committees and they are active in pre-normative research and conformity assessment.
38. **VSL**. The National Metrology Institute.	'VSL makes measurement results from companies, laboratories and institutions directly traceable to international standards. On behalf of the Dutch government, we manage and develop the national measurement standards and make an important contribution to the reliability, quality and innovation of products and processes in business and society.'[29]
39. Different organisations in Delft play a forerunner role in the area of **quantum computers**. **Delft University of Technology** does	The forerunner role includes standardisation. The Netherlands Standardisation Institute NEN participates in the recently established CEN/CENELEC Joint Technical Committee 20 Quantum technologies, Oskar

[26] https://www.thegreenvillage.org/en.

[27] https://www.thuas.com/about-thuas/our-campuses/delft-campus.

[28] https://www.tno.nl/en.

[29] https://www.vsl.nl/en.

research in this area. Also research institute **TNO** is active in this field. **QuTech** develops scalable prototypes of a quantum computer and a quantum internet.[30] Their Quantum Internet Division is the technical coordinator of the Quantum Internet Alliance, a community of 40 of Europe's leading academic, industrial and research technology organisations in nine countries, working together to build the world's first full-stack prototype quantum internet network. **Quantum Delta Netherlands**[31] coordinates the activities in this field in the country both in terms of contents and ecosystem. The local ecosystem is **Quantum Delft**.[32] Several start-up companies in Delft develop and produce components, for instance **Blueforce**[33] (cooling equipment), **Delft Circuits**[34] (cabling), **Orange Quantum Systems**[35] (quantum chips, test equipment), **Q*Bird**[36] (devices for quantum-secured data communications), **Qblox**[37] (control instruments and control software), **Qphox**[38] (quantum modems), **QuantWare**[39] (quantum computer assembly), and **Single Quantum**[40] (photone detection).	van Deventer (TNO) is its chair.[41] Together with colleagues, Van Deventer developed a systematic plan for standards development in this field. Their standards architecture resembles the well-known OSI model (van Deventer et al, 2022). In cooperation with TNO and QiTech, the companies Delft Circuits, Qblox, Orange Quantum Systems en QuantWare prepared proposals for standards development.[42] In their perception the only way for SMEs to compete with the big tech companies like Amazon, Google and IBM is by developing common industry standards for components (van Wijnen, 2024).

[30] https://qutech.nl/

[31] https://quantumdelta.nl/.

[32] https://quantumdelft.nl/.

[33] https://bluefors.com.

[34] https://delft-circuits.com.

[35] https://orangeqs.com.

[36] https://q-bird.com.

[37] https://www.qblox.com.

[38] https://qphox.eu.

[39] https://www.quantware.com.

[40] https://www.singlequantum.com.

[41] https://www.tno.nl/en/about-tno/our-people/oskar-deventer/.

[42] https://www.nen.nl/nieuws/ict/ontwikkeling-van-standaarden-voor-quantumtechnologie-van-start/.

6 Cross-case analysis

Maybe the most remarkable in the 39 cases is their variety. This applies in different ways, see Table 3 for a case-by-case overview. The scores are the interpretation of the researcher. Most of these scores are based on written sources but some of them are just a best guess without empirical evidence. The four columns are discussed in the sections below. The last section, 6.5 seeks for interrelations between the cases.

6.1 Mode of standardisation

A general assumption in standardisation literature is that standards emerge either as a conscious choice within a committee or government, or as the outcome of a battle in the market: three modes of standardisation (Wiegmann *et al.*, 2017). Several of our cases show another category, coined by Simons (1994) as historical standardisation: first there is a design, this leads to massive use, and because of that it is perceived as a standard. So it has become 'standard' thanks to acceptance in the market but not necessarily as a result of a battle or a conscious process of standardisation. Such a 'standard' may be formalised to become an official standard at a later stage – as in the case of the audio compact cassette. This category applies to the sizes of the acres (1), the language used in the Delft Bible (7), the Delft Blue pottery design (13), and urban design (14, 16, 34). This brings this category close to the concept of dominant design. Abernathy and Utterback (1978) defined a dominant design as a combination of principal components and basic core concepts that do not vary significantly from one product architecture to another and allow the needs of a mainstream market to be met.

The definition of standardisation used in this paper (de Vries, 1997) includes in-company or 'internal' standardisation. That category is not visible in the three modes of standardisation because those stem from economic literature about arrangements in the market. Company standardisation is one of the levels of standardisation distinguished by Brady (1929) and Verman (1973). Basic books on company standardisation include *La normalisation dans l'entreprise* (AFNOR, 1967), *The New Standardization* (Nakamura, 1991) and *Bedrijf en norm* (Ghijsen et al., 1962). Indeed, old sources – the topic became marginal in standardisation research but not in business practice.

In Delft we did not find any evidence of standards battles, therefore we did not include a column for that category.

In the cases 1-9 and 12, in the period before 1600, we did not find any internal or committee-based standardisation. Most cases were governmental standardisation: standards were set initially by the earls of Holland and the responsibility gradually shifted step by step to the municipal authorities, via the city rights arrangements. At that time, there was not a well-developed legal system. These 'regulations' were initially issued by the ruler (the earl of Holland) and step by step this responsibility was handed over to the city council. This paper focuses on technical rules. These were 'decrees' rather than laws. It can be discussed if these should be seen as technical regulation or as technical standards. In historical standardisation studies (e.g., *Centre de recherche en histoire des sciences et des techniques* (Eds.), 1997); Ritter, 1999), technical measures by rulers are seen as standards. Standardisation literature about the 'governmental mode of standardisation' (Wiegmann et al., 2023) is not clear about this: is this about standards developed by government or standards imposed by government? In the Delft example both is the case. But how to distinguish technical regulation from standardisation? In the European New Approach there is a clear distinction: the directive is the legislation and it refers to a standard developed by CEN, CENELEC or ETSI. In Delft the distinction between business and city council was tight. Formerly, the local government

consisted of the city elite, so there was personal overlap with leading business-people. In that sense, they made standards for their business via the municipality. Because of that, internal standardisation apparently was not needed. Moreover, all companies were small. A third explanation for their absence in the cases before 1600 may be that if any standards were in place in some companies, these probably were not visible to the outside world und thus not in archives and historical descriptions. In later years governmental standardisation shifted to the national government and nowadays also the European Commission, while the water management board continues. But meanwhile committee standardisation plays a more prominent role, and due to the increase in company sizes also internal standardisation. The latter started with rationalisation but then broadened to services, management systems and societal aspects. Interestingly, the category of historical standardisation continues for 2000 years already. A last development we can notice: before 1600 the cases can be classified in one mode of standardisation, since then the majority of them relates to two or more modes.

6.2 Entities to which the standard applies

Standards may relate to several entities: products, processed materials, software, services[43], processes and management systems. All of these can be found in Delft and most organisations use standards for different categories of entities. The early cases of management systems probably do not cover all elements we currently see as essential for a management system standard,[44] but it is remarkable to see old cases as well. The data do not always reveal if a companies implemented any management systems standard(s) – probably our listing is incomplete for that category. The cases show an additional entity category not mentioned in papers that address classification of standards: real estate (acres, water, houses, other buildings). All categories can be found throughout history, except of course for software standards. In many cases, not only current ones but also historical cases, different entity categories apply in one case.

6.3 Standards categories

De Vries (1998) distinguishes between basic standards (e.g., terminology, architectures), performance standards, solution-describing standards and measuring standards. All of these apply in Delft and in most cases we see more than one category. Standardisation literature recommends performance standards over standards that provide solutions (Montgomery et al., 2019), but we notice both of them, and even more cases of standards that prescribe solutions. These may hinder innovation, unless they specify and interface between entities (compatibity standards).

6.4 Standards making or standards taking

A standard is made for being used so it is self-evident that almost any case that relates to standards making also shows standards taking. The opposite is not true – a standard used in

[43] This distinction stems from older versions of standards for quality management in the ISO 9000 series. 'Processed materials' refers to for instance petrol, sugar, milk or chemicals – they are processed or produced in process industries and before being sold they need a form of packaging. Software differs from physical products in terms of production – all emphasis is on the design, the 'production' is just selecting the information carrier and then 'copy – paste'.

[44] As listed in ISO's *Harmonized structure for management systems standards* (ISO, 2023).

Delft may have been developed outside the city. And for standards development different levels apply: company-internal, local, national or international (Verman, 1973; de Vries, 1998).

Table 3. Overview of case characteristics.

Case #	Mode of standardisation				Entities to which the standard applies							Standard category				Standards making or Standards taking				
																	Making			
	Historical	Internal	Committee	Government	Product	Pocessed materials	Software	Real estate	Service	Process	Management system	Basic	Performance	Solution-describing	Measuring	Taking	In-company	Local	National	International
1	■							■						■		■				
2				■	■	■				■				■	■	■		■		
3				■		■			■	■				■	■	■		■		
4				■					■	■				■	■	■		■		
5				■								■	■	■	■	■		■		
6				■	■	■			■	■		■	■	■	■	■		■		
7	■				?	?	?	?	?	?	?	■							■	
8				■	■			■	■	■			■	■		■		■		
9				?		■		■	■	■	■		■	■		■		■		
10		■	■	■	■				■	■			■	■		■	■	■		
11			■	■				■	■	■		■	■	■						■
12		■	■	■				■	■	■		■	■	■		■		■		
13		■	■	■	■	■				■				■		■	■	■		
14	■	■	■	■	■	■		■		■	■		■	■	■	■	■			
15		■	■	■	■	■	■			■		■	■	■	■	■	■			
16	■							■						■		■	■	■		
17	■	■	■	■	■	■	■			■			■	■	■	■			■	■
18		■	■		■	■		■		■			■	■	■	■				
19			■		■	■	■		■	■			■		■	■				
20		■							■			■		■		■	■	■		
21		■	■	■		■	■	■	■	■	■	■	■	■	■	■			■	■
22			■		■	■			■	■				■		■				
23		■					■							■	■	■	■			
24			■	■	■		■			■			■	■	■	■				
25			■	■	■			■	■				■		■	■				■
26		■			■	■	■	■	■	■			■	■	■	■	■			
27		■	■		■		■		■	■		■	■	■		■	■		■	
28		■					■	■	■	■	■			■		■	■			
29			■	■	■				■	■	■	■	■	■	■	■				
30		■	■	■	■			■					■		■	■				
31			■		■		■		■				■		■	■				
32			■		■	■	■	■	■	■	■	■	■	■	■	■			■	■
33		■	■		■		■					■	■	■	■	■				
34	■							■						■		■		■		
35	■	■	■	■	■	■	■	■	■	■			■	■	■	■			■	
36			■		■	■				■			■	■	■	■				
37			■	■	■	■	■		■	■	■	■	■		■	■			■	■
38			■	■					■	■	■	■	■	■	■	■			■	■
39			■		■	■	■		■	■		■	■	■	■	■	■	■	■	■

6.5 Causal relations between the cases

The data do not reveal clear causal relations between the cases. However, at the level of persons there are interrelations. Roughly between 1300 and 1700, the city council played an important role. They operated the quality infrastructure, and standardisation was part of that. Since 1600, private companies got more influence but the dominating ones were owned by the 40 families from which the city council was chosen. So there were close personal links. The small size of the city also allowed numerous informal and formal personal contacts. During the last century, both the university and the standards body had and have links with other organisations. The oldest example is Van Marken, the first graduate of the predecessor of Delft University of Technology, in 1867 (van der Mast, 2019). Professors of the university were involved in Delft's urban design. This involvement made Delft a forerunner in urban design and architecture, Delft design became 'the standard' and this was replicated all over the country. Professors had contacts with industry leaders, both formally and informally, and gave advice about technical solutions (van der Vlis, p. 176). For most cases we lack data about a relation with the university. The same applies to companies' participation in NEN committees – the current set of companies involved in standardisation or in using standards is probably incomplete.

Other networks may have played a role as well: general business networks and specific standardisation networks. Indeed, some local business network exist and the chamber of commerce plays a connecting role. The data do not reveal any standardisation-specific activities, except for Technet Delft: an association of tech companies in Delft and surrounding villages and cities[45]. NEN used to be member and their PR officer even was Board member.[46] A standardisation-specific network also used to exist in the Netherlands: the national standards users organisation. It had regional 'circles' where standards experts from companies could exchange ideas. The 1987 membership list includes three companies from Delft (Winter, 1987) – not enough to explain the many other standardisation activities in the city.

6.6 Conclusions

The analysis reveals many cases of standardisation, some of them with an even global impact. There is an enormous diversity between the cases, throughout history. Applying four lenses to classify the cases reveals a lack of patterns, except for the governmental mode of standardisation. The findings show hardly any causal relationships between cases.

7 Discussion and conclusions

Using the case of Delft, this paper aims to explore the relationship between city character and standardisation in that city. Section 7.1 relates the city's character to standardisation and finds a positive relationship. Our data show many cases of standards and standardisation in Delft, both historical and current cases. However, our cases showed hardly any causality between the cases nor between city character and standardisation. Therefore, Section 7.2. seeks for an alternative explanation. Section 7.3 lists some limitations of the study and adds four cases. Next, Section 7.4 provides further discussion and suggestions for follow-up research, and the chapter ends with the Conclusion.

[45] https://technetdelft.nl/.

[46] https://technetdelft.nl/nieuws/in-memoriam-piet-vos-1940-2023/.

7.1 Relating city character to standardisation

Delft's character has been defined as 'Creating History'. Theoretically, this character can be related to standardisation. Based on the definition presented in Chapter 2 (De Vries, 1997), standardisation concerns solutions to actual or potential problems, intended and expected to be used by a substantial number of the parties for whom they are meant. So, first, standards are created, and, second, thanks to this substantive use, the standards are intended to have impact. Wiegmann, de Vries and Eom (2023) describe via which steps this impact may be achieved. So indeed, standardisation is a way of 'creating history': the created standards lead to impact.

In case the impact is limited we would not qualify it as creating history. Connecting this to our cases, Hugo Grotius (case 11) may be the most convincing example: the world was changed thanks to this form of standardisation. Standards making potentially has more impact than standards taking, and making international standards has more impact than making standards at lower level. For making internal standards the impact may be comparable to taking (and implementing) standards. However, our cases also show that internal standards may have substantial impacts, even at global level as in the Ikea case (26). Cases 1, 3, 4, 5, 8, 9, 13, 16, 18, 19, 20, 24, 25, 30, 31, 33 and 36 might be seen as 'normal', probably similar cases can be found in other cities. The other 22 cases are exceptional in one way or another, confirming the forerunner role of this city. The 17 'normal' ones are nevertheless listed, for several reasons. First, use of relevant standards may seem obvious but in business practice it is not. In the author's experience, a substantial share of the limited number of Dutch companies that indeed consistently use standards are in Delft. Second, these cases add to the diversity in terms of the four dimensions used in section 6 (Table 3). Moreover, in case some of the historical cases would have been omitted, it would no longer be clear that 17 out of the 50 historical windows relate to standardisation or standards use, another way of highlighting the high level of involvement of Delft in this field.

7.2 Alternative explanation for the relation between city character and standardisation

Characters of cities have been investigated by Bos (2016) as well. He recommends doing historical research and having interviews with people who know the city pretty well to discover the city's identity and then to have additional interviews to check it. Then the 'branding' is an underpinned – but still inter-subjective – finding rather than the result of efforts of marketeers. Bos developed his view on cities by combining his expertise in urban planning with theology. According to him each city reflects one or more characteristics of God. 'Creating history' would be an example of that: God as Creator and as the One at the start of history, being present during history, and leading history to its destination.[47] Bos argues that citizens and organisations in a city as well as authorities tend to behave according to this 'given' character of the city. So the city character may make the city fit for certain activities. Reflecting even as aspect of God's character, these activities can be seen as positive. However, there may be dubious activities as well and according to Bos (2016) then the way of this misbehaviour is also typical for the city. In the case of Delft the export of optical equipment to Iraq in the period of Sadam Husein would be an example of such misbehaviour (van der Vlies, 2016, p. 393), as well as the city's role in slavery (Jouwe, Verhoeven & van der Vlis, 2023): creativity used in a direction of oppression rather than serving others.

[47] For several years, Bos lived in Delft. He agreed to the 'Creating history' characteristic of this city (Source: personal communication).

This view by Bos (2016) could explain that we found so many cases of standardisation in Delft without any empirical evidence that the cases influenced each other – being a fruitful environment for standardisation might be inherent to the city as such. Bos (2002) recognises similar characteristics at the level of countries. In that sense his work can be seen as an extension of the research by Hofstede (2001) who studied differences between countries on several dimensions, and the later work by House (2010). Manders (2014) applied this to one case of standardisation: the implementation of the quality management standard ISO 9001. She expected several differences in terms of impact on both operational performance and market performance but most of these were not confirmed empirically.

The characteristic of 'quality' of Torino could also be seen as a reflection of an aspect of God's character, and other cities will have other characteristics. These can align with standardisation, or not. In the latter case this might explain a lack of standardisation.

7.3 Limitations

The many cases are scattered and there is no manifest relation. Because of the small size of the city (in former ages the 3rd city of the country with 20.000 inhabitants, then a decline to 6000, nowadays 110.000 – in size the 29th city of The Netherlands) there might be some informal links but our research method – desk research only – does not allow to conclude that. Investigating this for the past is not feasible but for the current situation it is. A follow-up action could be to extend this research with interviews with companies, and with representatives of current network organisations such as the municipality, the local business network, the chamber of commerce, organisations like rotary clubs, and, last but not least, the very active local historical association:[48] does or did the topic of standardisation play any role in these networks? The author of this paper once did a presentation about standardisation for a local rotary club – this is a small example.

Another limitation is in de selection of historical cases – by taking the 50 'windows' of the Canon of Delft as a starting point. First, these 'windows' tend to show highlights of the city's history. This explains the jump from 1653 to 1884 in the list of historical cases – in-between there was a period of decline. It remains unclear if this missing period can be linked to standardisation in any way. Also not visible in the data: the decline of the traditional industry base in Delft during the last decades of the 20th century. Delft became a services city: growth of the university, higher vocational education moving to the city, healthcare, research and design institutes and companies. Another limitation related to the choice for the canon is the criterion for inclusion in this canon: being characteristic for Delft. This perfectly fits this study's aim but this does not apply to the standardisation side. Some historical cases that are relevant from a standardisation perspective may have been omitted. This applies at least to four cases: the weigh-house, the guilds, machine factory Reineveld and the Covid- 19 measures.

The first mentioning of a weigh-house in Delft is from 1342. The current building is from 1539. As an active trading center, Delft was obliged to weigh merchandise in a city weighing scale, to ensure objective measurements. This activity ended in 1996. Of course, measuring is based on standards – initially local standards. Weighing equipment is still visible in the building, currently a restaurant.[49] By the way, this was the first restaurant in the Netherlands accepting bitcoins. The bitcoin choice can be studied from a standardisation perspective as well, for

[48] https://delfiabatavorum.nl/.

[49] https://de-waag.nl/Stadscafe/Geschiedenis/.

instance by using the lens of standards battles (Wiegmann et all, 2017) – connecting also this dimension to Delft.

A second historical case are the guilds. Case 13 mentions the Saint Luke Guild in the context of Delft Blue potteries but Delft had many guilds, one per profession. Guilds helped reduce transaction cost 'by creating a stable environment, which encouraged craftsmen to invest in training the successor generation. Second, through the coordination of complicated production processes. And finally, in the marketing stage, through the reduction of information asymmetries between producers and customers' (Epstein & Prak, 2008, p. 8). Guilds did not, as often assumed, 'impose a uniform standard of quality, but merely testified to the fact that the master was able to produce at a certain (minimum) level of expertise. Alternatively, guilds could require that their members' products meet certain quality standards, and attach a label or other testimony for export purposes' (ibid., p. 13). Epstein and Prak (2008) show that guilds contributed to innovation.

The third case is the medium-sized machine factory Reineveld (1840 – 1973). Their presentations at national company standardisation events in 1957 and 1960 (Vijgeboom, 1957; 1960) show that they applied product variety management based on standards in a systematic way, seeking the right balance between 'standard' and variety. So they did what decades later Exact and Ikea would do.

The last case concerns the local Covid-19 measures. Shops in the city centre cooperated in coping with rules and were creative in developing and agreeing on common measures (De Vries, 2021).

The selection of current cases relies on the author's knowledge of the local situation. Undoubtedly more cases would apply as many companies use standards and a subset of these a subset of these is involved in standardisation. As mentioned, some of the included company cases are not very special whereas other company cases stand out because of their forerunner role in standardisation (BPO, Exact, Ikea, Improve, Mojo), or because they are unique in the country (Deltares, Nmi, NEN, The Green Village, VSL). Altogether these cases make Delft much more a standardisation city than other cities of similar size – probably no other Dutch city offers more standardisation engagement[50].

A last limitation is that for most cases the driving forces behind standardisation remain hidden: the data show *that* it is in place, but not always reveal *why*.

7.4 Future research

The historical and current cases confirm that Delft was and is really active in the field of standards and standardisation. It would be interesting to study other cities that play a prominent role in standardisation, and to relate this to the character of that city. Prominent candidate cities are Seoul, Hangzhou, and Berlin. South Korea is very active in standardisation and a forerunner country in stimulating education about standardisation inside and outside the country (Choi & de Vries, 2013), and these activities are concentrated in the capital city of Seoul. Hangzhou is unique in hosting the world's only university specialised in standardisation and other elements of the quality infrastructure: metrology, conformity assessment (including certification,

[50] Eindhoven, in size the 5th city of The Netherlands, might be second. Eindhoven is the centre of innovation and technical industry in the country and has a technical university as well. The main company used to be Philips and they were very active in standardisation. In 1995 its company standardisation department was rated best in the world (Verity Consulting, 1995). But the company is in decline. ASML, global leader in lithography technology is the current innovation champion. They assure that their machines meet applicable standards, e.g., for safety, but they have limited involvement in standardisation.

accreditation and inspection), and market regulation.[51] But it also is the city of Alibaba – the author of this paper is not aware of any other company in the world being more professional in using standardisation for the success of its business. Berlin is the city of the influential German national standards body DIN and was the first city in the world with a chair on standardisation, held by Prof. Kienzle (Herpel, 1973). Currently, the main European research group on standardisation is in Berlin, the chair held by Prof. Knut Blind.[52] But is there any relation to city branding? For Seoul, Kim and Kim (2011) describe efforts to present Seoul as a high-end cultural city, representing the country. Standardisation can be an instrument for this 'high-end' part of the branding. For Hangzhou the city brand remains unclear. Wei and Shaikh (2022) found that the city's fame and reputation do not correspond with its city marketing efforts. Berlin Partners positions Berlin as 'a creative metropolis, as a startup hub and as an innovative technology and science location'[53]. That can be easily linked to standardisation but the question remains to which extent this positioning really reflects the character of the city. That is a more general issue: city branding has a specific purpose, namely to make the city attractive to a certain audience such as tourists or companies, but does this reflect how the city is?

Anyhow, the relation between characteristics of countries and cities on several dimensions of standardisation deserves further attention. Apart from the cities mentioned above, other candidate-cities would be those that, in one way or another, have shown forerunner roles in standardisation, either in the past or in present. Just to suggest a few: Gaithersburg and Seattle (USA), Tunapuna (Trinidad and Tobago), São Paulo (Brazil), Stockholm (Sweden), Paris and Sophia Antipolis (France), Aachen (Germany), Geneva (Switzerland), Bologna, Milano, Rome and Venice (Italy), Thessaloniki (Greece), Moka (Mauritius), Beijing (China), Tokyo (Japan), Kuala Lumpur (Malaysia), Singapore, and Bandung and Jakarta (Indonesia).

This study was inspired by the previous study on Torino (de Vries *et al*. 2018). That study took existing local standardisation (Slow Food), connected that to a city characteristic of Torino ('quality') and combined those to suggest additional local standardisation to upgrade the touristic offer of the city (restaurants serving local food, high quality, based on standards of quality and sustainability). This study on Delft is similar in showing a link between city characteristics and standardisation and in hindsight an addition to the Torino study might be that the quality culture of that city, traceable throughout its history, might have been a 'fertile ground' for the standards-based Slow Food initiative in the surrounding province, so a positive correlation between the two. This study differs in presenting not just two areas of standardisation (agriculture and restaurants) but 39 very diverse cases. A few of these concern a local level of standardisation as in the Torino case, other ones are 'only' about using standards. Slow Food expanded internationally; Delft also shows some cases of standardisation initiatives extending the local level to the national or international level. That such a small city can play such a prominent role in standardisation is an intriguing discovery – hopefully the follow-up research suggested above will reveal more about standardisation within cities.

Several authors have tried to relate standardisation to historical developments. Vermij (2010), for instance, studied the mutual influence between the industrial revolution and standardisation in The Netherlands during the period 1890 – 1970. Krechmer (2021) relates six categories of standards to subsequent phases in human history. But he mixes 'Entities to which the standard applies' and 'Standard category', is incomplete, and for the latest phases he seems to ignore other fields than ICT standardisation. Moreover, our findings suggest that all categories may occur in all phases. But relating standards to historical developments such as the guilds, the

[51] China Jiliang University, see https://english.cjlu.edu.cn.

[52] https://www.tu.berlin/en/inno.

[53] https://www.berlin-partner.de/en.

internationalisation of trade, the industrialisation, the globalisation and the re-appreciation for localisation and the revival of nationalism would be interesting – including the role of cities.

The study revealed seven cases of 'historical standardisation' (Simons, 1994): a 'standard' emerging from the repeated use of certain designs. In that sense similar to the market mode of standardisation in which a standard emerges after a battle between different specifications. But here there is no battle and following the definition by de Vries (1997) it is not standardisation because there is no conscious process aiming at balancing needs. But it can be seen as a standard because of its massive use. We also discussed that the distinction between standard and regulation is blurry. Apparently a new definition of the concept 'standard' is needed – another topic for further research.

In the entity-related classifications shows 17 cases related to real estate. In non-technical standardisation literature this category gets hardly any attention. Are its characteristics similar to other fields or are there any differences?

Standardisation being an interdisciplinary field of research (Grillo et al., 2024), studying the local level of standardisation may benefit from contributions from other disciplines such as human geography or political economy.

7.5 Conclusion

In this paper we have explored the relation between city character and local standardisation activities using the case of the city of Delft. Both in the history of this city and in current business practice we found many cases of standardisation, several of which extend the level of the city to the level of the country. Some of these cases even have lasting influence at a global scale. The character of the city, 'Creating History', relates to standardisation: created standards leading to impact. However, the empirical data do not allow to see causal relationships between city character and standardisation in a direct way. We found a possible explanation in theology: a given city character providing fertile ground for standardisation.

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Use of AI

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