
RESEARCH ARTICLE

The Most Expert in Europe: Patents and Innovation in the Building Trades in the Early Dutch Republic (1580–1650)

Merlijn Hurx

Famous early modern engineering feats in architecture, such as Brunelleschi's dome in Florence, have traditionally been presented in historiography as the accomplishments of individual 'authorial' figures. Yet, for many other innovative building technologies of the early modern period, the authorship remains unknown. Often such inventions were the result of incremental advances for which many people were responsible. The socio-economic circumstances that allowed for technological developments remain an understudied field in architectural history. This paper presents the building site as an important space of knowledge production. Difficulties that arose during construction had a stimulating effect on the exchange of ideas among various professional groups, including architects, master craftsmen, and engineers. A special case is found in the development of specialised building techniques in the 17th-century Dutch Republic. By the end of the Golden Age, the 'Hollanders', considered 'the most expert in Europe' in the construction of large structures in marshy conditions, were valued for their 'incomparable inventions' in hydraulic engineering and their skill in laying foundations. The work involved in this process — driving piles and excavating pits in marshy conditions — was by definition an interdisciplinary endeavour, and required the expertise of architects, masons, carpenters, and others. Building in these conditions not only posed serious technical difficulties, but also involved high costs, challenging master craftsmen to invent new cost-saving methods and techniques. In this paper, this innovative and interdisciplinary climate will be explored through the analysis of 17th-century patents, or inventor privileges, in the Early Dutch Republic (1580–1650). Patents are an understudied source in architectural history, yet architects and artisans from the building trades were highly active in obtaining such privileges. In addition, the patenting process was an important incentive to invest time and capital in technological innovation among various social groups within and outside the building trades, thus stimulating exchanges between people with theoretical and practical backgrounds.

Introduction

When in 1669 the English physician and art connoisseur William Aglionby wrote in his *Present State of the United Provinces* that Amsterdam's town hall surpassed the Seven Wonders of the World, he was not considering its classicist style or its richly decorated interior. Instead, what impressed him most was the expense and ingenuity of its foundation (**Figure 1**).¹ Much like present-day tourists, he was fascinated by the fact that the entire city is supported by an underground forest of piles (Aglionby 1671: 275–76).² Such admiration may seem naïve, but many other foreigners visiting the Dutch Republic of the Netherlands shared Aglionby's fascination with Dutch technological ingenuity. In 1641 the English writer John Evelyn wrote that 'the Hollanders are the most expert in Europe' at draining waters and constructing large structures in marshy conditions. Their 'incomparable inventions' in

hydraulic engineering and their skill in laying foundations were highly valued (Evelyn 1906: vol 1, 45).³ By the end of the 17th century, the Dutch Republic was regarded as the best place to acquire such specialised building know-how. Dutch engineers were in high demand abroad (Danner et al. 2005; Ciriaco 2006; Martens and Ottenheim 2013; Ash 2017), and several European powers, including Cosimo III de' Medici, Jean-Baptiste Colbert, and Tsar Peter the Great, sent their own engineers to the Dutch Republic to learn the 'Hollandish manner of construction' (*manir gollanskoj arhitektury*) (Martelli 2005; Mahoney 2010; Van de Vijver 2013).⁴ A fine example of foreign interest in such matters is the set of careful records Cosimo's agent Pietro Guerrini made in the 1680s during his travels through the Low Countries, of dredging vessels, drainage windmills, pile foundations, and roof constructions (Martelli 2005).

The contemporary admiration for these technological achievements stands in sharp contrast to the general image of the Dutch building industry in the historiography. While the Dutch Republic is acknowledged as a technological leader in Europe, the building sector is often viewed

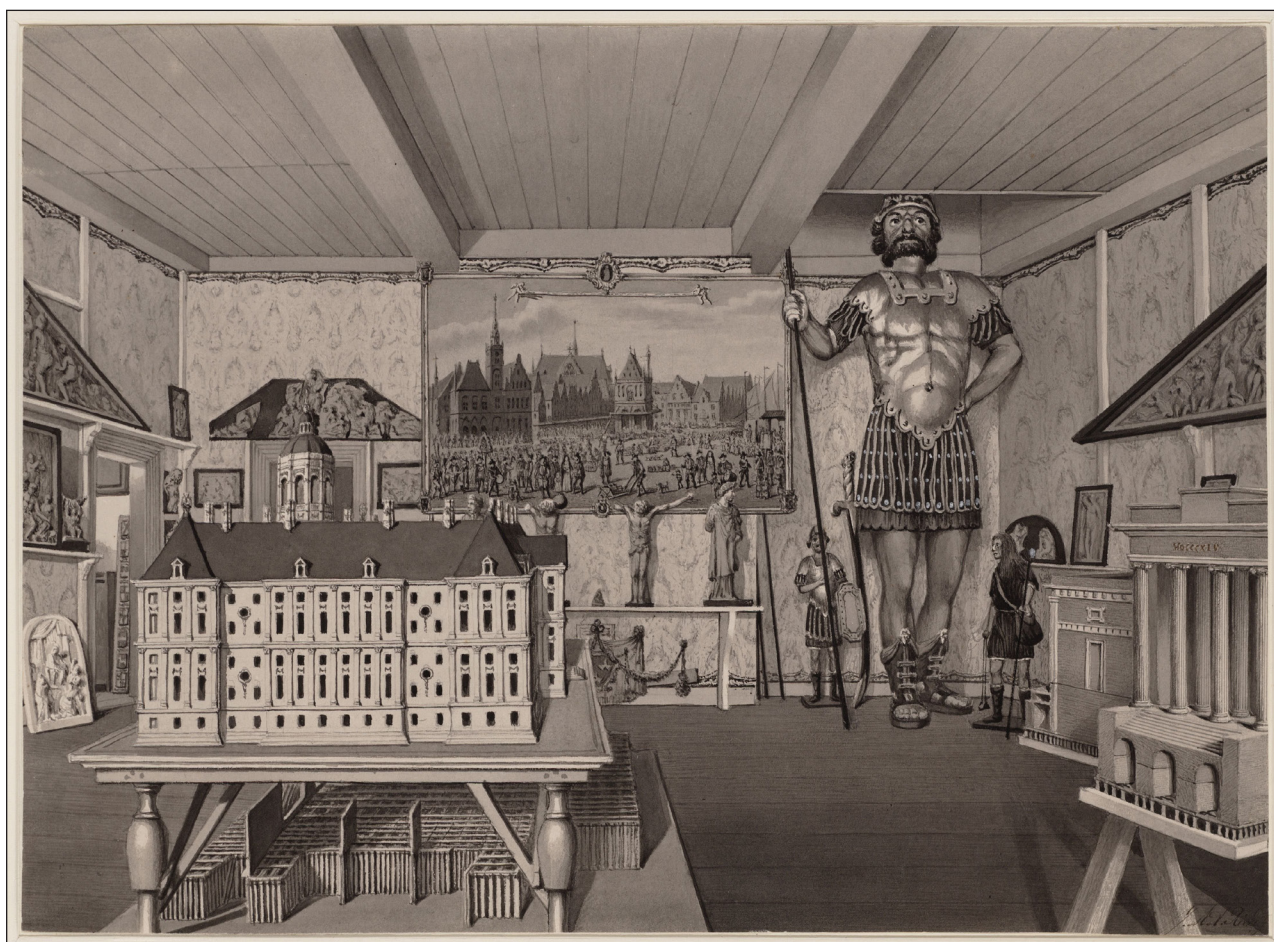


Figure 1: J.M.A. Rieke, view of the city model room of Amsterdam between 1870 and 1888. On the table in the centre of the room is the model of the town hall and below it is a model of pile foundations (detail). The original model from 1648 still survives, but the foundations are lost (Stadsarchief Amsterdam).

as one of the more traditional industries, having remained essentially unchanged up to the Industrial Revolution (Van Leeuwen 1993; Davids 2008). Technological innovation in construction in the early modern period has traditionally received comparatively little interest in architectural history, as it is thought to belong to the world of engineering more than of architecture. Likewise, the epistemological and social-economic conditions in which innovation in construction took place have only recently caught scholarly attention, as the topic of technical progress in architecture has long fallen outside the disciplinary boundaries of architectural history, construction history, and history of technology (Schlimme 2006; Renn, Osthus and Schlimme 2014). What is more, within the scope of architectural history, technological creativity is commonly considered something very distinct from artistic innovation. This approach has contributed to a dualistic view of design practise, in which the heroic, 'avant-garde' artist is juxtaposed with the simple master craftsman or builder.

This paper re-examines this dichotomy, investigating the technological creativity of masters from the building trades, while also considering the exchange between different professional groups as a key factor for the progress of building technology. Studies on the circumstances that allowed for technological advances in the early modern

period mostly pay attention to role of the guilds (Epstein and Prak 2008), while recently in architectural history there is a growing interest in the spread of codified building knowledge through treatises (Cardamone and Martens 2018). In this paper the innovative and interdisciplinary climate of the Dutch Republic will be examined through the study of patents, or inventor privileges, a rich but understudied source for the history of architecture.

By the end of the 16th century the process of conferring legal patents for inventions was ubiquitous in Europe. But with the exception of the similarly water-bound Republic of Venice, it seems that patenting was nowhere as prolific as in the Dutch Republic (Flehsig 2013: 101–2). Following its introduction in the 1580s, the Dutch patent system soon gained momentum, and until its heyday in the 1620s and 1630s, an average of seven patents was granted annually (from 1590 to 1640) (Davids 2000). Like in other parts of Europe, inventions were concentrated mainly in four fields: military technology (cannons and guns), hydraulic equipment (pumps, drainage mills, dredging vessels), heating equipment (furnaces, stoves and chimneys), and industrial windmill technology (sawmill, oil mill, fulling mill etc.) (Davids 2000: 265–66; Buning 2014b: 417). Inventors came from virtually all levels of society, but artisans from the building trades – the people who could

actually make hydraulic devices, furnaces, industrial mills and the like – formed a particularly active group.

Although scholars debate the significance and effectiveness of patenting as a means to spur innovation in the early modern period (Epstein 2004; MacLeod 1991), the patenting process was an important factor in the development of porous environments in which different bodies of knowledge were exchanged. Such openness of knowledge is generally seen as a key factor to innovation (Mokyr 1990; Mokyr 2002), and exchanges between artisans, professional groups, and scholars in the early modern period occurred with the greatest frequency in what Pamela Long has called ‘trading zones’ (Long 2015). The patenting process can be considered such a zone, as it offered various social groups an incentive to invest time and capital in technological innovation (Molà 2014), while also providing a common virtual ‘meeting place’ for the collaboration between inventors and investors. In addition, the interdisciplinary examination boards of privilege-granting institutions brought together experts of disparate backgrounds (Buning 2014a).

In the history of science and technology, as well as the history of law, the study of inventor privileges has gained new interest in recent decades. They have been less discussed, however, within the scope of art and architectural history. Yet various early modern architects are known to have been involved in the patent business, including, among others, Filippo Brunelleschi, Bernardo Buontalenti, Francesco Zamberlano (chief assistant to Andrea Palladio) and Juan de Herrera (Molà 2014: 10; Molà 2004: 241–42; Biagioli 2006: 143). In the context of the Dutch Republic, it is well known that the sculptor and architect Hendrick de Keyser was involved in the patent industry, as was Arent van 's-Gravensande, a pupil of Jacob van Campen. While the nature and significance of such inventions for construction have never been properly examined, the patent system was more than simply an ancillary activity of little consequence for architects. Instead, this paper argues that the Dutch patent system was a centrally important aspect of architectural production.

The first and second sections of the article consider the Dutch patent system and several specific inventions patented in the construction industry. In the last two sections, the patentees from the building trades, and the factors that contributed to their prominent role in the patent business, are analysed. The focus here is not the practical significance of patented inventions, nor whether patenting became an effective tool for the spread of knowledge. Rather, this article calls attention to the role of patents in the formation of an innovative and interdisciplinary climate.

The Dutch patent system

In the 16th century inventor privileges became a new way by which governments tried to encourage economic development. Patents for technical inventions were privileges that permitted the inventor to establish a time-limited monopoly. This allowed the inventor to benefit from the labour and resources he had invested in the invention, through either its exploitation or by selling to others a licence for the invention’s use (Molà 2014; Molà 2004; Davids 2000; MacLeod 1988). The origins of the patent go

back to the Middle Ages when the sovereign could issue letters patent to publicly confer a wide range of privileges. The oldest examples of inventor privileges stem from Italy, where already in the 14th and 15th centuries technical achievements were rewarded and safeguarded by allowing monopolies to operate for a given timeframe. However, the first systematic application of inventor privileges was developed in Venice in the last quarter of the 15th century (Belfanti 2006; Mandich 1960). In the first half of the 16th century, its practice spread across Europe (Buning 2014b: 416; Flechsig 2013: 24–96; Belfanti 2006; Popplow 1998).

The earliest patents for inventions in the Low Countries also date from this period, but they became more common from the 1560s onwards (Doorman 1940: 16). Initially, these privileges were granted by the sovereign, but with the independence of the northern provinces in 1581, the patent system was continued in the Northern Netherlands by three different authorities that took over the sovereign’s role: the central government of the Republic, known as the States General; the governments of the individual estates of the seven provinces; and town authorities. From the 1580s to the middle of the 17th century, the States General granted the largest number of patents, but after that applications decreased rapidly in favour of the States of Holland, the most powerful province of the Dutch Republic. This might be because to put an invention into practice in each of the provinces it became compulsory to obtain official acknowledgement of the patent from the corresponding estates (Davids 2000: 264). Because of its economic significance, Holland outdid all other provinces in the Dutch Republic, whose estates conceded only a limited number of patents in the 17th century.

Inventor privileges, or *octrooien*, as they were called, granted the patentee the exclusive right to put an innovation into practice for a fixed period, usually 5 to 12 years. Some patents allowed the inventor to distribute licenses for the use of his invention. Unlike current patents, inventor privileges in the early modern period were granted not only for newly conceived inventions, but also for the introduction of existing inventions into the territory of the authorities granting the patent. Obtaining inventor privileges was therefore not necessarily a matter of original authorship. Importers of locally new devices or techniques also successfully applied for an *octrooi* (Buning 2014b; Belfanti 2006; Biagioli 2006; Long 2001: 93; Long 1991: 875).

Applicants for inventor privileges had two chief motivations in filing a request: they hoped to profit from the exploitation of their invention, and they viewed the patent as a means to build a reputation as an inventor (Buning 2014b: 417). To obtain a patent, an application explaining the utility of the invention had to be submitted to the authorities, after which a committee of government officials would normally examine the applicant’s request. Depending on the occasion, such boards frequently invited specialists of diverse professional backgrounds, including scientific experts, artisans and military specialists, to meet to examine new patent applications. These gatherings provided an important ‘meeting place’ where disparate social groups could exchange ideas and methods, and thus

enabled the development of new modes of shared knowledge (Buning 2014a). From around 1590 it became common to supplement a written description of an invention with drawings or a model (Davids 2000: 267). Committees used this documentation to assess whether older patents were infringed upon, and to determine if an invention could work (Biagioli 2006: 152–54).⁵ Sometimes, prototypes were tested. Such a test was carried out in 1590 on a drainage mill invented by the celebrated engineer Simon Stevin, in which the mill's efficiency was measured and compared to an existing mill located in a polder near the city of Gouda (Buning 2014a: 63). One of the earliest documented examples in the Low Countries where such an experimental testing method was applied concerned the patent application of the famous painter Jan van Scorel for a new type of hydraulic cement, which he believed would allow for the construction of more durable dykes (Van Gelder 1918: 181).⁶ In 1550, van Scorel was granted a monopoly for the cement on the condition that one of his proposed dykes would withstand a season of winter storms along the seashore at the Zijpe in North Holland. The eventual damage would be carefully inspected by experts to assess the cement's durability.

The description of van Scorel's invention, recorded in a patent now conserved in the registers of the Chamber of Accounts of Holland, is rather oblique. This may well have been the intention of the inventor, who was not willing to disclose his ideas in detail (see also Biagioli 2006: 152–57). But unfortunately, almost all original applications for patents have been lost, because after the patent was granted, the application files were attached to it and returned to the applicant. The official document that entered the authority's records contained only a brief description of the invention (Doorman 1940: 21). It is therefore difficult to know the level of detail with which new inventions were described in the application.

With a few exceptions all original drawings and models have also been lost. A rare example of a complete, illustrated patent application is the recently discovered one filed by the city mason of Delft, Christiaan (Corstiaan) Anthonisz, which dates to 1571 (**Figure 2**). The application, addressed to King Philip II of Spain, concerned a new type of brewing furnace. By the end of the 16th century, developing fuel-efficient furnaces became an important pursuit for inventors. They were attracted by the prospect of increasing potential gains due to rising price of firewood caused by deforestation. Between 1582 and 1638 the States General granted a dozen patents for fuel-saving furnaces (see Unger 2001: 102–3), of which several were filed by masons (Doorman 1940: 124 (G 124); 156 (G 225)). The involvement of masons was most likely due to their first-hand knowledge of the construction of brick furnaces.

According to the letter accompanying Anthonisz's application, his furnace offered three major advantages compared to existing technology: it would significantly save on fuel, reduce the wear of the kettles, and improve safety. To explain his invention, Anthonisz added a brief description and a drawing of a ground plan together with an elevation of the front of the furnace. These images show that his invention involved a framework

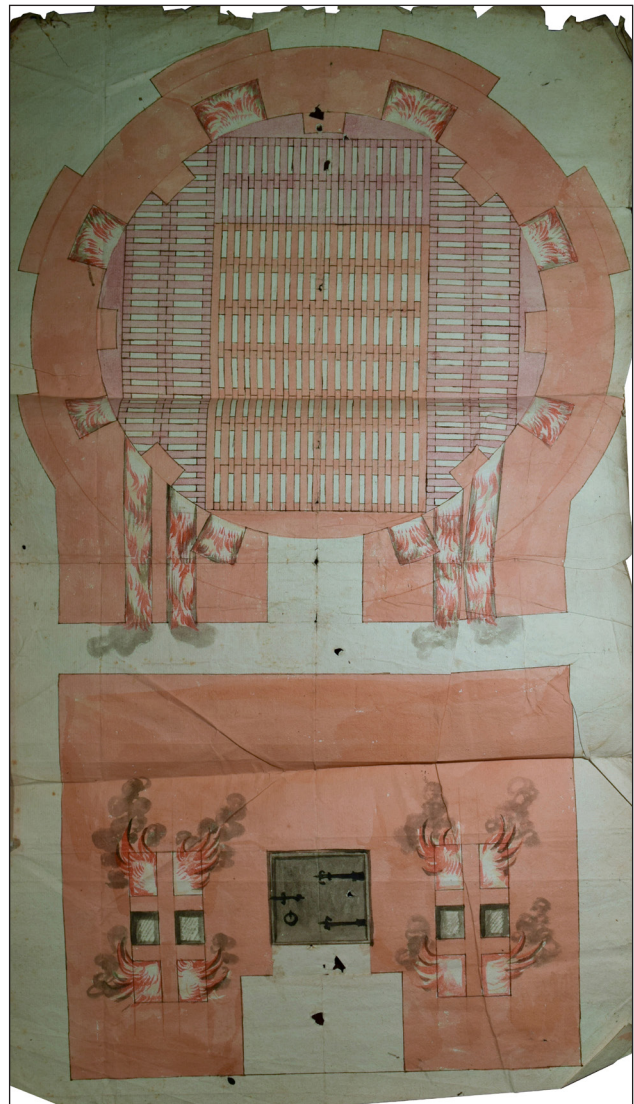


Figure 2: Christiaan Anthonisz, plan and elevation accompanying the original patent application for a new type of furnace, 1571 (Archives départementales du Nord in Lille). Photo by Merlijn Hurx.

of bricks with a lower central section onto which kettles would be set. In addition, Anthonisz's furnace had adjustable bottom vents to improve and control airflow, both of which the inventor claimed had never been applied before. He also declared that the venting system modified the shape and lowered the height of the flames through downdraft (*dalende tochten*), which he illustrated in his drawing by depicting the flames and fumes escaping through the horizontal vent pipes. His invention must have been a moderate success at the least, because in 1582 he obtained a nine-year extension of his patent term from the States of Holland, and in 1596 he received a patent for a furnace from the States General (Doorman 1940, 273 (H 1); 94–95 (G 27)). This last patent was probably an improved version of his first invention, because the description mentions that it had circumferential vent pipes akin to his 1571 furnace. To clarify the invention further, the application refers to a drawing by Anthonisz, unfortunately now lost, which was kept at the office of the States General.

Apart from Anthonisz's drawing, there remains a corpus of around 25 patent drawings from the period 1589 to 1602 in the resolution registers kept by the States of Holland (*minuten van de resoluties van Holland*).⁷ These concern a wide range of devices, such as the drawing of a drainage windmill invented by the city carpenter of Delft, Cornelis Dircksz Muys in 1589 (**Figure 3**), and an industrial mill from 1595 by Maerten Pietersz van der Mey, who was a former city carpenter of Alkmaar (**Figure 4**).⁸ After 1602, patent drawings were no longer recorded in the resolutions of the States of Holland. It is unclear why this practice was discontinued, but over the next decades thorough documentation became increasingly less common. It has been proposed that such documentation was no longer necessary as it became the rule that the patent had to be worked within one year, leaving it to market forces to determine whether an invention was useful or not (Davids 2000: 267).

Patents in the construction industry

In the early modern period masters from the building trades filed a considerable portion of the total number of patents. The majority of the innovations were in the field of civil engineering; the number of patents that exclusively concerned building techniques was more limited. Some patented inventions were for unconventional pioneering examples, such as the construction of underwater foundations and a new type of pitch for sealing flat roofs (Doorman 1940: 131 (G 144); 139 (G 169); Van den Heuvel

1994: 10; Van den Heuvel 2005: 69–78). However, applications seem to have concentrated on specific innovations, some of which will be discussed below. It is important to keep in mind that many improvements, such as new types of roof trusses and hydraulic cement (trass) were never patented during this period (Van Tussenbroek 2009; on trass see Davids 2008: 122–23). Van Scorel's invention of hydraulic cement in 1550 would remain an exception until the second half of the 17th century.⁹

Patented inventions in construction occasionally concerned innovations in quality, but more often they entailed advances in cost-effectiveness and increased productivity. A notable example of a product innovation that reduced building costs, and which received considerable attention in the 17th century, is the manufacturing of artificial marble and other imitation stone. Such *ersatz* products were usually made from stucco or terracotta, for which raw materials could be found near building sites, allowing builders to save on high import costs, as there were no quarries in the Dutch Republic. The earliest example of such a patent was obtained by the aforementioned Christiaan Anthonisz 'van Tichelsteyn', who in 1594 invented a cement imitation of blue and white limestone that could be used for architectural ornamentation. He promoted his products, called *tichelsteyn* (hence his nickname), to be as strong as roof tiles and as durable as blue limestone (Doorman 1940: 277–78 (H 11)). Not only was his product cheaper than stone, but it also weighed less,



Figure 3: Drainage windmill invented by the city carpenter of Delft, Cornelis Dircksz Muys. Patent drawing in the resolutions of the States of Holland, 1589 (NA, The Hague). Photo by Merlijn Hurx.

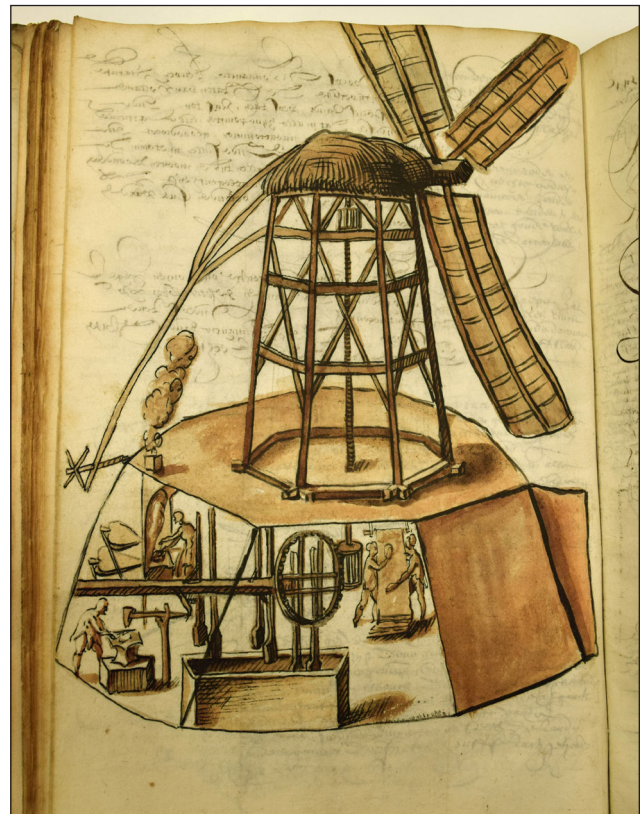


Figure 4: Industrial mill invented by Maerten Pietersz van der Mey. Patent drawing in the resolutions of the States of Holland, 1595 (NA, The Hague). Photo by Merlijn Hurx.

which was an important advantage. In 1611, two inventors from England introduced similar terracotta products for architectural ornamentation (Doorman 1940, 121 (G 113)), and in the same years, Hendrick de Keyser patented an invention of artificial marble. In his request of 1612 he claimed that it was impossible to see the difference between his product and real marble, and he stated that his invention would save money, 'because marble and other precious stones had to be imported from Italy and other countries at high costs' (Kossmann 1929: 287; Scholten 1993: 200–1).¹⁰ De Keyser's technique was soon followed by that of other inventors; in the same decade two other patents for the production of artificial marble (Doorman 1940, 290, 321 (Z 4)) were filed at the estates of Holland (1614) and Zeeland (1618).

While how these imitation materials were produced is unknown, the artist and preeminent botanist Johannes van Brosterhuyzen wrote a recipe in a letter to his friend, the famous scholar Constantijn Huygens, for a plaster that combined lime, buttermilk rennet, and pigments. After the plaster was applied, it was polished with hard pumice and treated with isinglass to obtain the characteristic lustre of real marble (Scholten 1993: 210, n21; Koldewey, Uyttendaele 2010: 295). The goal of these inventors was not only to produce an inexpensive alternative, but to compete with nature by creating effects that were impossible with natural stone – a point Cornelis van de Graeff from Delft underscored in his patent application of 1628. Van de Graeff produced painted tiles that were heated in an oven, which 'were not only equal to Italian marbles, but surpassed them due to their greater variety in colours' (Doorman 1940: 175 (G 291); Kossmann 1929: 286).¹¹ The high number of patents for artificial stone was likely encouraged by the favourable market conditions, and indeed the painter Salomon van Ruysdael is said to have become rich from his imitation marble, 'which was polished like real marble' (Koldewey and Uyttendaele 2010: 295).

More varied were the patents for mechanical innovations. In particular, master carpenters filed patents for new types of cranes, hoisting devices, and dredging vessels

(Doorman 1940: 159 (G 236); 290 (H 40)). These inventions were not restricted to the construction industry, but usually had a wider application. An exception perhaps is the pile-driving machine, an important labour-saving invention patented multiple times. Laying foundations in marshy conditions was expensive, often equalling the cost of the remainder of the building, according to contemporary sources (Aglionby 1671: 275–76). Although this probably was an exaggeration, expenses for wooden piles and the labour of pile-driving must have been considerable. The earliest patent for a pile-driving machine dates from 1595, when the Amsterdam carpenter Lambrecht Gerritsz claimed that 6 to 7 labourers could operate his new device for the same work that required 20 to 28 workers without his machine, thus promising an incredible reduction of the workforce by 73 per cent (Doorman 1940: 93 (G 21)). Other inventors would claim even higher savings on labour. In 1636 Jacob Jansz Gavory promoted his new machine by summarising the numerous project types for which it could be used – foundations of fortifications, sluices, church towers, bridges – and stated that only 4 to 6 people were required to operate the device, as opposed to the usual 20 to 40 labourers (Doorman 1940: 201 (G 378); see also 159 (G 236)). Other inventors went so far as to promise reductions of up to 90 per cent of the labour force, while Jan Claesz Pety, who in 1678 became master mason to the city of Leiden, invented a pile-driving machine in 1662 that was powered not by men at all, but rather by two horses (Doorman 1940: 186 (G 329); 237–38 (G 493)). According to Pety, 25 people were necessary to do the same job (Doorman 1940: 230–31 (G 472)). It seems unlikely that such inventions could meet their lofty promises, and the fact that all patents up to the 18th century continued to state that pile-driving was done by large teams affirms the questionable efficacy of such labour-saving machines (Boyer 1985).

The most important patented application of its time to drastically boost production was the wind-powered sawmill (**Figure 5**), an invention, dating to 1593, of the carpenter and millwright Cornelis Cornelisz van Uitgeest.¹² This invention employed a crankshaft to

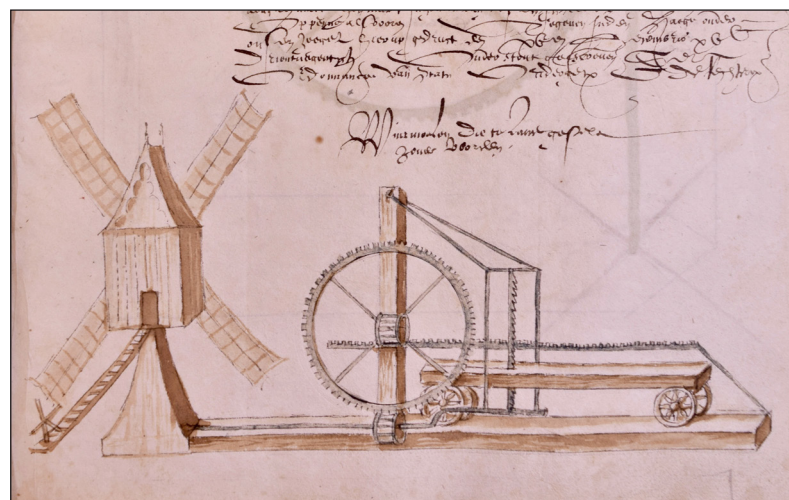


Figure 5: Illustration of the patent application for a wind-powered sawmill by Cornelis Cornelisz van Uitgeest. Patent drawing in the resolutions of the States of Holland, 1593 (NA, The Hague). Photo by Merlijn Hurx.

convert a windmill's circular motion into a reciprocating motion. The mechanisation of sawing is believed to have contributed significantly to the economic rise of the Dutch Republic, because it had a major impact on shipbuilding. In addition to vastly increasing physical productivity, the device also improved quality, as sawing could be done with greater accuracy and uniformity than previously (Doorman 1940: 44–46; Davids 2008: 184–85). This was, for instance, explicitly stated in a patent application for a wind-powered sawmill filed by two master carpenters from Schagen in 1617, some 20 kilometres north of Alkmaar. This particular windmill was specifically designed to produce wainscoting, and the inventors claimed that their wainscoting's tongue and groove joints were far more regular than those sawn by hand (Doorman 1949: 137 (G 164)).¹³

Mills could also be used for sawing marble and limestone. In 1618 the stonemason and lens grinder Davidt Hermansz Nieman, who worked with Hendrick de Keyser on the tomb of William the Silent in Delft (**Figure 6**), applied for a patent for a sawmill that would both polish and cut marble and touchstone (Doorman 1940: 139–40 (G 172); Scholten 2003: 69). Patents for similar sawmills were filed in 1662 and 1663, and in 1683 the city architect of Rotterdam, Claes Jeremiasz Persoons, also patented a new type of mill to saw marble (Doorman 1940: 294 (H 93); 302 (H 155)). Unfortunately, there is little data that allows us to assess

the impact of such devices on actual practice, but the recurrent applications demonstrate a clear desire to save on labour.

Inventors from the building trades

The inventors who presented their application to the Dutch authorities came from virtually all social strata, with different professional backgrounds, but one group clearly dominated the patent business. Marius Buning's calculations show that between 1584 and 1625, of all the patents granted by the States General, 42.2 per cent were awarded to inventors who came from the building trades or had close ties with the construction industry. Of this percentage 15.9 per cent of the applicants were architects, engineers, or land surveyors, 24.4 per cent were carpenters (including millwrights and shipwrights), and 1.9 per cent were masons (Buning 2014a: 61). Buning's figures are comparable to those of Karel Davids, whose calculations for the long 17th century are based on the patents issued by the States General and the States of Holland. Between 1580 and 1719, almost one third of the applications (31.5 per cent) were made by professionals in the construction industry, with 5.9 per cent of the patents filed by engineers, architects, and surveyors, 23 per cent by woodworkers, carpenters, millwrights, and shipwrights, and 2.6 per cent by masons.¹⁴

Within these last two categories, city carpenters (*stadstimmerman*) and city masons (*stadsmetselaar*) form an interesting group of applicants. These titles did not necessarily designate a proper office and originally could simply refer to the preferred contractor of a town, but from the end of the 16th century onwards, at least in the largest cities, they referred to the head of municipal building companies, which took care of the city's public works (Van Essen and Hurx 2009; Van Essen 2011). For instance, in Amsterdam, which had the largest company in the Dutch Republic, the public works were supervised by a master carpenter, Hendrick Jacobsz Staets, a master mason, Cornelis II Dankertsz, and the celebrated architect Hendrick de Keyser, who was the official architect and sculptor of the city. Together they were responsible for the design and construction of many of Amsterdam's public buildings, and also for its third major urban expansion with its famous ring of canals, built between 1613 and 1625. The technical difficulties they encountered as supervisors of these public building services must have stimulated their problem-solving abilities. Just one year after their appointment, both Staets and de Keyser filed a patent with the States General in 1596 and 1597 for a new type of moveable bridge that allowed water vessels to pass more easily (Doorman 1940: 95 (G 29), 96 (G 32); Kossmann 1929). In 1632, at the very end of his career, Dankertsz also invented a new type of stone bridge that could be constructed over the river Amstel without temporarily redirecting the course of the river or building a retaining dam. Dankertsz did not file a patent, and it is not clear what the invention consisted of, but it was obviously of great value to the city of Amsterdam, as the authorities awarded him the a generous amount of 600 guilders for his new invention ('*nieuwe inventie van de*



Figure 6: Hendrick de Keyser, tomb of William of Orange, Nieuwe Kerk, Delft, 1614–23. Photo by Merlijn Hurx.

nieuwe geleijde steenen brugge over den Amstel') (Van Essen 2011: 198–99).

Staets and de Keyser were not the only city master craftsmen who tried to obtain patents for their inventions. Between 1580 and 1650, at least nine other city masters, the majority from cities in Holland, filed applications. At least one patent was granted to Cornelis Dircksz Muys, city carpenter of Delft; Christiaan Anthonisz, city mason of Delft; Adriaen Jansz, Rotterdam city carpenter; Maerten Pietersz van der Mey, (former) Alkmaar city carpenter; Hendrik Cornelisz van Bilderbeek, Leiden city mason; and Arent van 's-Gravesande, Leiden city architect.¹⁵ Only three city masters came from outside Holland: the painter and sculptor Cornelis Bloemaert, who became engineer of the city of Amsterdam in 1591, Hendrick Struys, city mason of Utrecht, and Jacob van Aken, the city carpenter of Kampen.¹⁶

City master craftsmen were among the first to embrace the advantages of the patent system; in the first two decades (i.e., between 1582 and 1600) they filed 14 requests (**Table 1**), which account for 19.7 per cent of the total number of patent applications.¹⁷ The degree to which city master craftsmen applied for patents diminished

over time, but nevertheless, the number of patents they received remained considerable. Between 1580 and 1650, 2.1 per cent of the patents granted by the States General, and 14.9 per cent by the States of Holland, were obtained by city masters. The substantial difference between the two administrative bodies is not easily explained, and neither is it clear what considerations played a role when turning to either the States General or the States of Holland. However, it seems likely that because many inventions were of machines and devices for a city's public works, they were mainly used by the booming cities of Holland.

More than half of the patent applications filed by city masters up to 1650 came from only three inventors. The two patents of Hendrick de Keyser for artificial marble and a moveable bridge (1612 and 1597), which he filed with the States General, have already been discussed. But two masters from Delft were also remarkably active patent applicants: Cornelis Dircksz Muys and Christiaan Anthonisz, who received, respectively, five patents between 1583 and 1589, and four patents between 1582 and 1596. Like most inventors, Muys and Anthonisz restricted themselves to the trade in which they had an

Table 1: Patent applications by city masters, listed chronologically, from 1582 to 1650. Compiled by Merlijn Hurx.

Name	Function	Patented invention	Patent institution	Year
Christiaan Anthonisz	City mason of Delft	Furnace, extension patent term (1574)	States of Holland	1582
Cornelis Dircksz Muys	City carpenter of Delft	Drainage device	States of Holland	1583
Christiaan Anthonisz, Simon Fransz van Merwen, Cornelis Ewoutz Proot	City mason of Delft, land surveyor, craftsman	Wind-powered pump	States of Holland	1584
Cornelis Dircksz Muys	City carpenter of Delft	Dredging vessel	States of Holland	1589
Cornelis Dircksz Muys	City carpenter of Delft	Dredging vessel	States General	1589
Cornelis Dircksz Muys	City carpenter of Delft	Drainage windmill	States of Holland	1589
Cornelis Dircksz Muys	City carpenter of Delft	Mill	States of Holland	1589
Cornelis Bloemaert	City engineer of Amsterdam	Dredging vessel	States General	1590
Christiaan Anthonisz	City mason of Delft	Artificial stone	States of Holland	1594
Adriaen Jansz	City carpenter of Rotterdam	Lock doors	States of Holland	1594
Maerten Pietersz van der Mey	Former city carpenter of Alkmaar	Industrial windmill	States of Holland	1595
Hendrick Jacobsz Staets	City carpenter of Amsterdam	Bridge	States General	1596
Christiaan Anthonisz	City mason of Delft	Furnace	States General	1596
Hendrick de Keyser	City architect of Amsterdam	Bridge	States General	1597
Jacob van Aken	City carpenter of Kampen	Industrial mill	States General	1601
Hendrick de Keyser	City architect of Amsterdam	Artificial marble	States General	1612
Hendrik Cornelisz van Bilderbeek, Jan Egbertsz	City mason of Leiden, master carpenter	Mill	States General	1623
Hendrick Struys	City mason of Utrecht	Mill	States General	1639
Arent van s-'Gravesande	City architect of Leiden	Waterwheel	States of Holland	1643

expertise. Muys patented two types of mills (**Figure 3**), a drainage device (**Figure 7**), and the so-called Amsterdam mud mill, a dredging vessel that was driven by men operating a treadmill. Anthonisz's inventions covered a slightly wider field, and comprised a brewing furnace, the production of artificial stone, and a wind-powered pump to supply water for fountains. The number of patents they received was highly unusual; up to the 18th century only a small percentage of the patentees obtained more than three patents.¹⁸

Several factors may explain the prominent role of city masters in the patent application process. During this period the cities of Holland experienced an exponential growth, and several cities as Amsterdam and Leiden undertook major urban expansions (**Figure 8**). In addition, the Eighty Years' War (1568–1648) prompted many cities to develop fortifications. Both the planning of urban expansions and the construction of fortifications required the knowledge of (military) engineers and master craftsmen. Practical problems that arose at the building site must have fuelled the resourcefulness of these men, and several inventions were readily adopted for public works. A fine example is the city architect Arent van s'-Gravesande, who for the city of Leiden experimented with a new type of waterwheel to renew the water of the city's canals. For his invention, he obtained a patent in 1643, which

was purchased by the city of Leiden, even though the magistrate had already paid for the development costs (Steenmeijer 2005: 120).¹⁹

In addition to responding to concrete engineering problems, professional rivalry among colleagues also played a role in technological innovation. It seems no coincidence that Staets and de Keyser filed their patents for a bridge in the same year (Meischke 1994: 102), and also Muys and Anthonisz may have found encouragement in each other's patent applications.²⁰ Patents served as a sign of the ingenuity of the inventor, and therefore could be an important asset for masters who wanted a career in the service of the city. For instance, Cornelis Bloemaert's application for a dredging device in 1590 at the States General may somehow have attracted the attention of Amsterdam's magistrate, who appointed Bloemaert as city engineer the following year (Van Essen 2011: 146). However, most masters sought to patent their inventions when they were already in office. Patent applications could have been a strategy to strengthen the reputations of the city masters. Some masters are known to have actually profited financially from their inventions. A remarkable success story is that of Jacob van Aken, who resigned in 1605 from his position as city carpenter of Kampen, four years after he had patented a new type of mill to process copper, so he could concentrate fully on the exploitation of his invention (Kolman 1993: 247–49).

Patenting may also have been encouraged by the competition among the masters of different cities, as is suggested by a remark on the invention of improved locks by Simon Stevin. In his *Castrametatio, dat is legermeting en Nieuwe Maniere van Stercktebou door Spilsluysen* ('New manner of fortification by means of pivoted sluice locks') of 1617, Stevin recalls discussions he had with the city carpenters of Rotterdam and Delft around 1590 on scouring locks, and the agreement they made to share information:

And because at that time (as also at present), Master Carpenters often spoke about scouring locks, which would allow ships with upright masts to

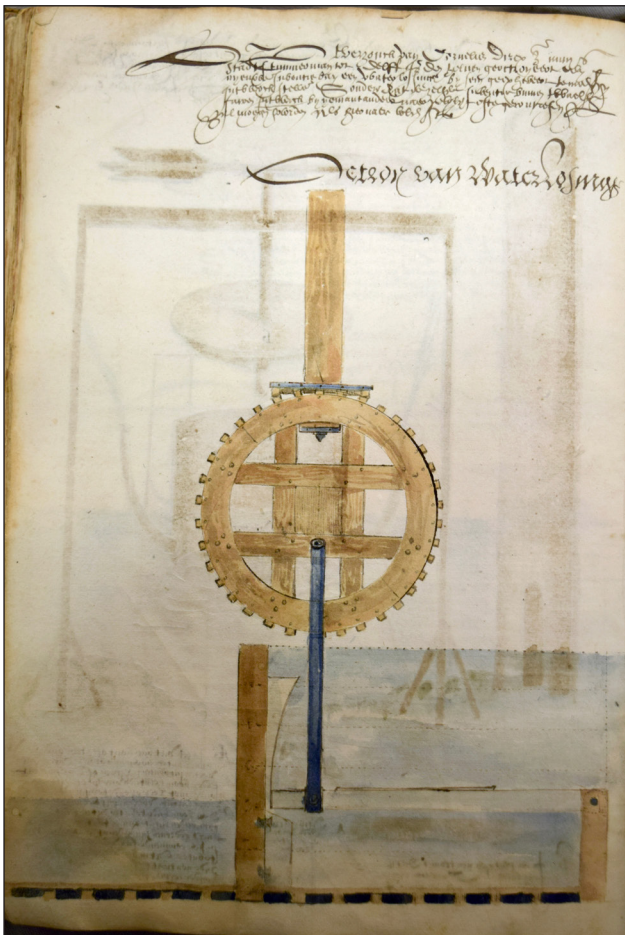


Figure 7: New type of drainage device by Cornelis Dircksz Muys. Patent drawing in the resolutions of the States of Holland, 1589 (NA, The Hague). Photo by Merlijn Hurx.



Figure 8: Joan Blaeu, map of Amsterdam after several successive urban expansions, 1657–59 (Stadsarchief Amsterdam).

pass through, as I discussed this matter with the late Adriaen Jansz, Town Carpenter of Rotterdam and with the late Cornelis Dircksz Muys, Town Carpenter of Delft, each of us three said he had invented something which he thought useful, and we agreed that each of us should explain his invention on condition that if profit or loss should result, we were to share it equally and cooperate with each other. (Crone et al. 1966, vol. 5: 107)²¹

Stevin and Muys both designed a different type of swivel-gate lock (**Figure 9**), but only Jansz applied for a patent in 1594 (Davids 2008: 440). The minutes and the drawing in the resolutions of the States of Holland show that the patent was for a single swing-gate held in place by a catch (Crone et al. 1996, vol. 5: 73–74). The three men, although in competition with one another, also agreed to cooperate and share profits or financial loss.

Exchange of knowledge

The comments made by Stevin on the sharing of information affirm the degree to which craftsmen and scholars interacted with one another. An important institution that facilitated the exchange between these groups was the *Duytsche Mathematique*, an applied mathematics programme at the engineering academy in Leiden, the curriculum of which was largely based on Stevin's ideas. Soon after Stadtholder Maurice established the programme in 1600, the academy was attended by numerous carpenters and masons, all of whom sought to learn elementary mathematics and land surveying (Van den Heuvel 2005: 24). Mathematical 'science' was vital to their practice, not only to measure building plots and to estimate quantities of building materials, but also to create new designs, such as oblique, perspectival masonry, and to calculate askew cuts, for which mastery of stereotomy was indispensable (De Vries 2009).

While the craftsmen were interested in applied mathematics, 'scientists' like Simon Stevin, Constantijn Huygens, Johannes van Brosterhuyzen, and Isaac Beeckman took note of the craftsmen's specialised techniques and

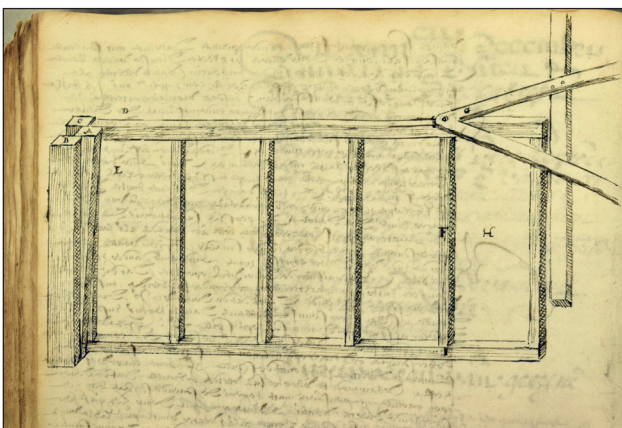


Figure 9: A single swing-gate for a sluice patented by the city master carpenter of Rotterdam, Adriaen Jansz. Patent drawing in the resolutions of the States of Holland, 1594 (NA, The Hague). Photo by Merlijn Hurx.

machines. Stevin approached craftsmen with very practical and detailed questions on building methods. For instance, in a transcript by Beeckman of Stevin's unfinished treatise on architecture, Stevin says he should ask bricklayers if the use of smaller quantities of mortar would be a good solution to reduce the settlement of a vault after the centring was removed (Van den Heuvel 2005: 69). In the same empirical spirit, Beeckman, a natural philosopher, investigated new building techniques with the help of craftsmen. In 1626, he established the short-lived '*Collegium mechanicum*' in Rotterdam, which was an informal group of like-minded friends who gathered weekly to discuss a wide range of subjects, including construction and civil engineering (Van Berkel 2013: 37–41; Van den Heuvel 2005: 25–26). Besides Beeckman, the group included a land surveyor, Jan Jansz Stampioen the Elder, as well as merchants and craftsmen. One of the matters that attracted their attention was a new type of windmill with horizontal sails, an invention patented in 1622 by a master carpenter of Leiden, Gijsbrecht Pietersz. To test the invention's performance, the members of the *Collegium* used scale models, which were possibly made by Pietersz himself (Van Berkel 2013: 38–39). Although the *Collegium* was hardly a success, it illustrates the growing interest among disparate social groups in construction and civil engineering.

The dialogue between scholars, administrators, artists, and craftsmen in the 17th-century Dutch Republic likely had a direct technological impact, but this has yet to be examined in depth. A concrete example of the these worlds coming together is Antonisz's patent for a wind-powered pump. In 1584 Antonisz, together with Cornelis Ewoutz Proot, a craftsman from Delft, and Simon Fransz van Merwen, a land surveyor and cartographer of Leiden, filed this new invention (Doorman 1940: 274 (H 4); Pelinck 1967: 60–61). Van Merwen was a versatile figure, an alderman and a burgomaster of Leiden, and supervisor, as *thesaurier-extraordinaris* (treasurer), of the municipal building company (Pelinck 1967). The practical problems he encountered while supervisor of the municipal building company may have encouraged him to invent new devices. In 1584 van Merwen obtained a patent from the States General for a watermill, and in 1589 he received a patent from the States of Holland for a new type of scoop wheel (**Figure 10**) (Doorman 1940, 82 (G 2), 276 (H 8); Davids 2008: 441). He seems to have acquired expert knowledge of building materials, since he was asked by the States General to inspect artificial stone from a producer in Calais, which was said to be as hard as rock and therefore suitable for the construction of quays and piers (Doorman 1940: 109).

Van Merwen also acted as designer. He made plans for the urban expansion and the new fortifications of Leiden; one of his designs from 1594 is still in the city's archives (**Figure 11**).²² In 1600, at the end of his career, he became one of the two first lecturers at the *Duytsche Mathematique*, at the instigation of Stadtholder Maurice. He was probably selected for his practical skills as a land surveyor, but he was also an able mathematician. For the city of Leiden, he was part of a committee that made a table to facilitate the



Figure 10: Simon Fransz van Merwen's patent for a new type of scoop wheel. Patent drawing in the resolutions of the States of Holland, 1589 (NA, The Hague). Photo by Merlijn Hurx.

calculation of taxes, and his interest in theoretical mathematical knowledge appears in his treatise on decimal fractions called *De vijff spetie inde tiende getalen*, which leaned strongly upon Stevin's work (Krüger 2014: 58–59; Westra 1992: 87). Van Merwen may have been exceptional in his versatility, but his case is a good illustration of the connections that existed between craftsmen and learned men at the turn of the 17th century.

Conclusion

The difficult ground conditions on which construction was carried out in the Dutch Republic called for the knowledge of experts with disparate backgrounds. While the building site can be considered an important zone where artisans, professional groups, and scholars traded ideas on the spot, patenting offered an additional, virtual meeting place. Learned and artisanal worlds became increasingly connected; a considerable number of masons and carpenters were eager to obtain elementary theoretical knowledge, while specialised techniques and machines were carefully studied by such 'scientists' as Simon Stevin and Isaac Beeckman. These men were not only interested in machine design on an abstract level, but they also discussed construction methods and building materials with experienced craftsmen to solve specific topical problems. Such exchanges were essential to the development of the innovative and interdisciplinary climate of the Dutch Republic. Patenting had a stimulating effect on this development because it provided a common incentive to pursue innovation, but it also offered an institutional framework for the development of new modes of shared knowledge.

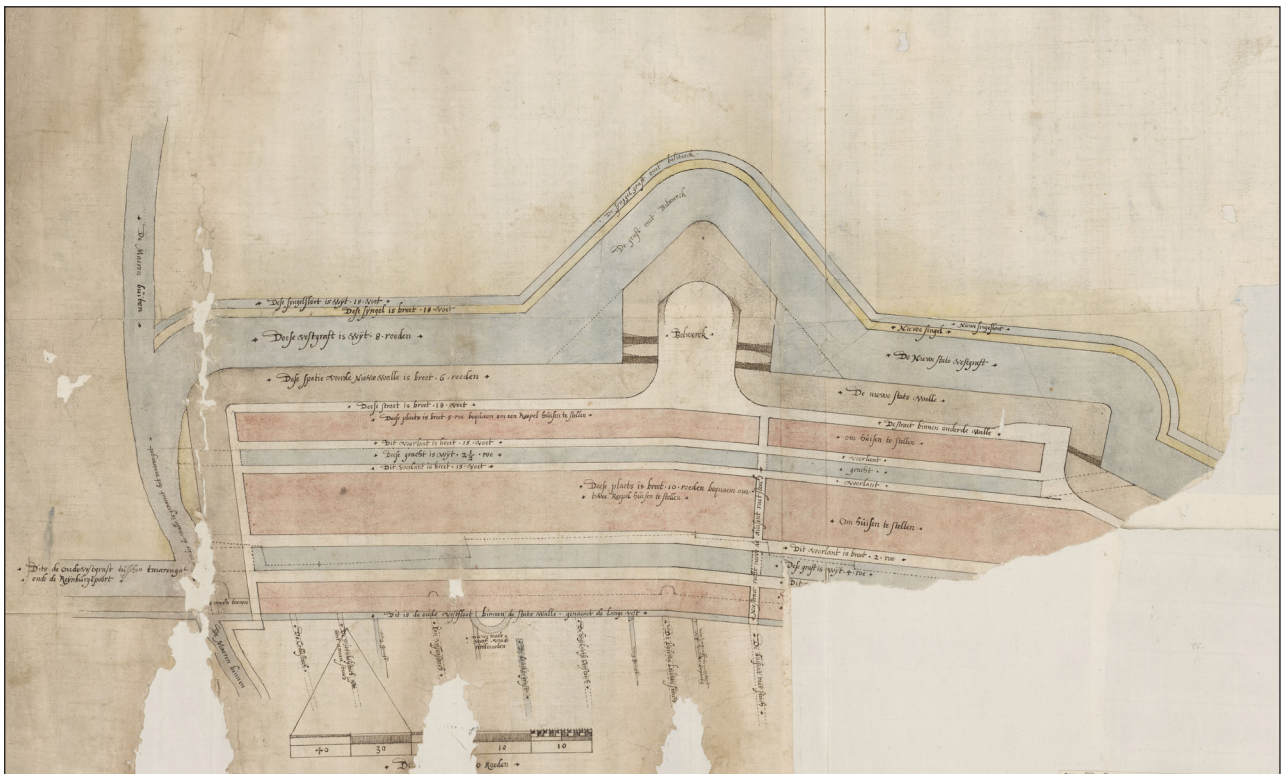


Figure 11: Simon Fransz van Merwen, design for the urban expansion with its new fortifications for the city of Leiden, 1594 (Erfgoed Leiden en Omstreken).

The rise of patenting in the Dutch Republic coincided with a phase of exponential growth of the cities in Holland and the establishment of municipal building companies. When constructing the infrastructure, hydraulic systems, and public buildings of the city, the masters in charge of these companies were challenged to find new solutions to the numerous difficulties they encountered. It is therefore not surprising that city masters were among the first to embrace the patent system. In the first two decades of the Dutch Republic, between 1582 and 1600, they filed almost one fifth of all patent applications made to the States General and States of Holland. The enthusiasm of city masters for new devices and construction methods reveals their desire to look beyond established craft traditions. Although many patents obviously did not result in the significant advances they promised, they clearly demonstrate a drive for innovation. Few of these master craftsmen, however, were in the vanguard when it came to stylistic innovation. This was due not to their conventional guild background, but rather to their interest in more technical matters. Simply put: not questions of form, but economy and structural stability were their primary concern.

The correlation between the building industry and technological innovation was not unique to the Dutch case. In Italy and Spain as well, master carpenters, master masons, and architects also sought patent privileges to further building efficiency and strength, reduce labour, and cut costs. In studying the technological creativity of the patent applicants, we are able to identify the experts who were essential for the making of the early modern city. This, in turn, provides a more comprehensive understanding of design practices, in which the exchange of knowledge between master craftsmen and prominent architects was indispensable.

Notes

¹ For the foundations, 13,659 piles with an average length of 12.5 meters were used (see Bie Leuveling Tjeenk 1939).

² On Amsterdam Aglionby wrote, 'All this great Town is built upon pilotis, which are great Trees driven by main force into the ground, which is all moorish, to be as a foundation to build upon; and ordinarily it costs as much as laying, as all the rest of the Fabrick does building up'. And on the town hall he wrote, 'The Town-house which is now a building, the foundations of which have cost many thousands of Pounds, is to be a Master-piece, and a miracle beyond the seven that Antiquity bragg'd so much of'. Aglionby based his publication on *Les Délices de la Hollande* by Jean-Nicolas de Parival, who in 1651 similarly considered the pile foundations of Amsterdam, and admired the great cost of the town hall's foundations: 'L'Hostel de Ville qui se bastit aujourd'huy, & duquel les fondemens, & les maisons que l'on a abbattues, ont cousté je ne sçay combien de tonnes d'or, doit estre un chef d'oeuvre, & un autre miracle par dessus les sept merveilles du monde; l'art & l'argent conduisant cette haute entre-

prise, ne, peuvent rien produire que de miraculeux' (Parival 1655: 79 and 81). My thanks to Sander Karst for bringing this source to my attention.

³ When Evelyn visited the construction site of the citadel in 's-Hertogenbosch in 1641, he noted in his diary, 'I went toward Bois-le-Duc where we arrived on the 16th, at the time when the new citadel was advancing, with innumerable hands, and incomparable inventions for draining off the waters out of the fens and morasses about it, being by buckets, mills, cochleas, pumps and the like; in which the Hollanders are the most expert in Europe'.

⁴ In 1724, Peter the Great instructed his agent in Holland, Johannes van der Burgh, to make sure that the Russian architectural students that had been sent to the Low Countries, learned 'the Hollandish manner of construction [*manir gollanskoj arhitektury*] and especially how to make foundations, because we have the same situation because of the water level and reduced thickness of the walls' (Van de Vijver 2013: 419).

⁵ Application procedures were remarkably uniform throughout Europe (see Popplow 1998: 105–6).

⁶ 'nieuwe wercken van dycagien die incoremptible zijn sulen ende eeuwelijck dueren van steene ende anders met sulcken bytume oft cemente an elx anderen gebonden ende vereenicht, dat zij niet verganckelyck zijn'.

⁷ Some of these drawings have been published, but they have never been analysed in any depth (see Pieters 2009).

⁸ Nationaal Archief Den Haag (NA), Staten van Holland na 1572, 3.01.04.01, inv.no. 346, 355, 358.

⁹ In the 17th century the only other patent on cement was filed in 1688 at the estates of Friesland (Doorman 1940: 326 (F 12)).

¹⁰ 'Ende alsoo dese voorsz. inventie seer profitabel soude zyn voor het gemeine beste, gemerct dat men daer door ten deele soude kunnen spaeren de marmersteenen ende andere cieraetsteenen die vuyt Italien ende andere vremde landen met groot gelt ende oncosten gehaelt worden'.

¹¹ 'den Italiaensen Marmorsteenen nyet alleen in Couleuren gelyck syn, maer oock in verscheydenheyf der selver, en in eenen aengenaemen luyster overtreffen, ende te boven gaen' (translation by author).

¹² Nationaal Archief Den Haag (NA), Staten van Holland na 1572, 3.01.04.01, inv.no. 353A.

¹³ 'werden de voorseyde spreyssele ende veren mette selve molen oogelyck veel netter ende beter gemaect als degeene die mette Hant gewrocht ofte gesaecht werden' (translation by author).

¹⁴ The actual figures may have been somewhat higher, as in many cases the occupation of the applicant is not mentioned. For instance, in a patent granted in 1683 by the States of Holland to Claes Jeremiasz Persoons of Rotterdam for a sawmill, no mention is made of his office as city architect of Rotterdam (Doorman 1940: 302 (H 155)). For Persoons, see Bos (1999).

¹⁵ For Anthonisz, see Doorman (1940: 94–95 (G 27), 273 (H 1), 274 (H 4), 277–78 (H 11)). For Muys, see

- Doorman (1940: 86 (G 6), 274 (H 2), 275 (H 5), 275–76 (H 7), 276–77 (H 9)). For Jansz, Pietersz van der Mey, and Bilderbeek, see Doorman (1940: 278–79 (H 12), 281 (H 18), 160–61 (G 239)). For van 's-Gravesande, see Steenmeijer (2005: 120).
- ¹⁶ For Bloemaert, see Doorman (1940: 89, see also Ottenheym, Rosenberg and Smit (2008: 12–13). For Struys, see Doorman (1940: 206 (G 391); see also Meischke 2000: 128–29). For van Aken, see Doorman (1940: 106 (G 60); see also Kolman 1993: 247–49).
- ¹⁷ This number includes applications for the extension of the patent term. The total number of patents granted by the States of Holland and the States General is based on Davids (2000: 265, Table 1).
- ¹⁸ Other notable examples are Cornelis Dircxz van Sonneveld (carpenter and millwright from Warmont), and especially the scientist and engineer Simon Stevin, who obtained eleven patents between 1584 and 1589 (Davids 2000: 272–73).
- ¹⁹ Also, the towns of Delft and Leiden adopted several of Simon Stevin's inventions shortly after he received a patent for them (Van den Heuvel 2005: 73).
- ²⁰ They must have known each other well, not only because they supervised the municipal works in Delft, but they are also recorded to have presented together a design for a lock to the waterboard (Hoogheemraadschap) of Delfland in 1599. (Postma 1989, 264).
- ²¹ 'En wanter tot die tijt (ghelijc ooc noch teghenwoordelic) onder Meester Timmerlieden veel ghezeyt wiert van schuerende Sluysen, om Schepen met staende masten deur te varen, zoo ist ghebeurt dat ic van die stof ter spraec komende met Adriaen Iansz overleden Stadtmeester van Rotterdam, en Cornelis Dircxsz Muys overleden Stadtmeester van Delf, elc van ons drien zeyde wat verdocht te hebben, dat hy meende goet te weren, en overquamen met malkander dat elc zyn vondt verklaren zoude, met voorwaerde, dat zoeder profijt of schade af quaem, dat wy't ghelijckelic deelen zouden, en malkander behulpich zijn'. (translated by Crone et al. 1966, vol. 5: 107).
- ²² Erfgoed Leiden en Omstreken, PV1001.1. (Published in: Westra 1992: 86).

Author Note

The author thanks Sander Karst, Libby Merrill, Nele De Raedt and anonymous referees for their comments and suggestions.

Competing Interests

The author has no competing interests to declare.

References

Unpublished sources

- Archives départementales du Nord in Lille, Cum. 13037/198.
- Erfgoed Leiden en Omstreken, PV1001.1.
- Nationaal Archief Den Haag (NA), Staten van Holland na 1572, 3.01.04.01, inv.no. 346, 353A, 355, 358.

Published sources

- Aglionby, W.** 1671. *Present State of the United Provinces*. 2nd ed. London: Starkey.
- Ash, E.** 2017. *The Draining of the Fens: Projectors, Popular Politics, and State Building in Early Modern England*. Baltimore: Johns Hopkins University Press.
- Belfanti, CM.** 2006. Between Mercantilism and Market: Privileges for Invention in Early Modern Europe. *Journal of Institutional Economics*, 2(3): 319–38. DOI: <https://doi.org/10.1017/S1744137406000439>
- Biagioli, M.** 2006. From Print to Patents: Living on Instruments in Early Modern Europe. *History of Science*, 44: 139–86. DOI: <https://doi.org/10.1177/007327530604400202>
- Bos, R.** 1999. *Claes Jeremiasz. Persoons, stadsarchitect van Rotterdam van 1660 tot 1690: een onderzoek naar Persoons' positie in de Rotterdamse stadsfabriek en zijn belangrijkste werken*. Unpublished thesis (MA), Utrecht University.
- Boyer, M.** 1985. Resistance to Technological Innovation: The History of the Pile Driver through the 18th Century. *Technology and Culture*, 26(1): 56–68. DOI: <https://doi.org/10.2307/3104529>
- Buning, M.** 2014a. Inventing Scientific Method: The Privilege System as a Model for Scientific Knowledge-Production. *Intellectual History Review*, 24(1): 59–70. DOI: <https://doi.org/10.1080/17496977.2013.841381>
- Buning, M.** 2014b. Between Imitation and Invention. Inventor Privileges and Technological Progress in the Early Dutch Republic (c. 1585–1625). *Intellectual History Review*, 24(3): 415–27. DOI: <https://doi.org/10.1080/17496977.2014.891175>
- Cardamone, C and Martens, P.** 2018. Introduction to Dossier: Building Techniques in Architectural Treatises: Construction Practices versus Technical Writings. *Ædificare, Revue internationale d'histoire de la construction*, 2(2): 27–35.
- Ciriaco, S.** 2006. *Building on Water. Venice, Holland and the Construction of the European Landscape in Early Modern Times*. New York and Oxford: Berghahn.
- Crone, E, et al. (eds.)** 1966. *The Principal Works of Simon Stevin*, vol. 5. Amsterdam: Swets en Zeitlinger.
- Danner, HS, et al. (eds.)** 2005. Polder Pioneers. The Influence of Dutch Engineers on Water Management in Europe, 1600–2000. *Netherlands Geographical Studies*, 338. Utrecht: Koninklijk Nederlands Aardrijkskundig Genootschap.
- Davids, K.** 2000. Patents and Patentees in the Dutch Republic Between c. 1580 and 1720. *History and Technology, an International Journal*, 16(3): 263–83. DOI: <https://doi.org/10.1080/07341510008581969>
- Davids, K.** 2008. *The Rise and Decline of Dutch Technological Leadership: Technology, Economy and Culture in the Netherlands, 1350–1800*. 2 vols. Leiden: Brill. DOI: <https://doi.org/10.1163/ej.9789004168657.i-634>
- De Bie Leuveling Tjeenk, J.** 1939. De paalfundeering van het Koninklijk Paleis te Amsterdam. *Bouwkundig Weekblad Architectura*, 60: 108–10.

- De Parival, J-N.** 1655. *Les délices de la Hollande*. 2nd ed. Leiden: Parival.
- De Vries, D.** 2009. Ambachtelijk metselwerk. *Bulletin KNOB*, 105(1/2): 2–14.
- Doorman, G.** 1940. *Octrooien voor uitvindingen in de Nederlanden uit de 16e–18e eeuw*. The Hague: Martinus Nijhoff.
- Epstein, S.** 2004. Property Rights to Technical Knowledge in Premodern Europe, 1300–1800. *The American Economic Review*, 94(2): 382–87. DOI: <https://doi.org/10.1257/0002828041301777>
- Epstein, S** and **Prak, M.** (eds.) 2008. *Guilds, Innovation and the European Economy, 1400–1800*. Cambridge: Cambridge University Press. DOI: <https://doi.org/10.1017/CBO9780511496738>
- Evelyn, J.** 1906. *The Diary of John Evelyn*. Edited by Austin Dobson. 3 vols. London and New York: MacMillan and Co.
- Flehsig, AJ.** 2013. *Frühneuzeitlicher Erfindungsschutz. Eine Untersuchung unter besonderer Berücksichtigung der Reichsstadt Augsburg*. Augsburg: Schriften zur Rechtsgeschichte, 23. Berlin: Lit Verlag.
- Koldewey, E** and **Uyttendaele, K.** 2010. Stucmarmer, scagliola en stucco lustro. In: Koldewey, E et al. (eds.), *Stuc. Kunst en Techniek*. Zwolle: Waanders. pp. 294–309.
- Kolman, C.** 1993. *Naer de eisch van 't werck. De organisatie van het bouwen te Kampen 1450–1650*. Utrecht: Matrijs.
- Kossmann, EF.** 1929. Hendrik de Keyser als uitvinder. *Oud Holland*, 46: 284–88. DOI: <https://doi.org/10.1163/187501729X00389>
- Krüger, J.** 2014. *Actoren en factoren achter het wiskundeonderwijs sinds 1600*. Unpublished thesis (PhD), Utrecht University.
- Long, PO.** 1991. Invention, Authorship, 'Intellectual Property,' and the Origin of Patents: Notes Toward a Conceptual History. *Technology and Culture*, 32(4): 846–84. DOI: <https://doi.org/10.2307/3106154>
- Long, PO.** 2001. *Openness, Secrecy, Authorship: Technical Arts and the Culture of Knowledge from Antiquity to the Renaissance*. Baltimore: Johns Hopkins University Press.
- Long, PO.** 2015. Trading Zones in Early Modern Europe. *Isis*, 106(4): 840–47. DOI: <https://doi.org/10.1086/684652>
- Macleod, C.** 1988. *Inventing the Industrial Revolution: The English Patent System, 1660–1800*. New York: Cambridge University Press. DOI: <https://doi.org/10.1017/CBO9780511522673>
- Macleod, C.** 1991. The Paradoxes of Patenting: Invention and Its Diffusion in 18th- and 19th-Century Britain, France, and North America. *Technology and Culture* 32(4): 885–910. DOI: <https://doi.org/10.2307/3106155>
- Mahoney, M.** 2010. Organizing Expertise: Engineering and Public Works under Jean-Baptiste Colbert, 1662–83. *Osiris*, 25(1): 149–70. DOI: <https://doi.org/10.1086/657267>
- Mandich, G.** 1960. Venetian Origins of Inventors' Rights. *Journal of the Patent Office Society*, 42(6): 378–82.
- Martelli, F.** (ed.) 2005. *Il viaggio in Europa di Pietro Guerrini (1682–1686). Edizione della corrispondenza e dei disegni di un inviato di Cosimo III dei Medici*. 2 vols. Florence: Leo S. Olschki.
- Martens, P** and **Ottenheim, KA.** 2013. Fortifications and Waterworks: Engineers on the Road. In: De Jonge, K, and Ottenheim, KA (eds.), *The Low Countries at the Crossroads. Netherlandish Architecture as an Export Product in Early Modern Europe (1480–1680)*. Architectura Moderna, 8. Turnhout: Brepols. pp. 361–78. DOI: <https://doi.org/10.1484/M.ARCHMOD-EB.4.00154>
- Meischke, R.** 1994. Het Amsterdams fabrieksambt van 1595–1623. *Bulletin KNOB*, 93(3): 100–22.
- Meischke, R.** 2000. Opkomst en verbreiding van het Classicisme (± 1630–1700). In: Meischke, R, Zantkuijl, H, and Rosenberg, P (eds.), *Huizen in Nederland. Utrecht, Noord-Brabant en de oostelijke provincies. Architectuurhistorische verkenningen aan de hand van het bezit van de Vereniging Hendrick de Keyser*. Zwolle and Amsterdam: Waanders. pp. 126–38.
- Mokyr, J.** 1990. *The Lever of Riches. Technological Creativity and Economic Progress*. New York and Oxford: Oxford University Press.
- Mokyr, J.** 2002. *The Gifts of Athena. Historical Origins of the Knowledge Economy*. Princeton: Princeton University Press.
- Molà, L.** 2004. Il mercato delle innovazioni nell'Italia del Rinascimento. In: Arnoux, M, and Monnet, P (eds.), *Le technicien dans la cité en Europe occidentale 1250–1650*. Rome: École française de Rome. pp. 215–50.
- Molà, L.** 2014. Inventors, Patents and the Market for Innovations in Renaissance Italy. *History of Technology*, 32: 7–34.
- Ottenheim, KA, Rosenberg, P** and **Smit, N.** 2008. *Hendrick de Keyser, 'Architectura Moderna'. Moderne bouwkunst in Amsterdam 1600–1625*. Amsterdam: SUN.
- Pelinck, E.** 1967. De functionarissen belast met de zorg voor de stadsbouwwerken te Leiden (1575–1818). *Leids Jaarboekje*, 59: 59–76.
- Pieters, H.** 2009. *Uitvinders in Nederland. Vier eeuwen octrooien*. Quest historie. Diemen: G+J Uitgevers.
- Popplow, M.** 1998. Protection and Promotion: Privileges for Inventions and Books of Machines in the Early Modern Period. *History of Technology*, 20: 103–24.
- Postma, C.** 1989. *Het hoogheemraadschap van Delfland in de middeleeuwen, 1289–1589*. Hilversum: Verloren.
- Renn, J, Osthues, EW** and **Schlimme, H.** (eds.) 2014. *Wissensgeschichte der Architektur. Band III: Vom Mittelalter bis zur Frühen Neuzeit*. Berlin: Max Planck Institute for the History of Science.
- Schlimme, H.** (ed.) 2006. *Practice and Science in Early Modern Italian Building. Towards an Epistemic History of Architecture*. Milan: Electa.
- Scholten, F.** 1993. De Nederlandse handel in Italiaanse marmer in de 17^{de} eeuw. In: De Jong, J, et al. (eds.),

- Nederland-Italië. Relaties beeldende kunst van de Nederlanden en Italië.* Netherlands Yearbook for History of Art. Zwolle: Waanders. pp. 197–214. DOI: <https://doi.org/10.1163/22145966-90000643>
- Scholten, F.** 2003. *Sumptuous Memories: Studies in Seventeenth-Century Dutch Tomb Sculpture.* Studies in Netherlandish Art and Cultural History, 5. Zwolle: Waanders.
- Steenmeijer, G.** 2005. *Tot cieraet ende aensien deser stede: Arent van 's-Gravesande (ca. 1610–1662), architect en ingenieur.* Leiden: Primavera Pers.
- Unger, R.** 2001. *A History of Brewing in Holland, 900–1900. Economy, Technology, and the State.* Leiden: Brill.
- Van Berkel, K.** 2013. *Isaac Beeckman on Matter and Motion: Mechanical Philosophy in the Making.* Baltimore: Johns Hopkins University Press.
- Van den Heuvel, C.** 1994. Stevins 'Huysbou' en het onvoltooide Nederlandse architectuurtraktaat. De praktijk van het bouwen als wetenschap, *Bulletin KNOB*, 93(1): 1–18.
- Van den Heuvel, C.** 2005. 'De Huysbou'. *A Reconstruction of an Unfinished Treatise on Architecture, Town Planning and Civil Engineering by Simon Stevin.* History of Science and Scholarship in the Netherlands, 7. Amsterdam: Koninklijke Nederlandse Akademie van Wetenschappen.
- Van de Vijver, D.** 2013. Epilogue. Paradigm Change in the Early Eighteenth Century. In: De Jonge, K, and Ottenheim, KA (eds.), *The Low Countries at the Crossroads. Netherlandish Architecture as an Export Product in Early Modern Europe (1480–1680).* Architectura Moderna, 8. Turnhout: Brepols. pp. 409–30. DOI: <https://doi.org/10.1484/M.ARCHMOD-EB.4.00157>
- Van Essen, G.** 2011. *Het stadsfabriekambt. De organisatie van de publieke werken in de Noordelijke Nederlanden in de zeventiende eeuw.* 2 vols. Unpublished thesis (PhD), Utrecht University.
- Van Essen, G and Hurx, M.** 2009. Design and Construction in the Cities of Holland, Part I. Supraregional and Municipal Systems: the Construction of Large City Churches and the Earliest Public Works (14th–16th Centuries). *OverHolland*, 8: 3–30.
- Van Gelder, HE.** 1918. Nieuws over Jan van Scorel. *Oud Holland*, 36: 177–82. DOI: <https://doi.org/10.1163/187501718X00138>
- Van Leeuwen, W.** 1993. Een complexe sector. In: Lintsen, HW (ed.), *Geschiedenis van de techniek in Nederland. De wording van een moderne samenleving 1800–1890. Deel III. Textiel. Gas, licht en elektriciteit. Bouw.* Zutphen: Walburg Pers. pp. 191–231.
- Van Tussenbroek, G.** 2009. Dachwerke des 17. und 18. Jahrhunderts in Amsterdam. Tradition und Erneuerung. In: Zalewski, P (ed.), *Dachkonstruktionen der Barockzeit in Norddeutschland und im benachbarten Ausland.* Petersberg: Imhof. pp. 105–23.
- Westra, F.** 1992. *Nederlandse ingenieurs en de fortificatiewerken in het eerste tijdperk van de Tachtigjarige Oorlog, 1573–1604.* Alphen aan den Rijn: Canaletto.

How to cite this article: Hurx, M. 2019. *The Most Expert in Europe: Patents and Innovation in the Building Trades in the Early Dutch Republic (1580–1650).* *Architectural Histories*, 7(1): 14, pp. 1–15. DOI: <https://doi.org/10.5334/ah.337>

Published: 28 June 2019

Copyright: © 2019 The Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC-BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited. See <http://creativecommons.org/licenses/by/4.0/>.

u[*Architectural Histories* is a peer-reviewed open access journal published by Ubiquity Press.

OPEN ACCESS 