**Medieval Technology**

Technology in the Middle Ages focuses on technologies that appear to be natively "European." Other technologies (such as paper, gunpowder, the compass, stirrups, among others) were based on older developments in other regions, particularly China from which they were transferred to other parts of Europe and the West.

**Agricultural Tools**

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| The **plow** is considered to be one of the most important (and oldest) technologies developed. In fact, the history of the plow stretches back to the Neolithic (New Stone) Age that began about 8000 BC in Mesopotamia. In the Middle Ages, however, the plow was radically improved and was used with multiple-oxen teams. This innovation facilitated the clearing of the forests of fertile northwest Europe. Before this time because of the nature of the soil, it was difficult to plow these fields. And, obviously, this inability to cultivate these fields reduced the population of northwest Europe. After the redesign of the plow, allowing the plow to plow the heavier and wetter soil of northwest Europe, there was a dramatic increase in agricultural productivity, and subsequently, the population of these areas. The working day of a farmer was still very difficult, even with the technological improvements of the Medieval Age. |  |

In addition to the redesign of the plow, crop growing style changed in Medieval Europe when farmers changed from a two-field crop rotation to a three-field crop rotation in the 8th century. According to White (1962), Charlemagne himself thought of this agricultural innovation. Why is it so significant? How did the three-field rotation work, as compared to the older two-field rotation? Under a two-field rotation, half the land was planted in a year while the other half lay fallow. Then, in the next year, the two fields were reversed. Under three-field rotation, the land was divided into three parts. One section was planted in the Fall with winter wheat or rye. The next Spring, the second field was planted with other crops such as peas, lentils, or beans and the third field was left fallow. The three fields were rotated in this manner so that every three years, a field would rest and be unplanted. Under the two field system, if one has a total of 600 fertile acres of land, one would only plant 300 acres. Under the new three-field rotation system, one would plant (and thereby harvest) 400 acres. But, the additional crops had a more significant effect than mere productivity. Since the Spring crops were mostly legumes, they increased the overall nutrition of the people of Northern Europe.

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| Two other technologies played an important role in the development of medieval agriculture. And, the consequence of these improvements was a major increase in agricultural productivity (White, 1962). Each of these three technologies will be discussed separately. |  |

**The Harnessing of Time**

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| Clocks are a fairly recent invention; that is, the first clocks were created  about 5000 to 6000 years ago by the great civilizations in the Middle East and North Africa. As with many technologies, the development of the clock was driven by societal needs. In these centralized civilizations (such as the Sumerian and Egyptian civilizations), there was a societal need to organize time more efficiently. The first clocks were shadow clocks or sundials where the time of day could be determined by following the shadows cast by the sun.  Mechanical clocks were first used in China, more for astronomical and astrological purposes rather than for telling the time. About 725 AD, a Chinese engineer, Liang Ling-Tsan invented the mechanical escapement, which is a key device in all mechanical clocks. One of the most elaborate clock towers was built by Su Sung and his associates in 1088 A.D. It is also interested to note that the developments in Chinese clock building were influenced by Muslims. During the period beginning with the Mongol conquest of China by Kublai Khan, the Chinese Mongol rulers employed Muslim astronomers. These Muslim astronomers developed improved astronomical instruments. |

 Mumford (1986) identified the clock as the "key" machine of the modern industrial age. He emphasizes the clock because of its uniqueness among other machines of its day.  It was a new type of power machine, "in which the source of power and the transmission were of such a nature as to ensure the even flow of energy throughout the works and to make possible regular production and a standardized product". He also notes that the clock served as a model for many other types of mechanical products.

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| However, the most significant difference between the clock and other machines was in its effect on society. Large mechanical clocks began to appear in the towers of several large Italian cities beginning in the 14th century. With the clock, time became divided into regulated units instead of remaining dependent on events or the day. Before the clock, people worked, ate, and slept according to the patterns of the sun and moon. After the clock, the day was presided over by a monitor from the time of rising to the hour of rest. Through the clock, "time took on the character of an enclosed space: it could be divided, it could be filled up, it could even be expanded by the invention of labor-saving instruments". |

As the clock became more widely used, abstract time became the new medium of existence. It brought with it a mechanical efficiency through coordination. This efficiency was seen as a desirable trait in society and its effect on our society is still evident today.

**The Use of Iron and Mining in the Middle Ages**

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| One of the most important developments in the Middle Ages was the experimentation and developments in iron production. As noted by Bert Hall in his essay, "Iron is one of the most useful metals ever discovered, but it is also one of the more difficult metals to understand in history, especially in medieval history. Iron comes in several forms, and the complications involved in producing each of these fostered further confusion."  In Europe by 900, there were significant changes in the production of iron. The above ground reduction furnace had been developed; this furnace allowed for the easier creation of iron. This iron could then be forged by local smiths into "parts for plows, spades, pitchforks, and shoes for horses beginning to pull with the aid of the new horse collar". |

In addition to the mining of iron ore to make agricultural and manufacturing products, the Medieval Age saw an increase in the mining of other metals including silver, lead, copper, gold, and anthracite. During the early to middle Medieval Age, the work of mining followed the pattern of manor-based agriculture. A family of miners would work on a seam of ore and they would get a percent of the ore that was mined. Those who mined precious ore (silver or gold) were usually paid in ore; the miners could then sell their ore directly to a goldsmith or silversmith. As in other craft areas, the mining industry underwent a transition during the the late Medieval period. Because of the demand for more ore, particularly precious metals for coins, there was a transition from a family, craft-based production to a "capital intensive industry subject to central management in which the miner was an employee of the Crown or its lessees". As ore became more difficult to mine from the ground, the mines became deeper. This led to the use of new technologies in the mining industry. One of the most important 15th century applications for the waterwheel was to pump out mine shafts. In any case, by the year 1500, iron production for Europe was 60,000 tons. This increase in iron reduced its cost and, at the same time, increased the number of tools available, particularly in agriculture.

**Weaving and the Textile Industry**

By far, working in agriculture was the most common job in the Middle Ages. The mechanization, fertilization, and other modern techniques that we take for granted were almost nonexistent. It took a large number of people to produce food for a society.

Of the crafts, the largest one was in cloth making. And, it is in cloth making that the first industrialization occurred during the Middle Ages. By the Middle Ages, the location of textile production was usually a household where the man was the weaver and the women prepared and spun yarn for the loom. All cloth was woven by hand on a loom and the most common materials of this time period were wool, cotton, silk, and linen. Each of these materials had its own production and most of them required the contributions of more than one individual. Manufacturing techniques remained unchanged over a long period of time. To produce wool, the fleece needed to be washed and then combed to remove tangles. Next, the yarn needed to be spun with a spindle.

Because of the time involved, it took many hand spinners to supply a single weaver. And, initially, weaving was difficult to do because the first looms used were vertical. By the 12th century, horizontal looms were used that allowed the weaver to sit while he worked. These looms most likely were adaptations of earlier silk looms developed by the Chinese and transferred through traders.

During the Medieval Age, wool was the dominant textile with linen as the next important manufactured textile produced. Linen is a particular difficult finished product to manufacture. Linen is derived from flax, a plant that has been cultivated for material since 3000 BC. If the process of making fine linen is difficult today, it is unimaginable how much more labor- and time-intensive this process was during the non-mechanized Medieval Age.

Cotton manufacture was also the result of technology transfer, this time from the Muslims. After the Muslim conquest of Spain and Sicily, the new Muslim government developed widespread cotton manufacturing. In the 12th century, when Sicily was reconquered by the Normans, the cotton weaving knowledge was spread to northern Italy and afterwards to the rest of Europe.  Silk, another important textile used during the Medieval Age, was not manufactured in any significant quantity in Europe until much later (16th century). A small amount was produced in Italy (click on this link to read a primary source that describes how the technology of making silk was transferred to Italy, But, until the late Medieval period, most silk was imported from either China or the Moslems.

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| During the early to mid Medieval Age, the textile industry was dominated by guilds, as were the other crafts. A guild was a workers' association. The main role of a guild was the regulation of its trade or craft. "No one not a member could sell at retail in the town. A foreign merchant had to sell to a guildsman, who would then re-sell to the citizens. In some cases foreigners were allowed to sell directly, but they had to pay a very heavy tax for the privilege. Foreign merchants were usually limited to one year's stay in the town or less - they could not set up shop permanently". Often, the goods (whether cloth or metal goods) would be sold through markets or fairs. |  |

The first guilds were merchant guilds in the late 11th and 12th centuries. These guilds were composed of all artisans, merchants, and traders within the town. As crafts began to develop and grow, the merchant guilds usually split up into craft guilds. According to Knox (1999), in Augsburg, "there were 17 guilds in 1350, 38 guilds by 1450, and over 60 guilds by 1550." In the textile industry, there usually were different guilds for the different steps in the textile manufacturing process: spinners, weavers, fullers, dyers, and wool merchants.

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| By the 13th century, the textile industry underwent an organizational change. Cloth making began  to be organized as a "putting out" system. These changes were first seen in the Flemish wool  industry when wool production was moved from the villages into the towns of the Scheldt valley.  The system is called a "putting out" system because the cloth merchant functioned as the  manager of the entire process. Previously, the cloth merchant functioned as a middleman between  weavers and the market. Now, the cloth merchant also acted as a middleman between the weavers  and the wool suppliers English sheep farmers). The cloth merchant acted as the "factory" foreman  and, more to the point, he was able to economically dominate the cloth industry. | Cohen. |

Another key innovation in the 13th century was the introduction into Europe of the spinning wheel.  "The Great or Jersey wheel, introduced around 1350, was the first improvement made in the process of cotton spinning. Thread could be spun faster on the wheel than with the traditional distaff". The final Medieval technical improvement to the spinning wheel was the addition of a foot treadle that powered the wheel.

By 1400, more changes had begun for the textile industry. These changes were aided by the dramatic social changes that occurred in the previous one hundred years. Because of the peace and general prosperity during the 13th century, Europe was overpopulated during the first part of the 14th century. And, with a rash of poor weather in the early 13th century, poorer harvest led to mass starvation in some parts of Europe. Added to this was an increase in warfare (for example, the Hundred Years War), and death by warfare. To compound the problem further, the [Black Death](http://www.eyewitnesstohistory.com/plague.htm) (the plague) struck Europe in 1347 through 1349. Historians estimated that between one-fourth to one-half of Europe's population died in the 14th century.

These societal events affected the economic life. For example, when Henry III of England was fighting against Louis IX of France in Aquitaine, "trade between England and France was greatly hampered. The Cistercians refused contributions to the royal revenue, and therefore Henry prohibited their profitable woolen trade with the continent. The Florentine and Flemish merchants were at this time those most interested in buying wool from England."

How did this decrease in population help the textile industry? First, because of the decrease in population, land became cheaper. And cheaper land caused a shift to more sheep farming, especially in England. (Remember that the English dominated the market for wool during the Medieval Age.) This led to the development of a new form of textile production in England where "the sheep-owning landowner established production on his own manor, outside the jurisdiction of both city and guild regulations". In Western Europe, the "putting out" system was ending and was being replaced by a factory-like production of textiles. At first, the workers usually worked out of their own houses while being visited by inspectors. Later, the workers were moved to a centralized "factory" or workshop where the length of the day and the amount of work was regulated. In any case, by the end of the Medieval Age, the stage was set for the total industrialization of the textile industry during the Industrial Revolution.

**Building Construction**

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| Before beginning our discussion of the techniques used in Medieval construction, it is best to understand the social structure of the times. Although the Middle Ages stretch from approximately 500 to 1500 AD, there were changes in the distribution of people in Europe. A particularly important social phenomena during this time period was the growth of towns, and later cities.  The growth of towns meant the development of a new type of worker and here the craftsmen become very important. After 1000, there was a revival of commerce in Western Europe and the towns were well positioned as the location for these traders. Also, since the spread of the heavy plow agricultural productivity increased. This meant that there were excess agricultural workers who now could move to a town and work in either trade or manufacturing.  Since most of the construction during this time was done with wood, carpentry was a lucrative trade. The carpenters generally formed their own guilds. For a guild to be recognized, it usually had to have a chapter from a town, church, or noble. |

There are several distinct categories of buildings during this time. In this section, we will discuss the range of construction from peasant housing to cathedral building. In all areas of building, there were dramatic changes throughout the Middle Ages.

**Conclusion**

As we can see from the stories of the various technologies, the development and diffusion of a technology depends not only on its invention but also on the social and cultural climate in which it was invented. For example, as discussed above, the rapid population declines of the 13th century, for example, led to an increase in sheep farms, which led to an increase in textile production. Not all technological change is as readily traced. James Burke, in his well-known book on technology and society, focused on the connections. As he says in his introduction, "Change almost always comes as a surprise because things don't happen in straight lines. Connections are made by accident. Second guessing the result of an occurrence is difficult, because when people or ideas come together in new ways, the rules of arithmetic are changed so that one plus one suddenly makes three. This is the fundamental mechanism of innovation, and when it happens the result is always more than the sum of the parts".

The impact of a technology on society is always unexpected because technologies are rarely "the end of the story." They lead to new technologies--or new uses--or new social modes. It is this interplay of technology and society throughout the Medieval Age that it so interesting. All the foundations for our modern society were laid in the Medieval Age including universities, the Industrial Revolution, and the Capitalist system.

But, technology did not develop solely in Europe. Many technologies, instead, were the result of inventions that were transferred from the **East (China, India, and the Muslim world**). In the next two sections, we will discuss the contributions of China and the Muslim world to the growth of technology in the West.