

Evolutionary aspects of product development in the textile and fashion industry with respect to marketing changes

2

2.1 Introduction

History lessons can provide a great deal of insight of the present time not only because evolutionary developments do not start from vacuum but also because human progress is largely a cyclical phenomenon, and no matter how progressive the world will become, human approaches to do things will inevitably be recyclable, perhaps in different forms but essentially identical in principle. Ever since the first human stepped on the face of the earth, he created necessities for living such as food, clothing, and convenient environment that we now call goods, products, or services. Yet, when the term product development is mentioned today, it would sound as a new thing that we learn about for the first time. Indeed, this term was used as an independent organizational approach in the late 20th century; nine centuries after the term “engine” or “engineering” was coined, and two centuries after the term “technology” was fully recognized and utilized.

If the term product development was used in the 19th century, it would have rightfully implied an engineering or technology job. At that time, product development primarily meant a process of improving existing products or converting new ideas into innovative products through appropriate design conceptualization and design analysis, which are typically engineering tasks. However, in today’s competitive market, the concept of product development has been expanded to accommodate and integrate critical product-related aspects such as consumer’s perception, product’s attractiveness, value appreciation, market niches, environmental and safety factors, sustainability, and anticipated performance over a product’s life cycle. These aspects are extremely complementary to the design process, but classic engineering education often ignores these aspects as a result of focusing on product functionality and performance characteristics. Therefore, a job description of a product developer today is no longer restricted to engineering background, and it may indeed cover a wider range of disciplines including business, marketing, logistics, consumer’s research, technology, and engineering qualifications [1–3].

In this chapter, evolutionary aspects of product development are briefly reviewed as it would take an independent book and multiple authors to cover the details of these aspects. This is because product development as we know it today integrates all element of a complete marketing network, which primarily aims at maintaining a continuous stream of products that exhibit better attributes and provide newer

performance features at a faster time-to-market pace. Therefore, this review will only account for product development with respect to marketing changes over time.

Historical marketing changes can be roughly divided into five phases [4–8]: (1) the customization era, (2) the production-focus era, (3) the product-focus era, (4) the consumer-focus era phase I (sales), (5) the consumer-focus era phase II (marketing), and (6) the information-focus (societal marketing) era. These eras cannot be described by an exact historical timeline of specific transitions; instead, they represent gradual and overlapping transitions. Indeed, all product development approaches associated with these marketing transitions still coexist in many countries even today.

2.2 The customization era

The customization era goes back to the first human on earth and extends from the ancient time to the industrial revolution of the 18th century. In this era, virtually, all products were handmade as powered machines were yet to be introduced. This was the era when humans had plenty of time to think and reflect on the environment of living things and realize that the earth is the only accessible human's environment. Human also realized the limited capacity of the earth environment to provide space, food, shelter, and energy.

Going further back in history, the earliest customization era was more of an “accustomation” era since it was all about familiarization, acclimation, adaption, and acquaintance with the natural resources of that period. This was the era of largely passive development described by historians at the “hunter-gatherer” era. In other words, humans in “accustomation” era were not ready to create and develop, only to survive with whatever was available. Basic living things such as food, shelter, and body covers were not developed; they were rather discovered.

Some archeologists suggested that humans in the very early years did not wear clothes and only relied on human hair as a body heat stabilizer to control the absorption of heat energy by the naked human skin in hot environment and the loss of heat in cold environment. This means that any human effort to develop artificial body covers, or what is now called “clothing,” must have come after early humans lost their body hair. Genetic data suggest that body hair was lost about 1.2 million years ago [9]. Although a single human still grows over 1000 km of hair on average over his/her lifetime, this is far less than the millions of kilometers of hair that a human grew in the early time. Interestingly, what remained of body hair today is a trillion-dollar business around the globe in the form of hair care products, wigs, and hair extensions. In addition, human hair is a critical element in forensic science via DNA, fiber identification, and protein analysis that can assist in investigating numerous crimes [10–12].

One of the first documented forms of product development in the customization era was the making of clothing, which can be traced back to the Mesopotamian era (3500 BC) and into the ancient Egyptian era. One of the earliest fibers used by human to make clothing was linen fibers. Most textiles in the Ancient Egyptian era were

woven fabrics made primarily from linen. The choice of linen fibers by the Ancient Egyptians (3000 BC) was perhaps a result of the lack of other fibers available. Fortunately, linen clothing absorbs moisture very rapidly, but it also dries quickly, making it comfortable fabrics for warm climates. The task of extracting linen fibers from the flax plant required a great deal of know-how [13–15]. To separate linen fibers, flax must be fully retted or soaked in water or chemicals (alkali or oxalic acid) to soften it by loosening the pectin or gum that attaches the fiber to the stem. The process of retting had to be performed very carefully since too little retting may not permit the fiber to be separated from the stalk with ease and too much retting or rotting will weaken fibers. Upon retting, the flax plants must be squeezed and allowed to dry out before undergoing the so-called breaking process in which the decomposed stalks are crushed using fluted rollers that break up the stem and separate the exterior fibers. This process breaks the stalk into small pieces of bark called shives. The shives are then scutched using rotating paddles so that the flax fiber can be completely released from the stalk. It is the author's opinion that the Ancient Egyptians who built the great Pyramids of Giza had also developed the first technology of natural fibers extraction or at least set its underlying principles.

One of the interesting questions that are often asked in the context of product development is what would make humans think of plant fibers and animal hair instead of recycled human hair, which is abundantly available even today, in making clothes? This is a good question for archeologists and historians that the current author is not qualified to answer. One speculation may stem from the high propensity of human hair to attract external parasites, which are both irritating and harmful to human body. Ironically, Alix Bizet, a French student in the Design Academy Eindhoven in The Netherlands recently designed clothes made of human hair (https://www.vice.com/en_us/article/yp55aw/a-dutch-student-is-making-clothing-out-of-human-hair). Whether one agrees with this fashionable approach, the French student tried to follow a logic that was never considered by any product developer in history.

The rest of the ancient history in developing customized textiles made from natural fibers is well documented in the literature. However, in the context of product development, the story of silk was quite unique [16,17]. Ancient Chinese were the first to discover that silk can be made into woven fabrics (3000 BC). They cultivated silkworms and invented the reel and loom required. The mysterious technology at that time involved in making silk fabric led to a Chinese monopoly of silk production for more than three millennia (until about BCE 200) during which smuggling silkworms across the Chinese boarder was a crime of death penalty. The luxury texture, softness, and luster of silk fabrics made it very popular around the world. The famous story of lucrative trade route known as the "Silk Road" was a result of the high demand for silk in the western world, which led to taking silk westward and bringing gold, silver, and wools to the east. Indeed, silk was considered as even more precious than gold. For this reason, the 4000 miles silk journey from Eastern China to the Mediterranean Sea was surely worthwhile. Later, a handful of Chinese immigrants went to Korea and transferred the silk technology with them, and from there, it was spread to India, Japan, and other parts of the world. By the 13th century, silk had entered Europe, and Italy had gained dominance in silk production.

Unfortunately, the secrecy surrounding the production of silk fabrics for 30 centuries had masked documentation of the evolution of this technology. By the 19th century, the interest in silk began to fade away as a result of the large production of cheaper Japanese silk, especially driven by the opening of the Suez Canal, and by the middle of the 20th century, the glory of silk fabrics was substantially vanished with the introduction of synthetic fibers that were initially developed to mimic silk fibers. Now, China is back to be the leading producer of silk around the world (about 146,000 metric tons annually), but the excitement and secrecy have gone forever.

Many historians use fashion and clothing as evidences of the early human realization of the concept of product development. Seven thousand years ago, ancient Egyptians pioneered the early concepts of product development through wide varieties of clothing for men and women that can be observed in the engraved arts on the ancient Egyptian walls today [17,18]. The common men's garment was called the "shenti," wrapped around the body at the waist. Some versions had cords attached to tie the garment, and in other versions, the fabrics are knotted at the waist or held up with a knotted cloth belt. This fashion was later evolved from a short, form-fitting kilt to a longer kilt, extending to the knee and then to the ankle. The paintings on the walls also indicate that Egyptian men often wore no shirts or simple shirtlike garments with their shenti. In later dynasties, some Egyptian men wore a tunic reaching to the knees over the shenti. This was borrowed later by the Roman's empire for working people. High-ranked scribes and many women in ancient Egypt wore long robes, called "kalasiris" usually in white linen. Egyptian clothing for women also included a form-fitting sheath. These are all evidences of the leading role the fashion industry played in the early time of the customization era.

The customization era continued to the time of the industrial revolution of the 18th century. Interestingly, up to the 1400s, the world population was less than 500 million people. By the time of the industrial revolution, the world was still less than 1 billion people. The customization era required high precision of making things and very skilled labor with long experience as these were the main criteria for customer's satisfaction. The relationship between the makers of products and their customers was at the highest level, and the loyalty to certain products was at the same level as the loyalty to product makers. Business competition in this era was very localized, and customers would go extra miles to find the right maker of a product. Advertising was primarily the word of mouth, and skilled product makers were always in demand. In other words, the maker of a product was at the center of business, and customers had to make efforts to find the right makers of the needed products (see Fig. 2.1).

Near the end of the customization era, many businesses were family oriented. This was clearly demonstrated in the textile industry of this era where families worked together at home. They raised their own sheep, which provided wool for spinning and food products such as milk, cheese, meat, and leather. Traders relied on family business a great deal to produce their goods, and this had resulted in economic independence of farmers. In addition, merchants delivered fibers to farms and villages to be spun in homes, which eliminated the cost of building large factories. This social and economic structure was good in this era given the small world population of that time.

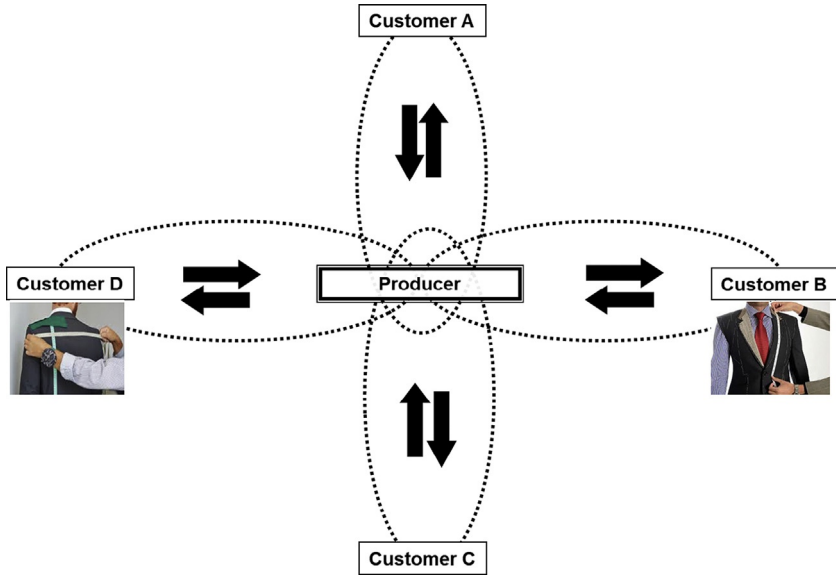


Fig. 2.1 Customization-focus era.

2.3 The production-focus era

The industrial revolution of the 18th century had transformed agricultural societies to more industrialized and urban regions. Machines powered by steam engines started to replace human power in many applications [19–21]. This had resulted in a significant shift toward manufacturing and mass production, which placed machine at the center of business as shown in Fig. 2.2. This era can be described as the production-focus era since the success of any business was primarily measured by production efficiency and cost of manufacturing. It was all about more volume and higher production rates to reduce cost and consequently reduce price. Labor was still intense since machines would not run properly without close supervision and human involvement. Many businesses planned their marketing strategies based on economies of scale, which is the production of more product units to reduce input costs. At the dawn of the Industrial Revolution in the mid-1700s, the world's human population grew by about 57% to 700 million, and by 1800, it reached 1 billion. This trend led to the common assumption that demand will always exceed supply and supply creates its own demand (or if somebody makes a product, somebody else will want to buy it). The theory of increasing demand prevailed, and the world population reached 2 billion people in 1927.

Before the industrial revolution (1760–1840), fibers were spun into yarns, and yarns were woven into fabrics using manual means. The early machine for turning fiber into a thread or a yarn was the so-called spinning wheel, which has an obscure origin. At the beginning of the 16th century, the first semimachined spinning system

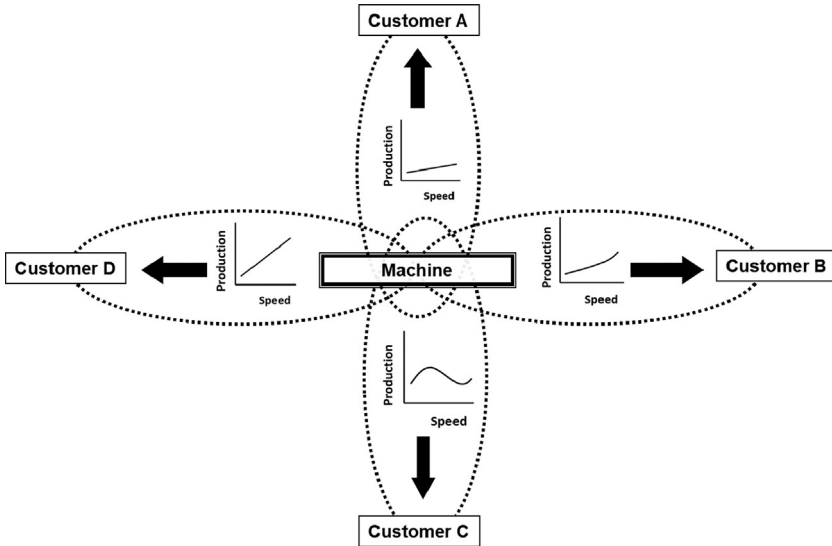


Fig. 2.2 Production-focus era.

called the Saxon, or Saxony wheel, was introduced in Europe [17]. It incorporated a bobbin on which the yarn was wound continuously, and the wheel was actuated by a foot treadle. Ironically, at that time the loom, which weaves the yarn into a fabric, was somewhat ahead in the process of development. This was a classic case of how invention and innovation can be independent of time sequence by virtue of consumer and market demands.

The shortage of yarn supply resulting from the improvement of the loom in the 18th century stimulated a series of inventions that converted the spinning wheel into a powered, mechanized component [17,18]. This development began about 1764 with the invention of the spinning jenny by James Hargreaves, an uneducated English spinner and weaver, who witnessed his daughter Jenny accidentally overturning his hand-powered multiple spinning machine. As the spindle continued to revolve in an upright rather than a horizontal position, he began to think in a different design direction that led to the invention of the spinning jenny with which one individual could spin several threads at one time. Ten years after the introduction of the spinning jenny, an English spinner by the name Samuel Crompton developed the so-called spinning mule. This machine permitted large-scale manufacture of high-quality thread. It was inspired by the problem of excessive defects produced on the spinning jenny and by the weaver demand for a defect-free yarn, but it did not add to the basic idea of the spinning jenny.

On the fiber production side, natural fibers such as wool, linen, and silk were the dominant fibers in the early period of the industrial revolution. Toward the middle of the revolution (1807), a breakthrough occurred with the invention of the first cotton gin by Eli Whitney, an American inventor. This invention dramatically fueled the

momentum of the industrial revolution [22,23]. It transformed the tedious and time-consuming process of separating cotton fibers from cotton seeds into a mechanical process that substantially increased ginning efficiency. This invention resulted in the United States becoming a major contributor to the industrial revolution and boomed US cotton exports from less than 500,000 pounds (230,000 kg) in 1793 to 93 million pounds (42,000,000 kg) by 1810.

The ring spinning machine as we know it today (excluding automation and process control) was invented by the American John Thorp in 1828. It was an invention because the idea of using a ring and traveler was introduced for the first time. By the 1860s, ring spinning had largely replaced Samuel Crompton's spinning mule in the world's textile mills because of its greater productivity and simplicity. In the second half of the 20th century, two new spinning systems were introduced, which accelerated the spinning process exponentially and shortened the spinning preparation process. The first was open-end spinning technology, which was invented and developed in Czechoslovakia in Výzkumný ústav bavlnářský/Cotton Research Institute in Ústí nad Orlicí in 1963. The second was air-jet spinning, which was introduced by the Japanese-based Murata Machinery Ltd. in 1997. The underlying principle of air-jet spinning was derived from an earlier invention by E.I. Du Pont de Nemours and Company in 1956.

The earliest development in loom design was through two revolutionary inventions in the weft and warp direction. The first invention called the flying shuttle was invented in the 18th century by John Kay, British weaver, in 1733 (not to be confused with the spinning inventor John Kay of 1767). It was a revolutionary development at that time since it replaced the older shuttle hand insertion by an uninterrupted flying shuttle that carried the weft through the warp threads faster and over a greater width of cloth. The flying shuttle was also able to handle wider looms, which saved a great deal of labor work. The second invention was the semiautomated loom invented by Basile Bouchon and Jean Baptiste Falcon in the period 1725–28 and further developed into a fully automated machine by the French engineer Jacques Vaucanson in 1745. Although these inventions did not materialize into large-scale commercial machines, they represented the sparking basis for the first economically feasible automated loom, called the Jacquard loom in 1801. This was the work of Joseph Marie Jacquard, a French inventor, who demonstrated a loom that enabled unskilled workers to weave complex patterns in silk. This loom was controlled by a chain of multiple cards punched with holes that determine which cords of the fabric warp should be raised for each pass of the shuttle.

In the context of product development, the invention of the Jacquard's technology provided an insight into two factors that still exist today in modern product development: (a) the social effect of product development and (b) technology migration. The Jacquard's technology was a real gain to mill owners seeking higher efficiency and less reliance on skilled labor, but it had also resulted in labor unrest because it put many skilled labors out of job. Technology migration was a result of using the principle of the Jacquard technology in products associated with information technology. The idea of storing and automatically reproduce complex information was never known to human before the invention of the Jacquard's technology. Following this

idea, many analytical engines were created [18,19]. In 1832, Semen Korsakov, a Russian government official, devised methods of searching information stored on punched cards for the Russian Police Ministry. In 1837, English mathematician Charles Babbage described plans to use punched “number cards” to input programs and data into his analytical engine. In 1846, Alexander Bain, a Scottish clock maker, used a “continuous card” in the form of punched paper tape to speed the input of text messages for transmission over the railroad telegraph. Indeed, the propagation of the concept of data storage and input on punched tape remained in use for small computers and machine tool control through the early 1970s. These major developments have led to the initiation of the first and largest information technology company in history, International Business Machines (IBM) Corporation in 1924, which introduced its own punched cards of rectangular holes and 80 columns (the standard data storage medium of its time) to dominate the early data processing industry.

The 20th century came with the arrival of electricity replacing steam machines by big electric motors without removing the pulley system. By 1940, it was realized that the flying shuttle was too bulky and subsequently too slow leading to small number of picks per minute (weft-insertion rate). As a result, the projectile loom was introduced in 1945. This had opened many ideas for weft insertion including the use of air and water jets for weft insertion, which accelerated the loom exponentially and resulted in weaving much broader fabric widths. These technologies became commercially available by 1950, transforming the loom from the era of shuttle loom to the era of “shuttleless” loom. In addition to water- and air-jet insertion, gripper machines employed a small projectile raising a weft from a side supply and taking it to the other side, and rapier machines applied a narrow but long rod moving from a side and picking a weft yarn. Today, all kinds of loom are utilized including the classic shuttle loom, which is still in use in many developing countries.

The next development in loom design was the concept of multiphase loom introduced during the 1970s, wherein all loom tasks occurred simultaneously to generate fabrics at rates exceeding 1.5 yards per minute. In addition, more complex fabric designs are now possible because of the introduction of CAD/CAM or computer-aided design and manufacture technology in 1980s. These developments have reduced the time of the fabric design process from weeks and months to hours.

The invention of the first knitting machine represented another example of a great idea that was dead on arrival because of its impact on social disruption. William Lee of Calverton near Nottingham, England (1563–1614), saw a huge market opportunity when he realized that England’s population was approaching 5 million people and market experts of this period estimated that this population needed about 10 million pairs of stockings annually or about two pairs per person. This was impossible to produce domestically at that time since hand knitting could produce only six pairs of stockings a week. In 1589, he invented the first stocking knitting machine, which is considered by many historians as the first major stage in mechanizing the textile industry, 200 years before the Industrial Revolution. Before this invention, hand knitting was widely spread in homes and was even taught in schools. Lee’s first machine was a direct imitation of the movements of hand knitters. The idea was based on using a spring, bearded, or barbed needle that were held in a strong iron bed, surrounded by a

huge wooden frame. The needle bed was held rigidly horizontal, and parts of the rest of the machine worked around it. Later, he improved the capacity of his machine from 8 needles per inch to up to 20 needles per inch and produced stockings from wool and silk. The problem, however, was that the world was still living the customization era in which any mechanized invention meant social dissatisfaction and displacement of skilled labor. As a result, Lee's invention was rejected by Queen Elizabeth I of England fearing labor unrest. In the context of product development, the merit of this story is that inventions, no matter how incredible, are likely to go nowhere without marketing opportunities.

It took more than 150 years and the industrial revolution for much further development in the knitting machine to occur as a result of the rising demand for cheaper stockings made of cotton. In 1757, Jedediah Strutt, an English hosier and cotton spinner, invented the Derby Rib machine, which consisted of an extra set of bearded needles that operated vertically, taking the loop and reversing them. This allowed a plain and purl knit to be used and led to ribbing and tighter flexible fabric. In 1802, Pierre Jeandeaupatented the first latch needle, which has a right hook and a latch around the axis. This was later improved by Matthew Leo Townsend in 1817. It was much more versatile than the spring needle, and it did not need to be placed horizontally, since the key was the work of the latch itself. As a result, it could be mounted vertically in a machine. This had made it usable in circular knitting machines, which had a great boost during the time of the American Civil War (1861–65) when the quartermaster general of the Northern army decided the quality of its socks and stockings was far better than the frame knits with necessary seams he had been offered (before then, only plain tubes were being made).

Today, the traditional textile industry is still largely production focused, and new development in spinning and weaving technologies are primarily aimed at increasing speeds and minimizing material waste through a great deal of automation and process control. This is because the industry is essentially mass based; raw materials, yarns, and fabrics are all sold by weight. In a mass in-mass out industry, the focus is primarily on maintaining high production rate and minimum material waste. When the fabric is transformed to the cutting and sewing stage where intense labor is required, the importance of production rate and minimum waste becomes even greater.

2.4 The product-focus era

By the beginning of the 20th century, the world was approaching 1.7 billion. More people meant bigger markets and more diversity in consumer needs. It also meant more producers of goods and services stimulated by many developments occurring after the industrial revolution. These changes marked the beginning of the product-focus era in which more emphasis was placed on the quality and the functional performances of products. In the industrial world, many companies installed automated technologies in their facilities, not only for further increase in efficiency but also more importantly for higher consistency in product characteristics. Countries that were famous for their poor-quality products such as Japan and Korea began to focus

more on producing high-quality products inviting famous quality experts such as Edwards Deming and Joseph Juran to assist them in achieving high quality. The product-focus era was associated with different philosophies of quality and many quality strategies including the following: statistical process control (SPC), quality engineering, and six sigma. The problem, however, was that quality was not free and the concept of zero defects initiated by Philip Crosby was too idealistic since many defects were due to inherent design problems that are not solvable, or solutions were too costly to justify higher prices to the consumers [24]. Nevertheless, quality strategies directed the industry to better management approaches of dealing with products.

The center of the product-focus era was the product, and the common assumption was that a high-quality product will automatically draw consumer's interest (see Fig. 2.3). There was only one element missing, which was consumer's input. Indeed, product quality implementation was largely between supplier companies and receiver companies with the latter set the quality standards and the former deliver. The ultimate user of the product was hardly consulted on what constitutes a product value.

The textile industry continued to be a major player in the product-focus era. Throughout the production-focus era (up to the end of the 19th century), the industry relied totally on natural fiber resources (cotton, wool, silk, etc.) to produce massive textiles. In the 20th century, the fiber segment of the industry entered the era of synthetic fibers as a result of major advances and discoveries in polymer synthesis, new spinning methods, and new polymer solvents. The first idea leading to the development of man-made fiber was proposed in the 17th century by Robert Hooke,

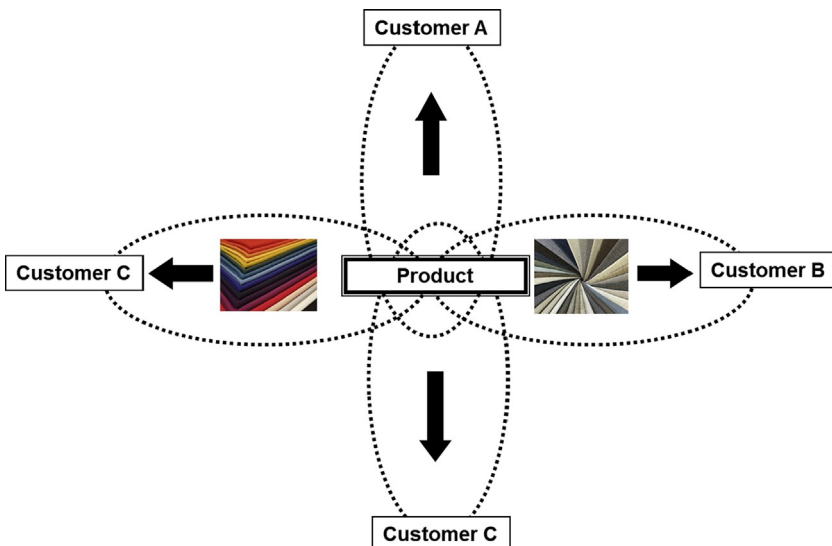


Fig. 2.3 Product-focus era: simple competitive loop.

an English physicist who is more popular for his discovery of the law of elasticity, known as Hooke's law. He suggested that it might be possible to imitate the process by which a silkworm produces silk. Today, this approach is known among engineers and scientists as "mimicking nature." He proposed forcing a liquid through a small opening and letting it harden into a fiber. This was a true creative thinking at a time powered machine was not invented.

The first implementation of the idea of producing synthetic fiber was in the late 19th century. Audemars, a Swiss-born chemist, received the first patent for artificial silk in the 1855. He was able to dissolve the fibrous inner bark of a mulberry tree and chemically modifying it to produce cellulose solution and then using needles dipped into the solution to draw filaments. This was the time before the familiar extrusion spinneret used for rayon fiber, which was discovered later in 1880s by Sir Joseph W. Swan, an English chemist and electrician, who was more famous for his work in developing a successful incandescent light bulb. This was the beginning of a continuous stream of synthetic fiber developments into the 20th century reaching its peak with the development of the revolutionary nylon fiber.

Many historians still remember the New York World's Fair of 1939–40, which was one of the most memorable expos the world had. Visitors of this expo were invited to see what was described as the "world of tomorrow" giving them a first glimpse of wonders such as the television, the videophone, and the Ford Mustang. It was also the first chance to see nylon, the world's first fully synthetic man-made fiber. It was being sewn into pantyhose by a display of knitting machines as two models played tug of war to demonstrate the strength of the fabric. Nylon had been discovered by the Wallace Carothers' group in DuPont's research division 4 years earlier. It was introduced at the fair as the new hosiery "wholly fabricated from such common raw materials as coal, water, and air," which could be made into filaments "as strong as steel." Nylon stockings went on to become a huge success, of course, selling 64 million pairs for DuPont in their first year alone. The introduction of nylon fibers had opened the door for developing and introducing more synthetic fibers including polypropylene and polyester fibers. In 2002, polyester fiber consumption around the world has exceed cotton fibers for the first time in history, and it has continued this advantage until today at higher-than-expected rates. In the context of product development, unlimited performance characteristics can be obtained using synthetic fibers. The production of synthetic fibers also opened the doors for numerous products made from blended fibers, synthetic and natural.

2.5 The consumer-focus era phase I: Sales

Both production and product-focus marketing approaches assumed that the producer of a product knows best, and his/her focus should be on using state-of-the-art technology to produce good-quality products at the highest efficiency possible with the assumption being that this is all it takes for a business to survive and prosper. The missing link in these eras was that the consumers were not consulted on their actual needs of the desired product features. It took almost a whole century for product

makers to recall the customization era and realize that without consumer's inputs, products may be of the highest quality but with no consumer's interest. Consumers were also passive in expressing their opinions on product performance or product diversity as they thought that what was produced represented the best the industry can do and product's performance should be evaluated strictly in view of the face value of a product as described by the producer.

By the second half of the 20th century, the world population exceeded 2.5 billion people, and industrial countries began to witness a significant increase in local competition between organizations making the same product or providing the same service. This has led to more options available to consumers of various products or services. It was also apparent that manufacturing companies can produce far more goods than the market can accommodate. This has led to a more significant role of consumer in the marketplace and a transition of marketing strategies toward focusing on more sales to consumers. Companies began to realize that for consumers to buy more products, they must be persuaded to do so. The primary approach to achieve this persuasion was through heavy advertising of products using different media sources that were also growing in this era. This was the era of forcing products into the hand of consumers through bombarding them with aggressive sales tactics, heavy public advertising, and very costly promotional campaigns. Indeed, many companies in this era elected to spend immensely on advertising at the expense of product development. Furthermore, the competitive advantage of this era was primarily dependent on how big the company in the marketplace and the power of its sales tactic and advertising (see Fig. 2.4). Although all these efforts had targeted the consumers, they were made again after products were developed internally and produced without much feedbacks from consumers.

2.6 The consumer-focus era phase II: Marketing

By the end of the 20th century, it was obvious that the world was undergoing a new marketing phase featured by revolutionary changes in world macroconnections including the following: a world population reaching 5.3 billion people (1990), the beginning of the internet revolution or the WWW era (World Wide Web, 1992) and the new wave of globalization represented by the World Trade Organization (WTO, 1995). Consumers were more than ready to welcome these changes after a period that lasted over 50 years (since WWII) in which they were saturated and tired of hard sell tactics. It was through these revolutionary changes that consumers and consumer advocates were able to send their messages loud and clear of enough is enough of sales push. Businesses also began to realize that simply producing quality products and pushing them onto consumers through heavy attractive advertising and promotional campaigns had exhausted their merits and resulted in consumer's fatigue. Ironically, this realization did not mainly come from large organization since many of these organizations, per the author's opinion, were too big to think and the old wisdom clearly indicates that "elephants cannot dance." The marketing era was largely inspired by creative and talented individuals including Bill Gates and Paul Allen of

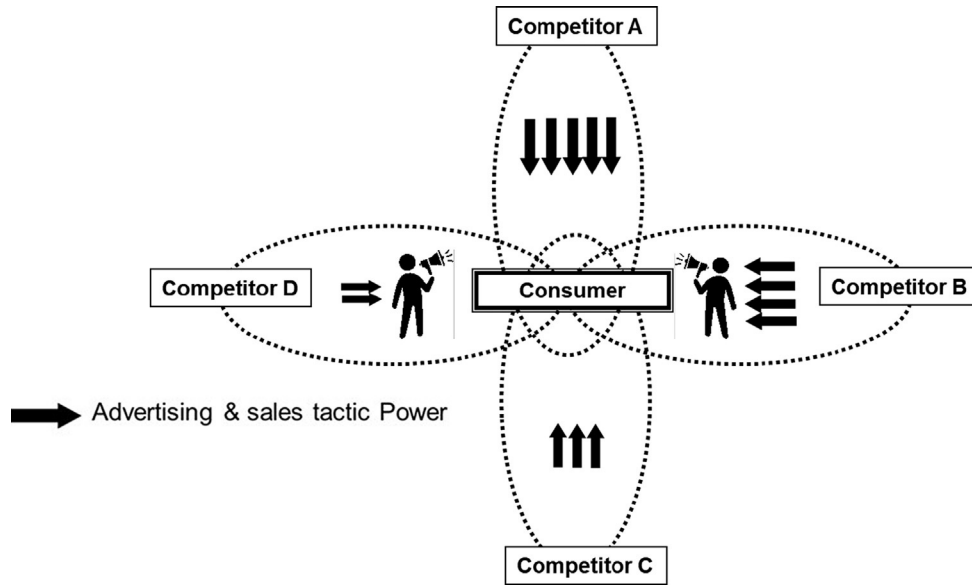


Fig. 2.4 Consumer-focus era: phase I: sales → advertising and sales tactic power.

Microsoft, and Steve Jobs, Steve Wozniak, and Ronald Wayne of Apple who were working since the mid-1970s preparing for the start of this new era.

The marketing era was based on a revolutionary reverse in marketing strategies through true disruptive unusual technologies. The growing world population meant that a true excitement through unusual ideas is needed for developing new products. In addition, companies needed to identify and locate their potential consumers, understand consumer's demographic variables, and realize consumer's needs and wants as opposed to producing products and then trying to convince customers to buy them (see Fig. 2.5). Furthermore, since needs are typically known and wants are not, it was important to induce wants into consumer's interest through creative ideas.

The consumer-focus marketing era was associated with many challenges. Perhaps, the ultimate challenge was to react to the growing individualization of demand yet providing products at the lowest price possible. This had resulted in a substantial transition from mass production to mass customization. In addition, organizations began to realize that they must work tirelessly in different directions including the following: (a) understanding market segmentation, (b) realizing the difference between macro and micro markets, (c) developing parallel approaches for brick and mortar and online markets, (d) establishing market segmentation by demographic factors, (e) establishing a trade-off between mass production and mass customization, (f) performing dynamic competitive analysis, and (g) understanding the true product life cycle. These aspects will be discussed in the next two chapters.

It is the author's opinion that the textile and fashion industry was ahead in the game of product marketing. Since the ancient era, the fashion industry was always about

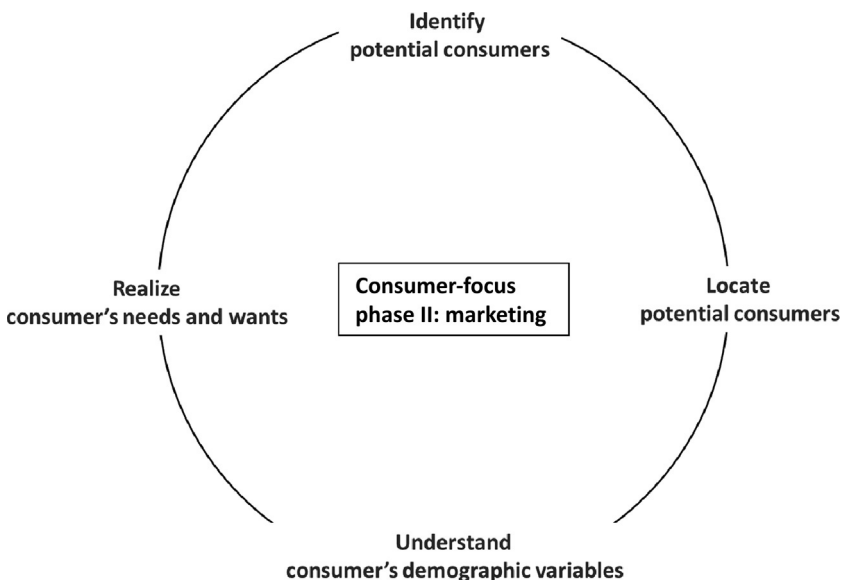


Fig. 2.5 Consumer-focus phase II: marketing.

marketing for human needs, cultures, class, age, and gender. This can easily be seen in the different fashions adopted by different cultures and civilizations from the ancient Egyptian to the Roman Empire to today's modern living. As we move to more recent history, it will only take watching one of the oldest movies ever made, which is "Arrival of a train," a silent movie that lasted 50s in 1895, to immediately notice the stunning performance of the textile and fashion industry in developing and producing outfits for men, women, and children at a time the train was pulled by a steam locomotive. Compare the outfits in this movie with those displayed in numerous movies over the last 70 years and you will see that this industry has never ceased to develop clothing of different styles, colors, and fits. This was all about marketing with full consideration of consumer needs and wants. Perhaps, looking at the evolution of men's suits [25], one can see how every fashion designer has been inspired by traditional styles at one time or another, meanwhile accommodating generational changes. As a result, men's suit design has evolved from the high conformity and the so-called Ivy League look in 1950s, to the rebellion and individuality look in 1960s, to disco funk style in the 1970s, to the power dressing of 1980s, to the baggy business casual of the 1990s, to the slim-fit and hip-hop style in the 2000s. This evolution clearly indicates that product development is culturally related through presenting contemporary ideas into existing products that accommodate the generational changes without sacrificing the product social or cultural values that most consumers like to adhere to. This concept is known today as "design reinvention [26]."

The new trends of functional fashions have taken product development in the fashion industry upstream, seeking product developments for different applications and different age groups. Now, product developments of functional fashion are creating new markets including the market of intelligent clothing with integrated sensors. The increase in senior populations in many countries has led to the development of clothing just for senior citizens (<https://www.huffingtonpost.com/>); a category of consumers that has been ignored by the fashion industry for many years. This type of fashion prioritizes comfort and efficiency using customized fits and items that are fitted with magnetic buttons, elastic waists, and thumb holes. Some of these garments are even produced with personalized name tags. It is the author's opinion that functional clothing will certainly place the fashion industry in a leading position in the business world, and one can only imagine going in the direction of clothing for millions of people of special need such as the deaf and the blind with fabric being the platform of compensating equipment, to realize the immense potentials of this great industry.

Another progressively active area of product development in the textile industry is the technical textile segment in which creative designs and R&D represent essential components of success and economic prosperity. The global technical textile market size can reach \$300 billion by 2050. It was \$160 billion in 2015 and in its way to achieve compound annual growth rate (CAGR) of more than 6% by 2022. Technical textiles are primarily function-focus products; they are manufactured for nonaesthetic purposes to offer numerous functional performances in many areas including the following [27,28]: home-tech products, automobile-support materials, medical and healthcare products, human protection and safety systems, agricultural products,

construction and highway products, filtration, and electronic-support products. Indeed, a quick look at a modern car will reveal that it has technical textiles all over the place resulting in lighter weight and lower energy consumption including the following: seat upholstery, carpets, seat belts, headliners, tire cords, liners, and composite reinforcements for automotive bodies. More examples of technical textiles applications will be presented later in this book.

Product development of technical textiles is typically associated with challenges that are different from those encountered in the traditional textile and fashion industry. These challenges include the following [27,28]: (1) the need for more high-performance fibers, (2) the need to understand the compatibility and interfacial characteristics between fibers and other types of materials (e.g., soil, metals, polymer resin, plastic films, and human organs), (3) the need for different manufacturing models, (4) climbing the learning curve of new manufacturing technologies, (5) the need for interdisciplinary cooperation between textile engineers and engineers in other fields, and (6) the ability to search and discover new market opportunities for technical textiles.

2.7 The information-focus (societal marketing) era

The 21st century began with a revolutionary universal wave of social and information microconnections. At the beginning of the century, Google was recognized as the newest and most capable world search engine, and the Global Positioning System (GPS) began to find its way in the roads and highways of the universe. In 2007, the world witnessed the introduction of Apple I-Phone, Facebook, YouTube, and Twitter. eBay, founded in 1995, began to move globally in the 21st century by building online person-to-person trading community on the Internet. Buyers and sellers were brought together in a manner where sellers are permitted to list items for sale, buyers to bid on items of interest, and all eBay users to browse through listed items in a fully automated way. The items are arranged by topics, where each type of auction has its own category. PayPal Holdings, Inc., which became a wholly owned subsidiary of eBay in 2002, is an American company operating a worldwide online payment system that supports online money transfers and serves as an electronic alternative to traditional paper methods like cheques and money orders. Amazon, which began as an online book seller in 1995, is now the world's largest online retailer. In 2018, Amazon reached 50% of the market share of online retailing, and it became the second company in history to reach \$1 trillion after Apple Inc.

The revolutionary information wave of the 21st century was reflected in many marketing aspects. Virtually, all organizations have interactive websites to display their products and services. Today's consumer can navigate through numerous digital content and online information to find the right product in the right time at the right place. Obviously, we are still living this era, and much more will be learned in the years to come. However, it is important to point out that the information-focus (societal marketing) era has brought back all the earlier marketing eras but in a largely digital form. In other words, history is clearly repeating itself in the current marketing era.

Via societal marketing, people can make, buy, and sell products that are personalized and customized to meet the needs and wants of an individual or a small group of consumers. Automation and robotic technologies are now programmed at the highest levels to achieve speed and consistency. Products have improved dramatically both in quality and performance as a result of the immense diversity of consumer needs and wants. Products can also be made via outsourcing and insourcing of various components of the product. Advertising has taken even more abrasive direction as a result of the enormous exposure of consumers to the whole world. Therefore, only organizations that can put all these pieces together will survive and prosper in the years to come.

The contribution of the textile and fashion industry to the information-focus (societal marketing) era is a huge evolution in progress. In recent years, terms such as “wearable technologies,” “smart fashion,” or “fashionable electronics” are associated with a true revolutionary development in which electronic components are integrated into clothing [29,30]. This development is transforming wearable textiles from merely fashionable products with a primary focus on styles and aesthetics to a combination of styles, aesthetics, and a wide range of functionality. Using wearable textiles, people will wear clothing that can provide critical personal information, monitor important health aspects, communicate with other devices, conduct energy, provide safety warnings, and transform into other shapes or forms to protect the wearer from environmental hazards. Indeed, if you think that clothing today is the most intimate product to human being, simply wait to see a much greater intimacy in the future wearable systems.

In [Chapter 1](#), the need for interdisciplinary effort to design textiles was discussed. This cannot be emphasized enough with respect to smart fashions. Indeed, virtually all engineering disciplines and many other fields will have huge opportunities to participate since the applications of smart textiles require continuing research and discovery efforts in key areas including the following [29,30]: conductive materials, antistatic materials, miniaturized electronics, wireless communication, data transfer, interface systems, material durability, material reusability, product integrity, special coating techniques, physiology, bioenergy, fashion design, fashion engineering, and economics.

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