Standardization in Ottoman Turkey

Feza GÜNERGUN

Starting from the 14th century, the Ottoman empire (1299–1923), ruled over a large territory for more than six centuries. Its long reign may be divided into two main periods, namely, the classical age and the modernization period.[1] From the viewpoint of the history of science and culture, we can say that the classical age, highly influenced by Turkish and Islamic traditions, continued until the last decades of the 18th century. The modernization period which followed witnessed the coexistence of both old traditions and European novelties, the latter being introduced and adopted with great enthusiasm during the 19th century.

However, from 15th century onwards, the Ottomans began to follow technical innovations developed in Europe, especially in such fields as war technology, mining, and cartography. Contacts accelerated in the 17th century, and the Ottomans learned more about Europe and its science and technology through the travel notes of Ottoman ambassadors, books translated from European languages, and other means.[2] Towards the end of the 18th century, Ottoman officials started to recruit engineers and officers from France to help reorganize the Ottoman military corps and to train engineers for the army. The goal was to reverse the relative decline of the Ottoman army by transferring Western science and technology.[3] These reforms constituted the beginning of the modernization period, which would last until the end of the Ottoman empire. Thus, by the 19th century, especially after the 1839 Reform Movement called *Tanzimat*, Ottoman administrators took Europe as "the model" and a multidimensional transformation occurred almost in every field, from state organization to architecture, from education to social life.

The push for standardization paralleled these developments. Ottoman standards of the classical period were replaced in the 19th century by European standards during the modernization movement. The Ottoman metrology of the classical era, which included elements of Islamic metrology, slowly gave way to the European metric system. This paper reviews the standards used in the production of various goods during the 16th and 17th centuries, and then examines standardization efforts undertaken in the modernization period, looking specifically at two areas : city planning and metrology.

16th–17th century Ottoman standards

Standardization in Ottoman Turkey can be traced back to the 15th century. During the reign of Bayezid II (1481–1512), laws were issed to regulate market prices. These laws, based on older laws (*kanun–i kadim*) issued in the time of Mehmed II (The Conqueror) (1451–1481), set fixed prices for goods produced or sold within Ottoman lands. For the historian they also contain valuable information about the size, quality, and other characteristics of commodities. Three laws for market dues (*ihtisab kanunlari*) have come down to us from the beginning of the 16th century (1501).[4] These were issued for the cities of Bursa, Edirne, and Istanbul, the three successive capitals of the empire. All three were notable centers for trade and handicrafts. These first laws appeared after the conquest of Istanbul by Mehmed II, whose strong policy of expansion and centralism led to the rise of an empire. They can be regarded as reflections of a powerful central administration and an effective state organization.

Fixed prices established by the judge were usually entered into the court registers (*sheriyye sicilleri*). Although rare, there were also separate registers called *narh defterleri* in which the characteristics of goods and their prices were noted. Two of these registers survive from the 17th century. Dated 1600 and 1640 respectively, they were both issued for Istanbul, the capital of the Empire.[5] Study of these laws and price registers sheds light on the standards used in Ottoman Turkey during the 16th and 17th centuries, and indicates that the size and quality of various goods in this period were already regulated. Textiles (fabrics, rush mats), clothing (kaftans, shirts, shoes etc.), building equipment (wood, timber, brick, glass, tools, etc.), house equipment and kitchenware, sea equipment (fishing nets, oars etc.), and miscellaneous commodities (bags, sacks) were produced according to established standards. The prices of these commodities were fixed by judges (*kadi*) in collaboration with the representatives of related guilds.[6]

Textiles

Many Anatolian cities were important centers for textile production during the Ottoman period. Although no standards covered all textiles, some fabrics were produced according to fixed standards in the 16th century. In a market law (dated 1501) of Bursa, a city well known for silk fabrics, the size and quality of the materials were generally expressed in terms of the numbers of threads (*tel*). The greater the number of threads, the higher the quality. The number of threads in the warp that a loom should be furnished with was fixed by law for different kinds of material.[7] (Table 1).

There were also standards established according to the weight of the

Table 1 Number of stripes to be used in the warp for various kinds of material recorded in the market law of Bursa (1501)

Name of the silk material	Number of stripes
Kemha-yi dolabi	7,000
Gülistani kemha	7,000
Atlas-i shehrî	4,200
Sultanî	2,200
Vâle-i musannef	2,200
Bürüncük	1,800
Mugrak väle	1,600
Yektâ tafta	1,600

threads.[8] For some fabrics, such as *çuka* (broadcloth), the standards were established in terms of hanks (*çile*). *Çuka*s of 60 and 70 hanks (the wrap consisted of 70 hanks; 40 teeth in a weaver's comb made a hank) are mentioned.[9] Some fabrics were sold piecemeal. In particular, a kind of haircloth called *çul* was woven in three different sizes. These sizes seem to have been standardized in the 16th and 17th centuries.[10] (Table 2).

In the 17th century the length and the width of "a roll" varied according to the type of material (silk, cotton, wool etc.) and the region where it was woven.[11] But the length and width of the material woven in a certain city were mostly standardized : the length of *bogasi* (a kind of twill used for linings), for example, was 10 *zira*s in Diyarbakir, Tokat and Kastamonu. In the 16th century, the compulsory roll length for fabrics in Koçhisar was 14 zira . Raw silk which was produced in Tosya was 12 *zira*. However, permission to shorten the length of the roll could be given by a special decree.[12]

There is also some evidence that rush mats, which were used for insulation in stone buildings, were produced in fixed sizes. A document dated 1588, stipulates that rush mats used in the small Istanbul mosques should to be woven according to the old standards, that is 4 *karish* in width and 15, 20, 30, 40 and 50 *karish* in length.[13] The same document states that the lengths of newly woven mats were 13, 16, 25, 32, 44 *karish* respectively, and mat makers were asked to conform to the old standards. It is clear that the shorter mats represented a form of malpractice among the mat makers.[14] Comparison of the sizes figuring in the price register of 1640 (Table 3) with those of 1588 makes clear the deviation from standards.

Table 2 Sizes of haircloth in 16th and 17th century Ottoman market laws

Istanbul (1501)	Edirne (1501)	Bursa (1501)	Before 1630
12 × 8 *karish*	12 *karish*	12 × 8 *karish*	12 × 8 *karish*
10 × 6 *karish*	10 × 7 *karish*	11 *karish* × 1.5 *arshin*	10 × 6 *karish*
9 × 6 *karish*	9 × 6 *karish*	—	9 × 7 *karish*

Table 3 Sizes of rush mats in the Istanbul price register (1640)

Type of the rush mat	length × width	length × width
Mosque rush mat	9 *zira* × 2 *zira*	27 × 6 *karish*
Rush mat called nine-thirty	6 *zira* × 2 *zira* 5 *rubu*	18 × 8 *karish*
Rush mat called eight-thirty	6 *zira* × 2 *zira* 2 *rubu*	18 × 6.5 *karish*
Rush mat called seven-twenty	5 *zira* × 2 *zira*	15 × 6 *karish*
Topaç rush mat	6 *zira* 2 *rubu* × 1 *zira*	18.5 × 3 *karish*

Clothing and shoes

According to the laws and price registers of the 16th and 17th centuries, Ottoman traditional clothes such as the *kaftan, ferace, dolama, çakshir* and *yelek* were usually produced in four standard sizes varying in length.[15] The ratio between the length of the clothes and the circumference of the skirts are generally given as 1 : 2. Measurements made in the Topkapi Palace Museum (Istanbul) show that the ratio 1 : 2 is also valid for the Sultan's kaftans. Slight variations in the length and width of the Sultan's kaftans seem to indicate that they were made to order (Table 4).

It is also noteworthy that the same sizes are mentioned for both women and men. However, a smaller size of 124 cm length existed for women.[16] Sizes of *gömlek* (shirts) worn to baths were classified according to the number of *dikish* ; and *peshtamal* (bath towels) according to the *kalem* number. These were produced according to definite standards, though these standards differed from those established for other goods (Table 5).

Boots and shoes were also produced in four standard sizes in the 16th–17th centuries[17] : *ulu ayak* (large foot), *ulu orta ayak* (between large and medium foot), *orta ayak* (medium foot), *kiçi ayak* (small foot). After the 17th century, new sizes like the *rüzgar ulusu, zergerdan, orta ulusu* were added to the above-mentioned

Table 4 Sizes of clothes in the 17th century

Size	Length in zira	Length in centimeters	Corresponding size
1	2 *zira* 3 *rubu*	155.5 cm	Extra large
2	2 *zira* 2 *rubu*	147 cm	Large
3	2 *zira* 1 *rubu*	138.5 cm	Medium
4	2 *zira*	130 cm	Small

Table 5 Sizes of shirts (gömlek) and bath towels (peshtamal) in the 17th century

Shirt sizes	Bath towel sizes
1st size : 100 *dikish*	1st size : 50 *kalem*
2nd size : 80 *dikish*	2nd size : 45 *kalem*
3rd size : 60 *dikish*	3rd size : 40 *kalem*
4th size : 40 *dikish*	4th size : 35 *kalem*

dikish : number of triangles in the side sewings of the shirts
kalem : thread groups attached to wooden or metallic nails of the loom

ones.[18] These sizes were generally applied to men's shoes. As for women's shoes, the adjective *zenane* (for women) was used together with the size. Although a size called *battal ayak* (oversize foot) was mentioned in the law of 1501, it was not emphasized in the price registers of the 17th century.

Building equipment (Wood, timber, bricks and tiles)

The fact that the types and sizes of the wood in the market were established in the beginning of the 16th century indicates the beginning of a standardization process.[19] (Table 6) The length of the wood that was brought for firewood from the forest to the city was also fixed : wood carried by mules was to be 3 *karish* ; wood carried by camels had to be 6 *karish*.[20] Sixteenth century documents specifying that the timber used in buildings should be cut in certain sizes make clear that there were also standards for timber. An edict to the Architect Sinan, dated 1582, contains four different timber sizes.[21] (Table 7).

A 1640 price register gives the names of about 60 kinds of timber.[22] The fact that the lengths and exact sizes of some of these timbers are also listed hints that they were cut according to certain standards. The list of the timber brought from the Kocaeli region between 1659–1696 to the *Tersane-i Amire* (Istanbul Dockyard), the largest of all the Ottoman dockyards, for use in shipbuilding also proves that there was standardization in timber.[23] Furthermore, the fact that 32 different kinds of nails are listed in the accounting books of the Istanbul Dockyard implies that nails were also produced according to established standards.[24]

Although the sizes of rooftiles are not mentioned in the 16th and 17th century

Table 6 Types and sizes of wood in the 16th century

Type of wood	Market Law of Edirne (1501)	Market Law of Bursa (1501)
Shelf wood	30 *karish*	—
Horizontal beam	25 *karish*	—
Saw handle wood	12 *karish*	8 *karish*
Axe handle wood	16, 15, 14 *karish*	—
Dice wood	—	12 *karish*
Roll wood	—	9 *karish*
Stave wood	2 *zira* (6 *karish*)	—

Table 7 Timber sizes from a 16 th century edict

Type of the mast	length × width
Pine mast (good quality)	10 *zira* × 12 *parmak*
Pine mast (medium quality)	8 *zira* × 10 *parmak*
Pine mast	6 to 5 *zira* × 8 *parmak*
Pine mast	6 to 3 *zira* × 6 *parmak*

* The *zira* mentioned in the edict is probably the *zira-i mimari* (75.8 cm) used by the architects.

Table 8 Sizes of glasses and saws in the 17th century

Size	Glasses (lengthxwidth)	Saws (length)
battal (extra large)	18 × 15 *parmak*	—
kebir (large)	14 × 12 〃	1 *zira*
vasat (medium)	12 × 8 〃	18 *parmak*
miyane (medium/small)	9 × 8 〃	12 *parmak*
sagir (small)	8 × 7 〃	11 *parmak*

documents,[25] they were produced according to a standard marked mold. Their size was fixed at 18×7×8 *parmak* at the beginning of the 18th century.[26] In 1733, the sizes of the tiles were reformulated, and their weights were set at 460 *dirhem* (Ottoman weight of 3.2 g). In 1750, tile standards were disregarded: new tiles were 13×5×6 *parmak* in size and 400 *dirhem* in weight.[27] In the price registers of the 17th century, 8 different kinds of bricks were mentioned. Except for two, their sizes were not given. The reason that the sizes don't appear may be related to the fact that their sizes, like those of tiles, were standardized.[28] Glasses and saws were produced in fixed sizes.[29]

Household equipment and kitchenware

The sizes of various goods used in house and kitchen—such as cases, baskets, boxes, mirrors, plates, bowls, jars, and pottery—were expressed vaguely as "large", "medium", "small", "extra small". However, Iznik porcelain plates, bowls and jars were classified according to their diameters.[30] (Table 9).

Table 9 Diameters of Iznik porcelain plates in the 17th century

Plate, large	15 *parmak*
Plate	12 *parmak*
Plate, size 2	11 *parmak*
Plate, size 1.5	10 *parmak*
Plate, size 1	9 *parmak*
Plate	7, 5 *parmak*
Sugar plate	5 *parmak*

Table 10 Standards for fishing nets used in the 17th century

Kind of Fish Nets	Number of Meshes
Zargana agi (garfish net)	40 in width
Istefanya agi (a net having wide-meshed parts and used in shallow waters)	40 in width
Tor agi (fine-meshed net)	30 in width
Hasir agi (wickerwork net)	28 in width
Uskumru agi (mackerel net)	370 × 45
Istavrit agi (horse mackerel net)	560 × 57
Lüfer agi (bluefish net)	500 × 300
Istakoz agi (lobster net)	200 × 25
Ilâkerda agi (tunny fish net)	150 × 17
Palamuda agi (bonito net)	500 × 300

Sea equipment

In the 17th century, fishermen used different kinds of nets for different kinds of fish, and the number of *göz* (meshes) in each kind was fixed.[31] (Table 10) Oars were also grouped according to their kinds and lengths. They were produced in fixed sizes varying from 9 to 21 *karish*.[32]

Weights and measures

The weights and measures used in the Ottoman Empire varied greatly because of the Ottoman policy of protecting and preserving the local traditions of the peoples they ruled. Different weights and measures were used in different regions of the country, and sometimes weights or measures with the same name had different values in different regions. Starting in the 16th century, the Ottoman state sought to standardize weights and measures in some regions, both for administrative reasons and for the collection of taxes, which took the form of grain. The *Istanbul kile* (measure of capacity of 37 liters) or *Istanbul okka* (measure of weight of 1,283 kg) were the accepted standards in feudal tax collection. On the other hand, uniformity among the weights and measures used in the *sancak*s (basic administrative units) was provided by a number of sancak codes. Standardization within the sancak involved extending a typical local measure to the whole *sancak*, and determining its equivalent in terms of the official Ottoman standards.[33]

Quality standards

As far as quality is concerned, most commodities in the market were classified into four categories, namely, very good (*gayet âlâ*), good (*âlâ*), medium (*evsat*), and lower quality (*edna*). Apart from these, phrases like "suited for sultans" (*sultanlara layik*), "suited for khans" (*hanlara layik*) were used to express high quality. To designate qualities lower than the above mentioned four, phrases like "worse, lower than all" (*daha edna, cümleden ashagisi*) were used. This quality classification was applied almost to all products, but especially to food and textiles.[34]

Miscellaneous

According to the information we have, bags too were produced in standard sizes at the beginning of the 16th century. Some of them were named after their color, e. g., *siyah torba* (black bag) 3×3 *karish ; boz torba* (grey bag) 3×3 *karish*. Others were designated according to the place where they were utilised, e. g., *merkep torbasi* (bags carried by donkeys) 2.5×2.5 *karish, seyishane çuvali* (stable sacks) 11×8 *kari*sh.[35] A price register of 1640 gives the lengths and widths of

different bags (*garar*).[36]

Graves for women were dug up to the height of the grave-digger's shoulder, for men up to the chest. In other words, women were buried deeper than men.[37] This practice was not based on the Holy Qur'an and traditions of the Prophet, basic sources of the Islamic religion. It derived rather from custom and special status in Islam assigned to the relation between women and men. The practice reflected the special regard for women and the concern to protect their bodies from exposure.

* * *

The fact that only three market regulations and two price registers have come down to us keeps us from making definitive judgments about standardization in 16th and 17th century Ottoman Turkey. However, it is obvious that the Ottoman state, in order to protect consumers, tried to standardize the goods on the market, periodically issuing regulations and price registers. As time passed, deviations from established standards crept in; materials were woven narrower and looser for instance, and the lengths of the fabrics rolls were shortened. Rush mats and bricks were produced in smaller sizes. The sizes of timbers were also changed.

Deviations from standards sprang from several causes, mainly economic. Increases in the prices of raw materials (dye, thread) for example, led to narrower and shorter fabrics; and this in turn made it hard for tailors to preserve standards in textiles and clothes. There is evidence, dating from the beginning of the 16th century, that bribes (*akçe*) paid to the municipal police allowed craftsmen to disregard standards, and sell lower quality goods. New codes or decrees were issued to ensure the preservation of old standards.

Standardization in the modernization period

As stated before, Ottoman contacts with Europe gained momentum from the 17th century on, and serious attempts were made to transfer European science and technology during the 18th and 19th centuries. The Ottoman reformers of the 19th century took Europe as the model in almost all fields, and considered the adoption of European standards as a mark of being European. I shall focus particularly on the steps undertaken in road building, urbanisation, and metrology.

Heights of houses and shops

Beginning from the 18th century, if not earlier, attempts were made to standardize the heights of houses and shops. Laws or decrees were promulgated especially after devastating fires in the city, and standards for heights were

reestablished. The height of houses in the 18th and 19th century documents was fixed (Table 11).[38] A code dated 1761 and sent to *Mimarbashi* (the chief architect) detailed the heights of shops according to their functions (Table 12).[39]

As buildings were being constructed contrary to the old regulations (*nizam-i kadim*), an edict was issued in 1210 (1795–96) setting up the maximum height for shops to be built within and without the city walls (Table 13).[40] The building regulations issued successively in the second half of the 19th century re-established the standard heights (Table 14).[41] However, writers of the period tell us that the standards set in the regulations were not rigorously applied.[42]

Table 11 Heights of the houses (18th and 19th centuries)

	1724 – 25	1817 – 18	1826
Muslim houses	12 *zira*	14 *zira*	14 *zira*
Non-muslim Ottoman subjects houses	—	10 *zira*	12 *zira*
Non-muslim houses	9 *zira*	12 *zira*	—

Table 12 Heights of the shops (1761)

Horse-dealers stables (*cambaz ahirlari*)	6 *zira*
Haircloth weavers shops (*muytab dükkanlari*)	5 *zira*
Felt mat shops (*keçeci dükkanlari*)	6 *zira*
Bakeries without wheels (*çarhsiz ekmekçi firinlari*)	8 *zira*
Pastry shops (*çörekçi firinlari*)	8 *zira*
Shops with wheels (*çarhli dükkanlar*)	10 *zira*
Grocers, tinners and trotter dealer shops (*Bakkal, kalayci ve paçaci dükkanlari*)	6 *zira*
Fruit and vegetable shops, drug-stores (*Manav, aktar dükkanlari*)	4 *zira*

Table 13 Heights established in the code of 1795 – 96

Shops adjacent to city walls	4 *zira*
Shops outside the city walls	
Treacle (*pekmez*), olive oil (*zeytinyagi*), cereal (*zahire*) shops	6 *zira*
Tobacco shops (*dühanci dukkanlari*)	6, 5 *zira*
Shops within the city walls	
Shops of artisans working with fire, such as casters (*dökümcü*), boiler manufacturers (*kazganci*), steelyard manufacturers (*kantarci*); shops of gunnery manufacturers for dockyards, grocers (*bakkal*)	5, 5 *zira*
Shops within and outside the city walls	
Coat makers (*abaci*), drugstores (*attar*), barbers (*berber*), tinplate makers (*tenekeci*), fish sellers (*balikçi*); felt cloth, (*kebeci*), hand painted handkerchief makers (*yemenici*) shops, stonemasons (*tashçi*) shops	4 *zira*

Table 14 Heights (in zira) of buildings in the 19th century

	1848	1848	1849	1863 – 4	1882
Stone houses	20	22	20	20 (24)*	30
Wooden houses	30	18	14	14 (16)*	20
Wooden shops	7	7	—	5	6
(with a room upstairs)	10	10	—	—	10
Stone shops	—	—	—	8	10

* heights between the parenthesis are only valid for buildings in the 6th Division in Istanbul.

The width of the roads

The Ottoman lands stretching across three continents witnessed the transit of armies and caravans. There were roads in the North–South direction, connecting the ports of the Mediterranean and Black Sea to the main trade lines ; roads in the East–West direction connected the Balkans to the Middle East through Anatolia. Although records tell us that the road network was looked after with great care and attention,[43] they offer no information about any attempt to standardize road widths during the classical period. Eighteenth century Ottoman documents do carefully note, however, much detail about the length of roads, the materials used, the number of workers and the cost.[44]

Attempts to regulate road width began within the framework of Tanzimat reforms. During the Tanzimat period (1839–1875), the modernization of Ottoman cities started with European urbanization as the model, and reformers supported the modeling of urban space based on European architecture and city planning. Regulations issued in 1839 and the years following the Tanzimat, tried to standardize the width of the streets and country roads according to *usul–i cedide* (new system or method). Standard heights for buildings were also established.

Regulations were first issued for the streets of Istanbul. Important streets would be 20 *zira* (15 m) wide each, with trees on both sides. 12 *zira* (9 m) of the street would be reserved for horses and carts ; pavements of 4 *zira* each would be built on both sides of the cart road. Other streets would be 15, 12 and 10 *zira* wide. This arrangement, proposed for Istanbul by the high officials of the Tanzimat, could not be put into practice, and successive regulations were issued after 1839 in the years 1848–49, 1863, 1869, and 1882.[45] These generally classified roads into four categories (1st, 2nd, 3rd, 4th class roads and blind alleys). The road widths given in these regulations changed with almost every regulation issued : the wide streets were to be 20 *zira* (15 m) in 1839 ; then 10 *zira* (7.5 m), 15 *zira* (11.5 m), 12 *zira* (9 m) and 20 *zira* (15 m) in 1848, 1863, 1869, and 1882 respectively (Table 15).[46] Interestingly, road widths established in 1839 and 1882 were exactly the same. In between, they went down, up and down

Table 15 Road widths as found in 19th century regulations

Regulation for buildings in Istanbul (1839)

Important streets	20 zira (15 m)
Other streets	15 zira (11.5 m)
	12 zira (9 m)
	10 zira (7.5 m)

Regulation for buildings (1848–49)		*Regulation for roads and buildings (1863)*	
wide streets	10 *zira* (7.5 m)	1st class roads	15 *zira* (11.5 m)
normal streets	8 *zira* (6 m)	2nd class roads	12 *zira* (9 m)
other streets	6 *zira* (4.5 m)	3rd class roads	10 *zira* (7.5 m)
		4th class roads	8 *zira* (6 m)
		blind alleys	6 *zira* (4.5 m)

Regulation for buildings and passages (1869)

Type of Roads	Road	Both Side	Total
1st class roads	7 m	2 m	9 m
2nd class roads	5 m 50 cm	1 m 50 cm	7 m
3rd class roads	4 m 50 cm	1 m	5 m 50 cm
4th class roads	—	—	3 m

Regulation for Buildings (1882)

1st class streets	20 *zira*
2nd class streets	15 *zira*
3rd class streets	12 *zira*
4th class streets	10 *zira*
blind alleys	8 *zira*

successively.

In the regulation of 1863, the widths of the streets were indicated in *zira*, the Ottoman unit of length. However, the *zira* was further defined as "equal to the three quarters of the French *mètre*." This record proves that European sources were used in determining the widths of the streets. This official text contains one of the earliest references to the meter before the metric system was officially adopted in 1869 by the Ottoman state. In the regulation of 1869, measures for width were given in meters while in 1882, they were again indicated in the traditional unit of length.

Standardization in metrology: the adoption of metric weights and measures

Beginning in the 16th century, administrators tried to standardize Ottoman weights and measures in some regions, and the Istanbul *kile* (37 litres) and Istanbul *okka* (1,283 kg) were accepted as standards for collecting taxes in some provinces of the Empire. Similar attempts were undertaken in the 19th century, with the aim of standardizing the Ottoman measure of length, the *zira-i mimari* (*zira* of architects, 75.8 cm). It is interesting to note that the 16th century efforts to establish metrological standards were related to agricultural and administrative needs, whereas in the 19th century the need arose from engineering problems.

a) *Establishing the standards for zira–i mimari and okka*

The need to standardize the *zira–i mimari* resulted from the difficulties encountered in the casting of cannons. Although the calibres of the cannon balls could be calculated theoretically, it was not possible to produce them with precision because the *ziras* used in the Imperial Arsenal of Ordnance and Artillery (*Tophane–i Amire*) varied in length. Guns, tools and instruments could not be produced accurately either. To avoid these problems, Engineer Mehmed Emin Pasha produced an "average *zira*" of brass in 1840, and had it compared in 1841 to the *metre* in Paris. The *zira–i mimari* was found to be equal to 0.757 738 *meters*. This *zira* was accepted as the standard for the Ottoman *zira* in 1846. In the same year, a similar standard for *okka*, the Ottoman weight, was prepared and kept for future comparisons.[47]

b) *Introduction of the metric system to the Ottoman state*[48]

The history of the metric system in Turkey can be traced back to the first half of the 19th century. The first references to the meter were made in 1830 by Ottoman engineers in the textbooks they compiled from French manuals on science and technology. Ishak Effendi's book on fortification (*Usul–i istihkâmat*, Istanbul, 1834) and Ibrahim Edhem Pasha's translation from Legendre's book on mathematics (*Usul–i hendese*, Cairo, 1836) are the first examples. These books briefly explained the new system, and gave the Ottoman equivalents of metric weights and measures so that the students of the Imperial School of Engineering (*Mühendishane*) could start practicing European techniques.

The official adoption of the metric weights and measures constitutes an important step towards standardization in Ottoman metrology. Several factors influenced Ottoman administrators to take this decision. Among these was the desire to transfer technical knowledge from Europe, and the need to solve problems resulting from the use of weights and measures of different values in different regions. Moreover, the steadily increasing trade with European countries made the use of the metric system a necessity. These requirements, together with the encouraging atmosphere of the modernization movement, led to the official adoption of the metric system in 1869.

With the *Law concerning the new weights and measures* issued on 27 September 1869, the Ottoman state adopted meter, gram and litre as the official units of length, weight and volume. The law laid down that, as of March 1871, the new weights and measures were to be used in all business and transactions carried out in government offices and local administrations. From March 1874, the metric system was to be applied throughout Ottoman lands.

Following the promulgation of the law, various measures were taken to facilitate the acceptance and use of the new system. The most important of these

was the publication in 1869 of the *Regulations regarding the use and control of the new measures*. The regulations specified the duties of the officials responsible for the application and control of the new units, the manner of producing metric weights and measures and dispatch them to the provinces, the application of the official stamp on these weights and measures, and so on. Work was also undertaken to teach the new system in schools. The Ministry of Education compiled a booklet introducing the metric system and made it compulsory reading in all schools. The Commission on New Weights and Measures (*Evzan–i Cedide Komisyonu*) which did the preparatory work for the introduction of the metric system, ordered posters illustrating the new weights and measures from Paris, and these were probably sent to secondary schools. Conversion tables were printed and distributed. Terms in Ottoman were coined for the new units (e. g., *zira–i ashari for metre*) and symbols such as m, m^2, and kg were represented based on Arabic alphabet.

A decree was issued in 1881 to facilitate the dissemination of the metric system within the country and its use by the general public. Compared with the law of 1869, the decree of 1881 introduced radical changes in terminology and in the presentation of conversion tables. It abolished the use of traditional weights and measures as of 1882, with the stipulation that they should be completely destroyed. In spite of the various proposals of the 1881 decree, the transition to the metric system was postponed at regular intervals by new regulations and official announcements during the last twenty years of the 19th century. There were several reasons for these postponements, such as the long–standing familiarity of the general public with the traditional system, and the malpractice of shopkeepers. A memorandum issued on January 1898 thus temporarily prohibited the use of the new weights and measures in the market.

In the first decades of the 20th century, permanent steps were not taken by the Ottoman officials to require the use of the metric system. In an empire experiencing difficult times after long periods of war, this issue was perforce neglected and postponed. Metrication in Turkey was reconsidered in the years following the proclamation of the Turkish Republic in 1923. A project proposed in 1925 was modified in the following years, and was accepted by the General Assembly in March 1931 as the *Law on weights and measures*. The new law rendered the use of metric weights and measures compulsory from 1 January 1933 onwards. However, actual implementation was postponed for a year, and the new measures were put into practice all around Turkey, beginning from 1 January 1934.[49]

The metric system was not used properly by the general public between 1869–1934, the sixty years following the promulgation of the law in 1869.

During this time, tradesmen tried to take advantage of the concurrent use of both systems, and this made the public unwilling to use the new measures. However, merchants trading with Europe supported the use of metric measures, and complained about the fraudulent practices of tradesmen which hindered acceptance. It should be noted, however, that the market of Istanbul differed considerably from those in other regions of the country, and that in the capital people were much more familiar with the new system.

Although it was not welcomed by the general public and shopkeepers, some signs indicate that the metric system was used regularly in government offices from 1871 onwards. The conversion tables prepared for use in the land registry during the second decade of the 19th century are an example. In this period, the metric system was also used in modern educational institutions (Engineering Schools, Military School, School of Medicine etc.) since the textbooks on science and technology were translated from European works. It is likely that the metric system was regularly taught in the secondary schools, for textbooks on mathematics included chapters introducing the new weights and measures. On the other hand, some professional groups contributed to the establishment and use of the metric system. In the chemical and pharmaceutical analyses carried out in the hospitals of Istanbul, metric weights and measures were used even before their official adoption. Similarly, European physicians and pharmacists practicing in the Ottoman state used this new system beginning from the middle of the 19th century.

The use of metric measures in Ottoman pharmacies had been discussed prior to its official adoption by the state. In 1867, a committee of scholars from the Imperial School of Medicine (*Mekteb-i Tibbiye-i Shahane*) in Istanbul expressed the need for metric weights and measures in the pharmacies. The first steps in this direction were taken in 1872 with the distribution of rules to all pharmacies requiring pharmacists to use metric weights and measures. In addition, books about pharmaceutical practices provided information on the metric system and published the metric equivalents of Ottoman weights and measures. Moreover, the issue of weights and measures was discussed at the Societé de Pharmacie de Constantinople (*Cemiyet-i Eczaciyan der Asitane-i Aliyye*). Following the steps taken by the government and the efforts made by a group of pharmacists and physicians, the metric system was introduced and partially practiced in Ottoman pharmacies. During the last decades of the 20th century, pharmacies were using Ottoman, French, and occasionally English weights together with the metric system. This variety was primarily due to the presence, particularly in Istanbul, of physicians of different nationalities who prescribed medicines in the units that they were accustomed to.[50]

The use of the metric system in government offices and by certain professional groups led to the coexistence of two different systems in the Ottoman state. It is true that this coexistence delayed the full adoption of the metric system in the Ottoman period. On the other hand, it facilitated its adoption in the Republican period since this coexistence familiarized the general public with the new weights and measures.

Another important factor that allowed the full adoption of the system in 1934 was the change in the geographical borders of the country. It was easier to apply the metric system within the borders of today's Turkish Republic than it had been in the Ottoman Empire, with its lands stretching from the Middle East to the Balkans. It must also be taken into consideration that the first attempts to go metric occurred during the last century of the six hundred year old Ottoman empire which witnessed long periods of war, and a host of economic and political problems; the reintroduction of this new system, by contrast, was realized during the first decade of the young Turkish Republic founded in 1923, which was a more homogeneous nation–state with a strong central government.

The adoption of universal time

The introduction of the universal time (Greenwich mean time) by the Ottoman administration may be considered a new stage in the process of Ottoman integration with Europe in the field of metrology. By participating in the international congress convened in Paris in 1913, the Ottoman state made the first steps towards adopting universal time, and signed the agreement for the establishment of the Bureau International de l'Heure (BIH).[51]

Nineteenth–century Europe and Northern America witnessed the rapid development of modern techniques of communication and transport. Parallel to this development, railroads and telegraph network spread quickly, leading to the need to measure time more accurately and precisely than ever before. Following the interconnection of railroads and telegraph lines, it was necessary to avoid the confusion and inconvenience resulting from the need to adjust watches as one sped by train from one country to another. Thus, all the countries in the world agreed to establish a standard time relative to a single line of longitude. In the congress which took place in Washington in 1884, the longitude that runs through Greenwich was accepted as the international meridian, and the first steps were taken for the *unification mondiale de l'heure*. Railway companies and navigators began to set their clocks relative to the Greenwich meridian. After the Conférence Internationale de l'Heure that convened in Paris in 1912, Greenwich mean time was adopted all over the world, and in all walks of life.

The Ottomans mainly used *gurubi saat* (*gurubi* time), which is a system of

numbering the hours starting with the sunset. Thus in *gurubi* time, which is also called *alla turca* time (Turkish time), the new day begins at sunset and the day is divided into 2×12 hours. In universal or mean time, however, the day begins at midnight and is divided into 24 hours.

Although Turkish time was commonly used in the Ottoman Empire, non-muslims and foreigners in Istanbul started using mean time around 1870. From 1868 on, the Observatoire Impérial Météorologique de Constantinople in Istanbul, started to announce regularly the *Temps Moyen de Constantinople* (Istanbul mean-time) in the daily newspapers together with Turkish time.[52] Some non-muslim aristocrats living in Pera were proud to set their watches by the British Embassy clock indicating the mean time. In 1870, Father Secchi,[53] in a letter that he wrote from Rome to the newspaper *Levant Herald*, proposed the use of mean time in Turkey and brought forth some arguments to persuade the Ottomans who might oppose this new system. The same paper argued also that the exertions of influential men—among whom was Mr. Coumbary, the director of the Imperial Observatory in Istanbul—would probably succeed in getting mean time adopted in Istanbul.[54]

Starting from the mid-19th century, the Ottomans transferred modern techniques of communication and transportation from Europe.[55] In the beginning of the 20th century, railway and telegraph networks spread all over the country, and the connection to European lines made the use of universal time essential. Universal time was probably first used in Ottoman Turkey by Rumeli Railways, which began to operate before 1913 and connected the Ottoman lands to Europe. As contacts with Europe rapidly developed, Ottoman institutions started to use *beynelmilel saat* (universal time) together with the *gurubi* time. Since this new practice was of European origin, it was called *Avrupa Saati* (European time), *alafranga saat* (alla franca time), *vasati saat* (mean time), *umumi saat* (universal time), or *zevali saat* (time reckoned from noon).

Another institution using mean time at the beginning of the 20th century was the Ottoman army. The Ministry of War disseminated a circular, dated May 1912, which listed the inconveniences resulting from using *gurubi* time and mean time together. Moreover, since military and civil services were always interrelated, it was deemed necessary to accept and apply mean time in civil offices. Thus, we may safely say that the decision to adopt mean time in government offices in Turkey was taken in 1912. Following this decision, the Ottoman Government joined the conference held in Paris in 1913, and by signing the agreement, started the process of using universal time in Turkey.

In order to receive the time signals emitted from the Eiffel Tower (Paris) which were sent twice a day to announce the adjustment of time, a "time ball"

was placed on the tower of the Marine Hospital (*Bahriye Hastahanesi*) in Istanbul, and through these time signals, universal time announcements started in Istanbul as of May 1915.

Following its adoption by communication and transportation companies, and military and government offices, mean time also came into use in daily life. In newspapers, meeting dates were concurrently announced both in *alla turca and alla franca.* This coexistence paralleled the situation observed in the adoption of the metric system : just like the old and new measures, *alla turca* and *alla franca* times coexisted for some years until the Republican period.

Apart from the economic and technological considerations, another factor forcing this development was the keen desire of Ottoman intellectuals to integrate with European civilization. A law enacted in 1926, following the proclamation of the Republic, stipulated that the adoption of universal time and the division of the day into 24 hours would be obligatory in all aspects of life. With this law, the longitude that passes through the city of Izmit, and is located 30 degrees east of Greenwich, came to be considered the basis for reckoning time all over Turkey.

Conclusion

From research conducted so far, it is obvious that the Ottoman state established some standards already in the 15th century. We do not have any information about standards used before the conquest of Istanbul in 1453. The available information on standardization belongs to the period after 1453, and is closely related to the establishment of the central government. The first laws for market dues that have reached us are the laws dated 1501. These laws fixed standards regarding the quality and size of goods produced by the craftsmen and sold in the markets. Among these goods were such items as textiles, leather, clothing, shoes, and wood. The purpose of creating and maintaining standards was to insure that the production of these goods conformed to certain norms. By regulating prices and controlling the market the government sought to protect both the consumer and the producer.

From the 17th century onwards, the fixed price practice expanded and standardization came to cover a greater variety of goods. In the 18th century, we come across standardization in new areas for which there was no previous data. The first regulations, from 1724 and 1725, specify the height of buildings. The height of shops, where different professions were carried out, seem to have been standardized from 1766 onwards. The sizes of roof tiles, which were fixed in the 17th century if not earlier, were redetermined in the 18th century.

In the 19th century, Ottoman attempts to modernize and transfer European

science and technology paved the way for the introduction of European standards in various fields. The regulations that were issued following the Tanzimat in 1839 and which aimed to standardize the width of the roads bore the imprints of European city planning. The importation of manufacturing technology and equipment, the creation of modern mechanized factories, the recruitment of foreign technicians, and the flow of European goods in Ottoman markets also led the Ottomans to learn more about European standards. However, the guild system continued to produce goods according Ottoman standards, though their conformity with the established standards seems not to have been as rigorously controlled by the state as it was in previous centuries.

The most important 19th century development in standardization was in the field of metrology; the initiative there was first taken within military institutions and related with engineering issues. Metric measures were used in the early 19th century in the Imperial School of Military Engineering within the practice of European techniques. The *zira* was first compared to the meter though the initiatives of Emin Pasha, an Ottoman military engineer. However, the official adoption which took place in 1869 aimed mainly to resolve the confusion caused by the multiplicity of weights and measures in Ottoman lands. It is interesting to note also that the official use of the universal time started in the army, prior to 1912, when the Ottoman government decided to adopt it in government offices as well.

In Ottoman history, the 19th century is usually considered the century of transformation. As the century progressed, Ottoman standards were slowly and inevitably replaced with European ones. The Ottomans gradually gave up their centuries-old measuring system and started their integration with European metrology. As in various other areas, this century was without doubt the period of reform for Ottoman metrology. However, the widespread use of European metric units in Turkey did not occur before the 1930s.

Appendix

Ottoman weights and measures mentioned in this article and their metric equivalents		
1 *zira (arshin)*	=	68 cm
1 *zira-i mimari*	=	75.8 cm
1 *endaze*	=	65 cm
1 *karish*	=	22.6 cm
1 *rubu* (1/8 *zira or arshin*)	=	8.5 cm
1 *parmak* (1/24 *zira-i mimari*)	=	3.2 cm
1 *dirhem*	=	3.2 g

Notes

1. Historians of politics and economics, taking into consideration the military defeats of the Ottomans in the last quarter and the economic impact of Europe in the last decade of the 16th century, have defined the three hundred year period between 1300–1600 as the "classical age" (Halil Inalcik, *The Ottoman empire: the classical age 1300–1600* [London: Weidenflend and Nicolson, 1975], p. 41–42, 52). However, although contacts with Europe increased in the 17th century, Turkish and Islamic traditions were still dominant. Therefore, as far as scientific, cultural and social life is concerned, the Ottoman "classical age" may be extended up through the end the 18th century.
2. Ekmeleddin İhsanoğlu, "Some remarks on Ottoman science and its relation with European science and technology up to the end of eighteenth century" in W. G. J. Remmelink, ed., *Journal of the Japan–Netherlands Institute*, Proceedings of the "International congress on the transfer of science and technology" (1st: June 5–7, 1991, Amsterdam), 3 (1991), 45–73; "Ottomans and European science", in Patrick Petitjean et al., eds., *Science and empires* (Dordrecht: Kluwer Academic Publishers,1992), 37–48; "Ottoman science in the classical period and early contacts with European science and technology" in E. İhsanoğlu, ed., *Transfer of modern science and technology to the Muslim world*, Proceedings of the "International symposium on modern science and technology and the Muslim world" (Istanbul: Research Center for Islamic History, Art and Culture /IRCICA, 1992), 1–48; "Ottoman Science" in Helaine Selin, ed., *Encyclopaedia of the history of science, technology, and medicine in non–Western cultures* (Dordrecht: Kluwer Academic Publishers, 1997).
3. Mustafa Kaçar, "Osmanli imparatorlugunda askeri sahada yenilesme doneminin başlangici," in F. Günergun, ed., *Osmanli bilimi arastirmalari* (Studies in Ottoman science) (Istanbul: Istanbul Universitesi Edebiyat Fakültesi, 1995): 209–225.
4. Omer Lütfi Barkan, "XV. asrin sonunda bazi büyük şehirlerde esya ve yiyecek fiyatlarinin tesbit ve teftisi hususlarini tanzim eden kanunlar", *Türk Tarih Vesikalari*, I, 5 (1942), 326–340, II, 7 (1942), 15–40, and II, 9 (1942), 168–177.
5. Mübahat Kütükoglu, *Osmanlilarda narh müessesesi ve 1640 tarihli narh defteri* (Narh 1640) (Istanbul: Enderun Kitabevi, 1983); "1009 (1600) tarihli narh defterine göre Istanbul'da cesitli esya ve hizmet fiyatlari" (Narh 1600), *Tarih Enstitüsü Dergisi*, no. 9 (1978): 1–85.
6. Narh 1640, p. 13.
7. Barkan, II, 7, p. 15–40; Faruk A. Sünter et al., *Türkiye'de standardizasyon ve Türk Standartlari Enstitüsü* (Ankara, 1964), 15–16.
8. Barkan, II, 7, 33.
9. Narh 1640, 111.
10. Barkan, I, 5, p. 337, II, 7, p. 34–35, II, 9, p. 173; Osman Nuri Ergin, *Mecelle–i umur–i belediye* (M. U. B.), vol. 1 (Istanbul: Matbaa–I Osmaniye, 1922), 415.
11. For the varying lengths of bogasi see Narh 1640, p. 126–131; M. Kütükoglu, "Asakir–i Mansure–i Muhammediye kiyafeti," *Dogumunun 100. yilinda Atatürk'e armagan* (Istanbul: Istanbul Universitesi Edebiyat Fakultesi, 1981): 519–605.

12. Suraya Faroqhi, *Osmanli'da kentler ve kentliler* (Istanbul: Tarih Vakfi Yurt Yayinlari, 1994), 175.
13. Ahmed Refik, *Onaltinci asirda Istanbul hayati* (1553–1591) (Istanbul: Devlet Basimevi, 1935), 135, 107.
14. Narh 1640, 73,185.
15. Narh 1640, 122 (for *ferace*), 124 (for *dolama, yelek, ferace*), 125 (for *çakshir*), 135 (for *kaftan*).
16. For the smaller size, the length of the kaftan is given as "1 *endaze* 7 *rubu*" which was equivalent to ~22 cm. Narh 1640, 135.
17. Barkan, II, 7, 33; Narh 1640, 188–193.
18. Narh 1600, 31; Narh 1640, 187–189; M. U. B., I (1922), 426.
19. Barkan, II, 7, 36, and II, 9, 168–177.
20. Barkan, II, 7, 36
21. A. Refik, *Onaltinci asirda*, 64–65.
22. Narh 1640, 294–96.
23. Idris Bostan, *Osmanli bahriye teskilati: XVII. Yüzyilda tersane-i amire* (Ankara: Türk Tarih Kurumu, 1992), 105–106.
24. *Ibid.*, 125.
25. A. Refik, *Onaltinci asirda*, 64–65, 109.
26. A. Refik, *Hicri 12. asirda Istanbul hayati (1100–1200)* (Istanbul: Devlet Matbaasi, 1930), 31.
27. *Ibid.*, 169–170.
28. Narh 1640, 299.
29. Narh 1640, 306 (for glasses), 307 (for saws).
30. Narh 1640, 310–311.
31. Narh 1640, 291.
32. Narh 1640, 292.
33. Halil Inalcik, "Introduction to Ottoman Metrology," *Turcica*, XV (1983), 329–330.
34. Barkan, I, 5, 332 et al. (for shoes and boots); Narh 1640, 99 (for drugs), 109–110 (for materials), 166–167 et al.(for furs).
35. Barkan, II, 7, 34–35.
36. Narh 1640, 243.
37. Barkan II, 7, 38.
38. M. U. B., I (1922), 1058–59.
39. *Ibid.*
40. A. Refik, *Hicri onüçüncü asirda Istanbul hayati (1200–1255)* (Istanbul, 1932), 9–11.
41. M. U. B., I (1922), 1062.
42. *Ibid.*
43. M. Kütükoglu, "Osmanli iktisadi yapisi," in E. İhsanoğlu, ed., *Osmanli devleti ve medeniyeti tarihi* (Istanbul: IRCICA, 1994), 589.
44. Cengiz Orhonlu, *Osmanli imparatorlugunda derbend teskilati* (Istanbul: Istanbul Universitesi Edebiyat Fakultesi, 1967); "Mesleki bir tesekkül olarak kaldirimcilik ve Osmanli sehir yollari hakkinda bazi düsünceler," *Güney-Dogu Avrupa Arastirmalari Dergisi*, I (1972): 93–138;

"Köprücülük", *VII. Türk Tarih Kongresi*, vol. 2, (Ankara : Türk Tarih Kurumu, 1973) : 701–708.

45. M. U. B., I (1922), 1340–42, 1344, 1064, 1069.
46. For 1863 see *Düstur*, I. Tertib, vol. 2 (Istanbul : Matbaa–i Amire, 1289/1872), 499–514 ; for 1869 see *Ibid*, 302–309 and for 1882 see M. U. B., I (1922), 1069.
47. F. Günergun, "L'équivalence des mesures Ottomanes avec les anciennes mesures françaises et les mesures métriques : les premières comparaisons et les tables de conversion", paper presented at the International Congress of History of Science" (19th : August 22–29, 1993, Zaragoza), in press.
48. F. Günergun, "L'introduction du système métrique dans l'état Ottoman," in B. Garnier and J. Hocquet, eds., *Genèse et diffusion du système métrique* (Caen : Editions–Diffusion du Lys, 1990) : 178–189 ; "Introduction of the metric system to the Ottoman state," in E. İhsanoğlu, ed., *Transfer of modern science and technology to the Muslim world*, Proceedings of the International Symposium on Modern Science and the Muslim World (Istanbul : IRCICA, 1992) : 297–316 ; "Du zira au mètre, une transformation métrologique dans l'empire Ottoman," in Patrick Petitjean et al. eds., *Sciences et empires* (Dordrecht : Kluwer Academic Publishers, 1992) : 103–110.
49. F. Günergun, "Metric system in Turkey : transition period (1881–1934)," in W. G. J. Remmelink, ed., *Journal of the Japan–Netherlands Institute*, Proceedings of the Conference on the Transfer of Science and Technology between Europe and Asia since Vasco da Gama (1498–1998) (3rd : October 28–30, 1994, Istanbul), 6(1996) : 243–256.
50. F. Günergun, "Desimal metrik sistemin Osmanli eczahanelerine girisi," *Doga–Tr. J. of Pharmacy*, no. 1 (1991) : 55–66.
51. E. İhsanoğlu and F. Günergun, "Adoption of the universal time in Turkey," paper presented at the Internationaler Kongress für Osmanische Wirtschafts–und Sozialgeschichte (1300–1920), (7th : July 25–29, 1995, Heidelberg).
52. *La Turquie*, 19 Novembre 1868, 1, col. 5
53. Angelo Secchi (1818–1878), Jesuit astronomer known for his work on stellar spectra and the classification of stars that he proposed in late 1860s.
54. *The Levant Herald Constantinople*, 2 April 1870, 2, col. 2–3 ; 6 August 1870, 2, col. 2–3.
55. E. İhsanoğlu and M.Kaçar, eds., *Çagini yakalayan Osmanli*, Proceedings of the symposium Modern Techniques of Transport and Communication in the Ottoman State" (Istanbul : IRCICA, 1995).