Proceedings of the 2nd Faculty of Industrial Technology International Congress
International Conference
Bandung, Indonesia, January 28-30, 2020
ISBN 978-623-7525-37-0

The Role of Technology and social transformation challenge in Industrial Revolution 1.0 – 4.0.

Fred Soritua Rudiyanto[1,*], Agus Sachari[2], Setiawan Sabana[3], Yannes Martinus Pasaribu[4]

[1,2,3,4] Faculty of Visual Art and Design, Institut Teknologi Bandung (ITB), Bandung - INDONESIA

[*] Corresponding author e-mail: fredsaritua1975 @gmail.com

Abstract

The Industrial Revolution has been permanent related to technology society and human readjustment to the technology. The changed of technology society and human adaptation are impulse and reaction as a social being that sometimes conflicting each other so, therefore, need to look for the best solution to the clash and the social problems that emerged. Further understanding of the industrial revolution required a brief historical knowledge related to the industrial revolution. This article explains the background of several technology histories and the social life as supporting or the impact of the industrial revolution. Facing the challenges from the future need to be considered and forecast especially related to the present industrial revolution, particularly to the social impact that might be happened, that allowing generate pre solution to eliminate the friction among human.

Keywords: Challenged, History, Industrial Revolution, Social life, Technology

1. Introduction

To understand the industrial revolution 4.0 or the nowadays industrial revolution required comprehensive and knowledge why the industrial revolution ensued and drive of it. The depiction hereunder are a few parts that relevant to the concatenation major swoop in the industrial revolution which can break concerning the role of technology and social changed because an invention or technology improvement sustainability. This article is prepared as rumination to the social life prediction that might be occurred in the nowadays industrial revolution or 4.0.

Secondary data of heuristic, the sorting of importance occurrence and author preferences were used to composing the series if industrial revolution history, especially interpretation which related to the technological invention that will applied in automotive or vehicle development. For data selection related to the occurrence's, author utilize the documentary video from trusted media, that shown physical evidence, proconsul ship, that has been reprinted from the era of industrial revolution and also international or local article journal which then was cited, rephrase to construct this article, so it has histography plot or timeline, and structural sequence.

2. Discussion

2.1. Strive and Survive Before Industrial Revolution 1.0

The end of the medieval century was a great invention era of the historical human dimension, and it was known as the first era of the industrial revolution in European. Scientists and Engineers at those time try to look the alternative energy that could drive system such as hydraulic, machine, besides the energy who come from wind, or ebbtide ocean energy. In the 10th and 13th centuries are resurrection and the huge technology invention (Gimpel, 1976). Afterward, Gimpel also told the story about the huge boom of invention from the scientist and the engineer, and then slowly reduced as an industrial revolution consequence since 1750 and also occurring at several places in United Stated, and it was known as the first industrial revolution. In the medieval century, machinery was built manually, daunting and involves numerous workers. Machinery is a common thing for the farmers or factory owners, because they tackling and built the system on their own, also on water and wind energy conversion system to support their work, such as corn grinding, olive pondering, weaving cloth, leather tanning, and paper-making. A report from the 12th century the Cistercian monastery or in French it referred to as Clairvaux

monastery, suggested that mechanization became a crucial thing and major for the European economy. It was described that technology became a loud hymns, and there were 742 reviewed about that story and it was a real condition that revealed by one of the Cistercian monastery.

The abbeys were built in many countries in Europe with the distance almost thousands of miles between one and others. The abbeys places and locations were in Portugal, Sweden, Scotland until Hungary. All the parish has the same building design and water power as a source energy, and there was a story about the monk activity, if in the parish there were a blind monk and were transferred to another parish, therefore that monk specifically known his position in the room that he was (Gimpel, 1976).

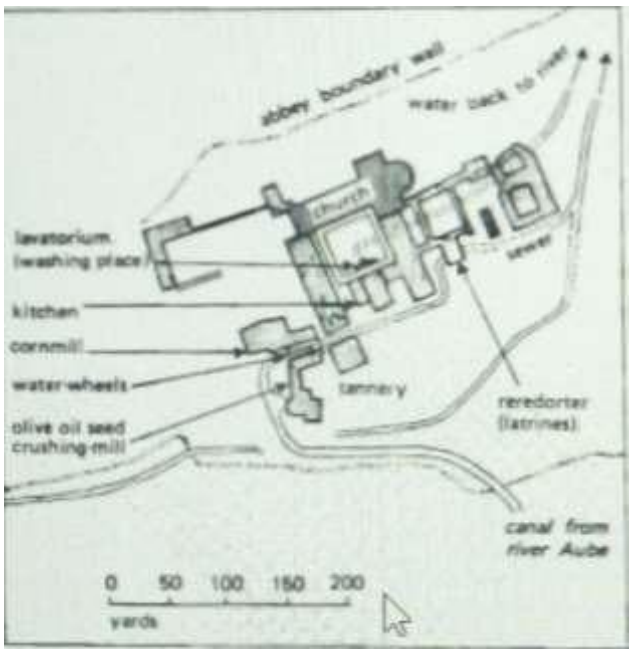


Fig. 1: Spatial Planning of Parish Clairvaux (Cistercian). Source: Holmes & Meier Publisher

Various way of life as discipline was implemented to the monk activity, e.g. for the monk in Saint Bernard, such as the arrangement for very tight schedule, so if there were any violation and deviation by the monk to the rules, and it would be getting a penalty or punishment, latter it becomes as Henry Ford rationale to follow the system and applied the punishment when he was built his assembly line in Ford Company. Except doing the spiritual activities, the monks at that era also involve to the production system to preserve the parish or daily necessities, and it was done by the monks over the European, by processing various natural resources which is available on the area, for example olive raw materials was only in stock in Provence area and it could not found in north of France, thereby in Provence carried out the process and built the mechanism to pondering and milling to produced olive oil. Another example if an area was found the iron ore, so mechanism for forged production was built, and if they were failed planting and harvest the grape, the other things that they will be doing is built a production place to produce beer. The report exposed by parish Claivaux describe the presence of water was so important as apart from conversion energy and mechanism for processing from resources of water, for example, was water conversion energy to produce fire and warm atmospheric that used to keep the temperature of beer that has been produced by the monk and put in to the barrels. The water usage beside for domestic the monks, it was also used to support the production system in those parishes (Gimpel, 1976). Article form Lubna Sungkar (Sungkar, 2007) describe of concerning French urbanization. French people were moved from their belongs and decide to stay and lived near the road and the river edge, and later have a better life enhancement, so that led to the emerge of villages that evolved in to a new city called "*Bourg"* even though the exposure was not made a clear note about the amount of the population in the occupied areas. The community system in those era was a feudal or based on dissimilarity concept, disaggregated by 3 main community categories, such as the nobility people (*Ordre de Noblesse*), comprising the derivative nobility and the new class of nobility, who get the nobility title from the King, the

ecclesiastic class (*Ordre du Clerge*) consist of the *règuliėr* and *sėculiėr,* as a clergy who lives in the parish and the clergy who lives with the society or the commoners people (*Ordre du tiers Etats)*, who became dairy cows for two top-class community (Carpentier, 1987). The social trends, many commoners' people improve their life by serving the country as military troops, and that was the only way to show loyalty to the emperor and later described as *de facto* nobleman, which the duty was as an officer. The continuously succeed in the officer and achievement to the high level of rank causes that the officer could be got facilities to attend on the royal party and have a right to seat close to the King, and also get a special facility to avoid the taxes (Eddy Kristiyanto, 2005).

2.2. Secure and The Born of Industrial Revolution 1.0

The feudal system disaggregated the occupation certainly between the landlord (*sėigneur*) that have task as a leader, protect the land, for the clergyman they have function for pray dan teaching, meanwhile the farmers and craftsman's have a duty to ensure all the life needs in material (Sungkar, 2007). The trouble then, that will be faced by the farmers and the craftsmen are overpressure from the landlord and the circumstances of unsupported climate, also the emerging of the outbreaks that causing the crop failure. Most of the farmers and craftsmen were immigrating and wandering and the result was a huge urbanization to the new villages and evolve as a city and was known as *Bourg*, as a trading city, therefore, bring out the word of *"bourgeois"*. The reality at that time, was the movement of the society to the area's or places which the resource of energy became the main factor to support the production or human occupation, so that water resources as a origin energy could raise the economic level for drive all the mechanism (Salzmann B.A, 1913). The other thing that usually happens at that time was the large number of wars. The war requires enormous logistics related to the readiness of war equipment, mobilization by using the horses and walking troops, all these activities required food and clothing. The war Logistic emerged the trading between the royal, nobleman and gave the auspicious for the community or *Bourg* that had been through by the soldier. For sure, the church and the monks at those eras could not get involved, as a consequences of their functions and mission as a clergy, this opportunity was taken by certain societies to provide all the demand of warfare, then resulting the wealthy community or new bourgeois outside the overpower royal area (Sugiharto, 2018).

The feudal system disaggregated the occupation certainly between the land lord (*sėigneur*) that have task as a leader, protect the land, for the clergyman they have function for pray and teaching, meanwhile the farmers and craftsman's have a duty to ensure all the life needs in material. The trouble then, that will be face by the farmers and the craftsman's are overpressure from the landlord and the circumstances of unsupported climate, also the emerging of the outbreaks that causing the crop failure. Most of the farmers and craftsman's were immigrate and wandering and the result was a huge urbanization to the new villages and evolve as a city and was known as *Bourg*, as a trading city so therefore bring out the word of *"bourgeois"*. The reality at that time, was the movement of the society to the area's or places which the resource of energy became the main factor to support the production or human occupation, so that water resources as a origin energy could raise the economic level for drive all the mechanism. The other thing that usually happens at that time was the large number of wars. The war requires enormous logistics related to the readiness of war equipment, mobilization by using the horses and walking troops, all these activities required food and clothing. The war Logistic emerged the trading between the royal, nobleman and gave the auspicious for the community or *Bourg* that had been through by the soldier. For sure, the church and the monks at those era could not get involved, as a consequences of their functions and mission as a clergy, this opportunity was taken by certain societies to provide all the demand of warfare, then resulting the wealthy community or new bourgeois outside the overpower royal area.

The rise of *bourgeois* increasing the social gap among them, based on the acquisition of material and punctilious to execute the property. Webner Sombar describe that the wealthy could be achieved not only from the work hard to earn the money or get a high amount of wages but it depends on how to press the expenses and accumulate more asset. Meanwhile the nobleman tends to squandered the money and giving the charity, as a way to show the opulence and do the things that excessive indulgence than to help and with a vengeance, and while the ***bourgeois*** has a frugal lifestyle and prefer to be parsimonious, all the things related to the assets should be calculated, so sometimes people called them as an egoistical social class, which was they step always based on the extrapolated of the assets, moreover the marriage was a part of business and unification the social class and also contributed to gain the assets, who became a main drive to other aspect of life (Sungkar, 2007).

The *bourgeois* has struggled to achieve the success in materialistic because the mindset among them, which the dignity, prosperity could be achieved and admitted if became a rich man. The gap between the wealthy people and poor became wider as well as the shape of new feudal system between the employee and the labor classes, then also the emerging conflict and competition among the *bourgeois*, the nobleman and the clergy, after the privilege was given to the *bourgeois* class, e.g. in education field, who initially exclusive for clergy or monk, nobleman and limited for peasants and craftsman's. Parish and cathedral school are main institution that develop and effectuate the education even it was constrained, to reduced illiteracy in particular area, and it was responsibility of the priest or family through the trivium subjects (grammar, Rhetoric and logic), in the future it was evolve and establishment as university all around the Europe in 14th and 15th century, during that period the clergy in addition has the religious knowledge also getting knowledge such as archeology, anthropology, natural sciences, physics, astronomy, biology, art, languages and other's, as a consequences of absolute power and church financial capability to develop, moreover to negated the knowledge and science cause high dependency from the clergy to the church and King, an example, the scientist in 19th century describe, the impact of church absolut power there was no Christ scientist in the medieval century admitted that the earth is not round, moreover the scientist like Lindberg and Ronald Numbers stated that the scientist from medieval century has been estimating and calculating the length of circumference of earth, although it was Ronald Numbers quote as a myth that widespread and regarded as the true history without the support from the newest historical studies (Numbers, 2009).

Lubna Sungkar (Sungkar, 2007) described, in the 16th century the bourgeois started to penetrate the Laws carrier when on the time, The king concerned all the opinions from the legal experts. Getting an expert in Law science become one of the bourgeois ambitioned, they directed their children to learned about it so their children might have a role in government for Law degree were highly respected and had important parts in government posts. This lifestyle did not occur on aristocrats' hedonic lifestyle. Bourgeois engender Industry generations, bankers, entrepreneurs and professionals services groups of doctors, notaries and lawyers.

Those bourgeois professions related to the establishment of the Academies, Oxford University in the 12th century and Cambridge University in the 13th century, for example, these were mentioned and proved by the lecturers and documentation in Oxford in early 1096 and the university around Parish Church on early 1100. Later on, Henry II-restricted England students to study at the University of Paris around 1167, in 1188 a historian named Gerard visited Oxford University from Wales, and met the deans to admit students from overseas and two years later Emo University of Friesland became the first university who admitted overseas students. Around 1200, Oxford become after Paris and Bologna which developed as an education center in West Europe, whilst constrained of aristocratic rights and immunities feud with the other residents, which increased the rent housing, soaring goods costs and loans (Lawson J., Silver H, 1973), therefore Oxford students change over Cambridge around 1209. In 1300 Oxford gained 1500 students when they provided a dormitory to answer the problems, afterward it become Oxford College and Oxford University (for Theology master science) and Cambridge University which possess 500 students (Gillard, 2018).

England formed an institution such as *The Royal for Improving Natural Knowledge* (1662) and French formed *The French Academy of Science* (1666) by King Louis XIV and advised by Jean- Baptist Colbert for built and protect scientific research in French.

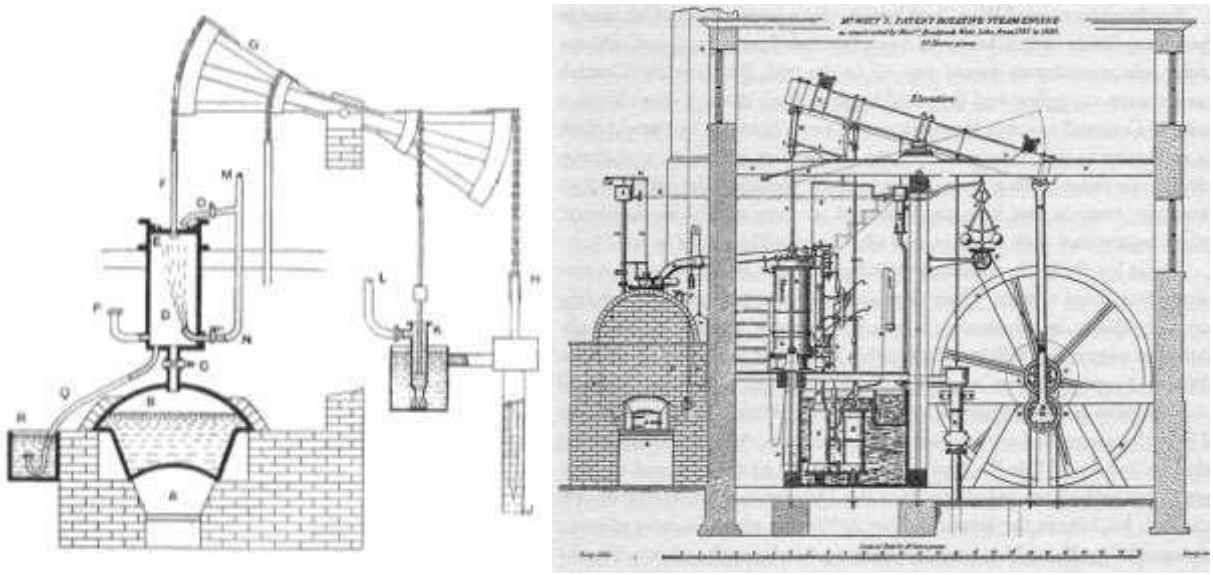


Fig. 2: Thomas Newcomen and James Watt Steam Engine Design. Source: Chronozoom.com

Emma Griffin an England historian who studied specifically the history of workers and their social activity explained how their life in England Industry Revolutions, e.g. in Quarry mills factory *(quarry bank)* in 1800. England's income sources in 1825–1830 were from products made from cotton material and hold 95% of the commodity markets by cotton spinning to yarns and fabrics. There are 900 similar industry in England areas, to increase the productions and to compete among the factories, Samuel Greg, Quarry mills owner whom called as the Cotton King and assisted by Peter Ewart (Trust, 2001), started to applied the propulsion from steam engine in 1810 to reduce the bondage from water which frequently lack in summer and other factories around quarry mills usage. Dr. William J. Asworth from University of Liverpool stated that the revolution started from the Steam Engine utilization, more specific, Industry revolutions was Water Energy utility. Quarry mills industries at the beginning using the giant wheel which called "Great Wheel" with a weight of 44 tons and produced 100 horsepower was the biggest factory in England with water streaming as a driving force source.

Fig. 3: Great Wheels

Source: Power at Quarry Bank, Nationaltrust.org.uk

Hundreds of workers consist of children and female workers invited to operate all the machine and textile equipment, kids have 12 hours workhour or more in a day, in charge to clean the dust and the fallen out cotton or other work. The workers prefer *Quarry mills* because the textile factory offered more amount of wages than as Hodge, and *Quarry mills* also prepare the shelter, cloth and food as long as they work at the factory, and it was known as *Apprentice system,* related to *parish system,* which is a system for looking labor with the parish church support, to round up the poor and displaced children then they will hired at the factory with food, cloth and place to stay as mutual when they work at the factory. One of the requirements for the children worker is the capability for 12 long hour's works, and if they could not be made, the factory owner will send the kids back to the parish.

The Patriarchal System was made for foodstuff selling monopolized by the factory owner to the workers and their family who lived in the factory area, worker bought their needs from the local market that running by the factory, therefore the money that was given by the factory as wages will return to the factory owner, or by using voucher (tommy voucher system), and it was given to the workers and could be exchange with the foodstuff based on the worker level (Documentary, 2018).

A letter in 1796, was revealed from the *Quarry mills* archives in a documentary movie that was produced by Chanel 4 United Kingdom, it describes an agreement between Samuel Greg and Job Rowley as an overseer, concerning to the orphan and the name is Jane Lamb, they consist of the agreement was about working hours for 12 hour a day and 6 day in a week, the documentary film also describe the average age of workers, start from 9 years old until 21 years old, the archive also describe about conflict the age of contention, causing Jane Lamb should work for one years longer as a result of the date of birth forgery that where numbered one year younger and Jame Lamb fight the owner of *Quarry mills* for her problem. To the increasing production, in 1866, the adult worker was brought from north area to achieve 250 workers, and placed on housing with 50 meters distance from *Quarry mills*. For mold the work ethic, the work system at *Quarry mills* was built by the doctrine of Sunday Service that embrace by Samuel Greg, through Unitarianism based on civility, self-improvement and hardworking ("thinking is the hardest" or Unitarianism character is interpreting the bible by using historical, difference with orthodox approach, without finding the meaning in the bible text and accept the meaning from the utterance of Jesus, very critical to the bible and as a the absolute of truth, holding fast to the unity of Allah and reject the Trinitarian).

Problem regarding the time of work continued and resulting the friction between workers and factory owners around the United Kingdom, struggling with circumstances could not be heard by the Royal by the small number political right or 2 % of vote in parliament, incurring a huge workers movement on 16 August 1819, approximately 60.000 people congregating around the Manchester in *Peter Street* area and became a important history record and very known in United Kingdom, with the aim to demand the right to vote for poor people and life betterment. The event also caused 15 people were killed and 600 people were injured due to the clashed with the cavalry troops and known as the accident of *Paterlo Massacre*. The United Kingdom parliament at the end produced reformation action which allowed more people vote the parliament, event it was limited to the middle to hi-class community, and it raises the new restlessness for the worker in city area, in contrast to the rural area such as *Quarry mills*, the workers were placit condition because the Unitarianism doctrine who develop by the church and the factory owner. Other than mentioned above, *Quarry mills* also undertook the concept of Paternal system as an opportunity that gave by the factory owners to the workers for doing the social activity and the responsibilities of the factory owner to protect the workers environmental, by affording them shelter and education. In the *Quarry mills,* education imparted to the adult workers and the children, specialty for adult was taught the history knowledge, science, astronomy, and agricultural science, while the children taught how to read and counting (Logic). This system was so famous around of *Quarry mills* until drew the attention and visited by John Audubon an anthologists and famous painter from America, to saw and attest the education system, and the education core were taught not only for leisure, but it was conceived for mold the mental discipline, hard worker, and gave the tranquility, allowing to control the worker behavior pattern, and shaping them became an ideal worker. The other system that introduced in *Quarry mills* was the distinction of worker cloth and the owner, for the worker they used collars with a simple design, without an ornament studs, using the plain pattern and square collars, so that form a functional working cloth.

The surge of work time was keep on fought with a purpose to restrictive the work time, specially for the children, which conduct by John Daugherty, until in 1833 the United Kingdom parliament unleashed *Factory Act*, to restrict the working time for the children, and gave the opportunity for education, and celebrate the Christmas and Good Friday before the Easter. The surge because the *Factory Act* decision lead the factory to the fluctuated condition. The reduction and restriction of working time for 10 hours cause the production decline, therefore Robert Greg wrote a book titled: *Factory Question,* about how the government should interfere with the labor problems. Finally, to keep the production balances, the factory authorities start to use the steam engine and the automaticmechanic machine. At the end of 1850, British was industrialized by utilizing the steam engine technology and established automation for yard production and cloth from cotton material right up to 20 times more productive than human.

2.3. Industrial Revolution 2.0: From Mechanization to the Electronic and Materialistic

The second industrial revolution generally known start in 1870 until 1914, although in detail the years start of second revolution industry was predicted around in 1850, in line with the slowing the famous invention after years 1825, thereby steam engine was the biggest and known invention until last 3 decade, and the following invention of technology in next year were not too much known as consequences of focus on the product development and product improvement. The known invention in the era of the second revolution industry was energy, material, chemist, and medicare which gave a huge impact on production as a result of the effectivity improvement toward the researches and the development activity on research on micro things. At the end the inventions could reduce the product marginalization, except on the invention who did the breakthrough thus reveals the new vision (Mokyr, 2003).

The entanglement of second industrial revolution in Indonesia ascertainable from the Dutch colonial history that associated to the exploration activity and mineral mining tied with machine mechanization as a result from the technology development at that era, Nusantara was undergone on mineral exploration under the authority of Hindia Dutch colony were established from the Dutch company as known VOC (*Vereenigde Oostindische Compagnie*). The second industrial revolution in Indonesia caused the transformation, or more accurately called the exploitation transformation, from agriculture to the development mineral mining industry, so therefore, there were famous idioms regarding: "*Molukken is het verleden, Java is het heden, en Sumatera is de toekomst* "which mean Molukken or Maluku island is passed, Jawa or Java island is known and Sumatra island is the future. This provoking was famous around the 19th century among the Hindia Dutch colonials (Sitompul, 2018), as a result of the totality mastery to the spices and the beginning industrialization of mineral mining mobilization. The progression of mineral drilling and petroleum in Indonesia also related to the development mining technology in other countries, especially pertaining to the globalization production of petroleum as a result from technology transformation in 19th century to the 20th century, that is the invention of internal combustion engine (ICE) diesel or petrol engine, and then applied to mining industry. The first initiation in the used of ICE for well drilling carried out in 1870. The engineer and constructor in many places in Russia develop the drilling technology by using the energy hydraulic pump which then replaced the electric power source. In 1873, H.G Cross from Amerika obtaining patent for "single-stage turbine' and built a construction of internal combustion engine drilling and put it under the well mine in 1883, although there were several problems when they try to applicate the invention. In 1890, technician and engineer from BAKU, K.G Simchenko develop a turbo drilling machine or rotary machine that can move down by the assistance of hydraulic motor that spinning during the drilling, and five years later the others BAKU engineers received the patent for drilling turbo engine development which notch by using the electrical wire power drill (Mir Yusif Mir., 2012). (Mir Yusif Mir., 2012).

The second industrial revolution well known on emphasis to the value transformation aspect in production organization, second industrial revolution became a witness for a great growth of industry and economic scale also output (Alfred Chandler term), highly regarded factor to the economy in a part of manufacture activity and caused some of the industry growth and became larger than before, especially the industry who develop objects or product and industry chemical material. E.g. the cost of production for container structure, and related to the cylinder volume which comparable to the surface area and volume capacity. In the beginning, it depended on the form of a cube and the volume, and also the cost of production per unit including the amount of unit production.

Quality inspections of the completed were growth due the chemical industry progression, oil refinery, and as the

start of development the container or pack industry, thereby could be developed automatic vending machine with the ability to accommodate various potables container with the same dimensions, and it caused consideration to the dimensions when developing a product in order could be able to store by various type vending machine. Economic value has become a serious concern and it was well organized by producing with the term of mass production with the ability using the similarity component or parts and interchangeable to it. To increase profit, and to support sales activity, therefore the industry conduct the monopoly such as Carnegie Steel, DuPont, Ford Motor and General Electric were located in America by created representative company and partners in Europe, and perpetually to hired as little as possible of labor amount so that known as character for industry in 1914, others characteristic is developing specific of niche market, which mold the industry became flexible and could serve specific services and localized (Scranton, 1997).

Steel

1850 is the beginning era of the use of steel material, although wrought iron was mostly used than steel. The usage of wrought iron for engine part and railway needs a huge cost, including for other usage as iron material for machinery or as a construction material. The weakness of iron at that time was elastic and the lack of strength. Another trouble was how to mold the iron material at a lower cost. The solutions were developed and solved by Henry Bessemer in 1856 (Mokyr, 2003). The steel process in Bessemer converter used pig iron, extracted from the iron process on high temperatures. Steel could be produced from iron ore and scrap iron, and need purification to remove the manure or excessive element such as phosphor, silicon, sulfur and carbon or oxygen, nitrogen to produce certain steel specifications. Bessemer method was the control of carbon contents that contained in iron material, perpetrated by oxidation and spout the air into the converter liquid containing iron through an aperture Tuyer in the bottom of steel cylinder, the steel converter has 6 meter high and beforehand were covered by refractory which was containing silica thereby enrichment of oxygen in the converter will be reacted to the manure or a nonmetallic element that might be not necessary for the reaction of oxide carbon, and also lees iron were consist silicon and manganese. After the oxide separation has been done, therefore, produce steel rough (ingot), then the steel were ready to process or further manufactured into different kind shape according to the needs or ordered (Wijaya, 2015).

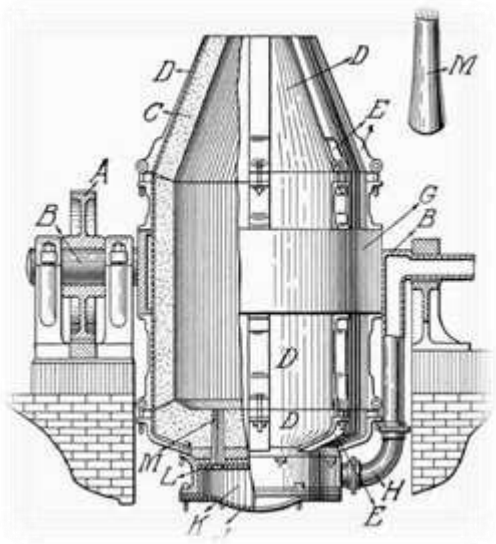


Fig. 4: Konstruksi Konverter Bessemer

Source: chestofbooks.com

Chemicals

On 1840, Justus Von Liebig, a Germany Organic Chemist published his book Organic Chemistry in its Application to Agriculture and Physiology, which discussed about every aspects related physiology with Agriculture Physiology and later known as Minimum Liebig Law. His reviews about Humus Theory stated that Mineral required from the Soil, Carbon dioxide, Hydrogen and Oxygen. Liebig also discuss about The Nitrogen which

cultivated from the Oxygen, even though this was not suitable for the majority of the plants, the theory applied for plants from the family of Fabceae), therefore Liebig revealed that Soil nutrition's which came from plants, substitutable with fertilizer given (Mustaqin, 2018).

1856 William Henry Perkin started his experiment with Quinine synthetic, a malaria medicine from charcoal tar. In the experiment, Perkin oxidized Aniline by using gallium dichromate and toluidine, as an impurity which reacted with aniline and produce a solid element in color black which assumed as a fail synthetic organic. While cleansing the beaker with alcohol, Perkin saw there is a violet part of the solution as a side result of the experiment. The violet part become the base of the synthetic color industry. The aside result become very influential in Chemistry Industry in rears later. As an example, a large company such as BASF produces thermoplastic, sponges, urethanes, polystyrene, acrylonitrile butadiene styrene (ABS) which uses in home appliances products.

Motor Fuel, Car and Transportation

In 1885, Gotieb Daimler with his partner Wilhem Maybach developed 4 steps motor fuel machine which invented by Otto in 1876, therefore they produce an engine with advanced technology and they have the patent rights for the modern fuel motor prototype. Daimler was a Technical Director of Deutz Gasmotorenfabrik where Otto was the owner, which stood since 1872. Later then, there was a controversial about whose the inventor of the two wheels motor engine between Daimler and Otto.

Daimler – Maybach invented a small size, lighter and fast motor engine which already using carburetor as a device to exhale the fuel. The form of the engine machine of Daimler- Maybach is a machine with a vertical structure. The specification of the machine become a motor design revolutionary case. On 8 March, 1886 Daimler applicate the machine by designing the four-wheel vehicle in the world. In 1889, Daimler invented a two cylinders machine with V configuration. Later on Daimler – Maybach built an automobile industry together by building the vehicles and produced from the bottom part to top part by piece to piece. The vehicle they built reaches 10 miles per hour velocity with 4 parts of speed accelerations (Ratiu, 2003).

In America, Henry Ford with his team successfully created T model Ford vehicle, which built based on observation and organizing teamwork in the production system. In building their line production, Henry Ford consulted with Frederick Taylor, a management expert for testing the efficient production methods and form. Hendy Ford observed on the production lines of the Midwest factories which already use a conveyor belt (Wilson, 2014). Bill Ford (great-grandson of Henry Ford) said, Henry Ford had ideas for the point productions which he received from the frozen packaging site in Illinois. Henry Ford scanned that each worker have their certain tasks when the meat passing through the conveyor belt.

Henry Ford applied the observation result to build his Ford Motor industry production lines system (Reynoald, 2013). Henry Ford hiring Norval Hawkins a smart accountant who leads the sales division which enforced advertising campaigns that influent the market (Bob Casey, 2010). The consequences from the line production system, T-Model Ford produced efficiently and reduced production cost of the vehicles, from 800 US dollars to 280 US dollars each vehicle, thereby the vehicles become affordable for the public.

Fig. 5: Ford line production & Model-T.

Source: mtfa.com

In its progress, transportation mode become massive and even greater parallel with technology development. Transportation mode start to using Fuel engine or gas turbine, as an example, Titanic vessel which using 3 main engine, consist of 4 step pistons engine, triple multiple expansion engines and one low tension parson turbine, which made the vessel cruises away even with its enormous size, cargoes and passengers. Titanic had 69 meters of height, 82 meters in width and 260 meters in length with 6000 tons of weight. Another Transportation mode that increased by the invention of steel with Bessemer method was the Train industry. It defined by the appearance of various intercity train track, interurban or street railway which using diesel and electricity power rail with low voltage were 500 to 600 V DC and intercity busses.

Sky transportation mode or airplane develop from many inventors, Wright brothers was one of the inventors. As assumed, Santos Dumont who enhanced ailerons as a control instrument which hanging on an airplane and become the first production of airplane series which reach a velocity of 120miles/hour. As a war facility, Italy was the first country who produced the airplane as one that applied upon war on Libya areas in 1911. The airplane engines were *inline engine,* the phenomenal *V-type engine,* and the legendary H-engine and Rotary engine from Rolls Royce Merlin (Gibss., 1985).

The first commercial airline's company is DELAG which using Zepplin (Iatrou, 2014). In heir first year, they accommodate 34.000 passengers in 15.000 flights (Dan Grossman, 2017). The history recorded that 30 June until 12 July 1914 the Second Industry Revolutions period, a pilot named Sikorsky Ilya Muromets, achieved flying record from Saint Petersburg to Kieve, Via Versa with 1200 distances miles. The first flight took 14 hours and 38 minutes with refuel in Orsha and the return trip took 13 hours with refuel stop at Novosokolniki.

2.4. Industry Revolution 3.0: Network Ascendant Era

Three main aspects that delivered the Industry Revolution are Vacuum tube, Transistor, and integrated circuit. Based on Thomas Alva Edison's invention, electron might devolve from one conductor to another in vacuum space, which was called as Edison Effect. John Fleming implements Edison effect through two electrons tubes or diode and named as valve, it works as a signals detector, alike Radio Marconi Telegraph (J. Bata, 2014).Vladimir Zworykin in 1920 using an iconoscope tube which is a vacuum tube as the basis of television camera. It conceived the electro-mechanics television era. Bell Laboratories produces them the first time in 1927. The Following development is the discovery of computer. In the early years, it develops by using an electron tube and caused the dimension size, it become very impractical. John Barden, Walter H. Brattain, and William Shockley invented transistor in 1948 which made from semiconductor material such as arsenide gallium crystal, sulfide cadmium, cadmium telluride, indium antimonite and substitute the triode tube function, with smaller size and lower power which therefore made them could manufacture in cheaper and mass production. Transistor components connected through PCB (printed circuit board) with brazing techniques. Transistor development finally delivered Integrated Circuit Concept which developed by Geoffrey W.A in 1952. And in 1958 J.S Kilby invented an integrated chain in form as a fragment (chip), single silicone in micro dimension, which contains of defused and settling electronic circuits. Texas Instrument produced them at the first time (Rosadi, 2004). Further development is the quantities of the components that inserted in the chip and knowns as small, medium, large and very large scale integration that delivered IC microprocessor as the brainpower of the Computer, and it produced by Intel.Inc United States in 1971(J.Bata., 2014). To perform the components and communicate inter devices, the computer uses a binary language using numbers 0 and 1. Number 0 means it disintegrated with the signal or electricity voltage. Number 1 is the contrary. The binary data group always consists of 8 bit or 1 byte.

Computer smaller size development become more personal and affordable not only for big institutions like it before. The Computer with simpler software simplifies to write, basic calculation, games and programming code such as BASIC, COBOL. Software and hardware development moves as the activities and humans need, such as picture processing, vector and image graphics, calculating and processing data and complex data algorithm, also simulations which demands to approach the reality. As an example computer substitute architectural manual drawing techniques, design techniques, and engineering techniques. It also used in vehicles designing and or buildings, that allowing small scale calculating and rapid actual size afterward. Drawing table, rulers, calculator and ink pen substituted with software and printer, which also operated by single operator that made a designer task even simpler and multitasking as a creator and computer operator to provisions of all the ideas.

For sharing data and accelerate the other area tasks, computer users were getting connected. The connection is through cables from one to another computer. Analog data start transforming and switching to digital and stored on a hard disk. Connection technologies extern computer initiated by United Stated government which called ARPANET program on an internet known by now. In the beginning, the program connects only four university website for military necessaries.

In 1971 is the invention of e-mail (electronic mail) by Ray Tomlinson who presented '@' icon which defines 'at', and he start to expand the computer network to abroad United States, and on March 26th 1976, Queen of England succeed to sent her first e-mail. The consequences of the rapid network development caused regulated protocol required.

Transmission Control Protocol or Internet Protocol established in 1982. Network computer rivalry emerged in Europe continent named EUNET which consists of countries, Dutch, England, Denmark and Swedish, knowledge as e-mail service and USENET Newsgroup. To simplify and homogenize the network usage, agreement created through Domain Name System (Stewart, 2000). Further invention which enlarge international network usage is Internet Relay Chat (IRC) as a facilitator 'chat' (conversation) between computer users, founded by Jarko Oikarinen in 1988, which connecting more than 100.000 computers in one network. 1994 internet development reach 3.000 website address and rapidly enlarged by the online buying system from the network computer (Barry M Leiner et all, 1997).

Internet of thing (IOT) is a network which connect everything with internet base through protocol stipulation to collect information and using censors element to exchange information and communication which generate certainty, position, searching, observing and administration comprehension (Keyur K Patel, 2016). Intersection with IOT phase product development recently is avoiding repeat innovation from one opponent or itself and the company kept. Innovation could be developed to produce ideas and concepts which manifested through a new product (Sundardam, 2016). Ideas are considerations through observations and analyses process which produce a solution. Concepts are subconscious thought which shaped by experiences got, and it was 'intuitive'.

The advantages of using IOT in developing program is simplifying data complex mapping that made data group analyzed. For example, consumer data tendency in money consumption, through IOT, we can collect the money traffic digital banking data, therefore which restaurant who have multitude visitor in town, and even consumer tendency for a product could be known in detail. This is an important data for a designer to develop a product. The other examples, coolant and lighting product, users could control remotely as there is a network connection between the user and the room which to be controlled.

IOT can also be used in searching for preferences or inclination about consumer expectations. News's, statements and pictures uploaded on social media are priceless information about a condition of a community, are in the wider section. The big data recorded in a social media bank data server where the social media companies are. And the data separated in criteria and keywords made. Other examples, for a presidential election, data from social media can be processed through keywords made, which made mapping tendencies and voting quantities probabilities of a candidate could be done.

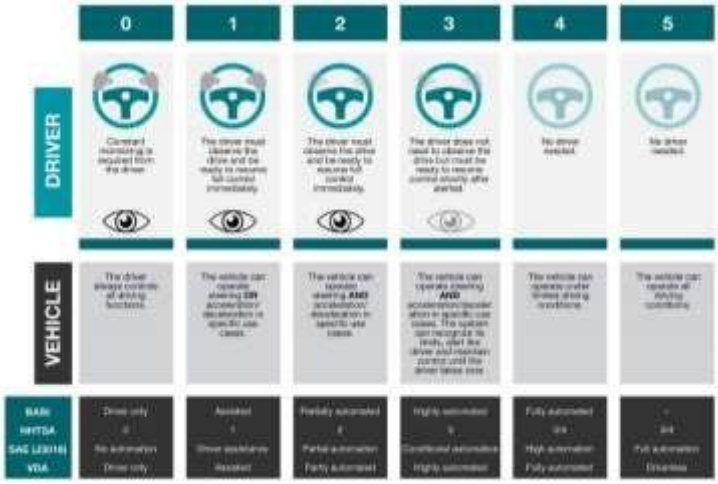
Observation survey taken regarding a consumer with IOT technology could be done in remote, details, massive, rapid and highly supported for the team design who will be analyzing and resuming data despite the expensive material or sett-up system.

2.5. Industry Revolution 4.0: Significant, Legacy, Sharing

The word of Industry 4.0 introduced by The Germany government in 2011 at Hannover Fair, which is the initial action for manufacture based on digitalize and exploitation for new technologies industry (Rojko, 2017). Therefore the production of industrial products determined by global competition and rapid necessity of production, to adapt from the market changing condition which integrating business and manufactures process, as also implemented on the integration of industry player and company, which connected with supply chain value (supplier and customer) and technical aspects which require general concepts of Cyber-Physical System (CPS) and Industrial Internet of Things (IIOT) implementation on industry production system.

Industry Revolution 4.0 era is the supremacy of The Artificial Intelligent Supremacy era and the enormous development of IOT. Machines which developed in accordance to 4.0 code industry were machines with autonomous system, therefore it would conduct independent decision based on algorithm acquisition which implemented on and the ability to record real-time data. It also could performed analyzing processes and recording previous data activities (Rojko, 2017). One of the Industry Technology 4.0 implementation is on Transportation Industry. The autonomous system which require connectivity and capability from various system to integrate, or the system ability to perform and applicable by different system.

Autonomous vehicles divided into grades, as shown on the table below.



Picture 7. Autonomous Grade

Source: ecnmag.com

At the supreme level of autonomous, the driver is no longer necessary. The vehicle can operate in varieties situation and circumstance. In order to runs perfect, autonomous vehicle requires infrastructures design which consist of road infrastructure, server, provider, wireless network, real-time shipping and acceptance data network, layered security system to secure data and software, sensors that acts to collect activities and situations inside and outside of the vehicle, simple and understandable user friendly application, complex algorithms, with nearly 100% synchronize with simulation situation, and the ability to renew, maintain and enhancing to the new versions. As the example of autonomous usage is online driver service, known as *ojek online* in Indonesia. Autonomous vehicle distinguished present in front of the customer without driver and able to deliver goods to a destination with the order input through the application. Transportation Autonomous Technology development solved various migrate transportation problems with significant differentiation from non-autonomous technology. Autonomous vehicle develop from electric vehicle which then integrate with Computer capability, network, and artificial intelligence which allowing the non-human drive vehicles, in other words, an intelligence machine substitute the driver. A customer could utilize the vehicle through the application provided by an autonomous service company, or equally with the application for ordering an *ojek* online. The certain differentiation or transformation in autonomous vehicles is the vanishing of interaction between passenger and driver which is only focusing on delivering to the destination or uninterruptable. Transportation activity centralized in reaching to single destination point "one-stop point' and finished. Autonomous concepts could vanishing personal vehicle ownership, and transformed to sharing vehicles or whomever order and owned by autonomous vehicle company. Personal vehicle ownership would be quite expensive due to parking lot limitation and trait of personal ownership which forbid other people to use. Vehicle touring activity for relaxation activity would be vanished and decreased for it would provoke conflict between the systematic and regulated machine with the unpredictable human. A philosophy technology advocate, Martin Heidegger stated that ontologically, technology has changed the essential manner of human existence (Heidegger, 1977).

3. Conclusion

Industry revolution correlates with how human solving, searching for the opportunity and moreover in sustaining their lives from their issues through technology and how to fulfilled every necessary. Industry Revolution also conceived personal and team success story, therefore every opinion and thoughts regarding the daily lifetime insight implementation of the figure became a role model and transformed people's previous outlook. Clashes between a group of people to the point of inter-nation in the form of economy value raises Human's life irregularities. The irregularities occurred tried to resolve by the rules, agreements and partnership cooperation. For every phase generates a gap between the beneficial side and exploited side. Strategies made to find the intersection agreement for making all things run in organized, despite it would never satisfy both sides. Gap between machines, as an invention from technology rapid development which probably overcome human intelligence. The Social nature of humanity could be replaced by machines, and in one-day machines would have more sensitiveness, more sentiment and more romantic then human. Machine might be even more humanist then human being, which made humans as machines creators, more concerned and fussed about invent complicated and sophisticated machines. Industry revolution 4.0 is the newest and so now phase from the industrial revolution. Technology created to contribute opportunities for human beings to comprehended significant things, that living life is not only for self, that money and objects are not everything.

For sharing, human beings should not merely accomplished economic enlightenment for the first time, in other words, technologies delivered forethought that sharing and advocate might start from the lower social level. Generate legacy for human beings to share and advocate in pursuing happiness, are the responsibilities of the Industrial revolution.

4. Acknowledgements

We are really grateful because we managed to complete our article The Role of Technology and social transformation challenge in Industrial Revolution 1.0 – 4.0 assignment within the time given by Agus Sachari. The assigment cannot be completed without the effort and co-operation from Setiawan Sabana, Yannes Martinus Pasaribu. We also sincerely thank to National Institute of Technology, especially FoITIC team as the organizer the international congress for Towards industry 4.0: Challenges and Opportunities for Industrial Technology and Other Sectors.

5. References

Barry M.Leiner et all. (1997). Brief history of the internet 1997. -: Internet society.

Salzmann B.A. (1913). English industries of the middle ages. London: Constable and Company LTD.

Bob Casey., H. D. (2010). Henry Ford Innovation : From Curators. Illionis: The Henry Ford Education.

Carpentier, J. e. (1987). Histoire de France. Paris: Seuil.

Dan Grossman, P. R. (2017). Zepplin Hindenburg : an illustrated History of LZ-129. China: Britihs Library.

Documentary, C. 4. (2018). Private life of the industrial revolution ; steam engine ; history documentary; real thruth history. Belfast: Chanel 4.

Eddy Kristiyanto, O. (2005). Absolutisme negara dan lembaga agama: pasca aufklarung di eropa barat. M lintas, 216.

Gibss., S. (1985). Aviation. London: The Stationery Office.

Gillard, D. (2018). Education in England : a history. Scotland: Queen's Printer For Scotland.

Gimpel, J. (1976). The medieval machine, the industrial revolution of the middle ages. Victoria: Penguins Book.

Iatrou, K. (2014). 100 Years of Commercial Aviation. Hamburg: Hermes Air Transport Club.

J.Bata, W. (2014). Elektronika dasar, sejarah perkebangan dan komponen elektronika. Science of world, 1-19.

Keyur K Patel, S. M. (2016). Internet of Things-IOT: Definition, Characteristics, Architecture, Enabling

Technologies, Application & Future Challenge. IJESC, 6(5), 6122-6131.

Lawson J., Silver H. (1973). A social History of education in England. London: Methuen & Co.Ltd.

Mir Yusif Mir., B. (2012). A brief History of oil and gas well drilling. Azerbaijan: Visions of Azerbaijan http://www.visions.az/en/news/366/4ca556e3/.

Mokyr, J. (2003). The Second Industrial Revolution, 1870-1914. In R. H. Joel Mokyr, The lever of Riches (pp. 219-245). IIlinois, Evanston: Northwestern University.

Mustaqim, W. A. (2018). Hukum minimum Liebeg - sebuah ulasan dan aplikasi dalam biologi kontemporer. Jurnal Bumi Lestari, 28-32.

Numbers, R. L. (2009). Miths and thruth in science and religion ; a historical perspective. Actualizacao Rapida, 250-256.

Ratiu, S. (2003). The History of the internal combustion engine. TImisaora: Faculty Of Engineering Hunedoara.

Reynoald, D. (2013). Henry Ford's Assembly line : How it's still rolling along 100 years later. CBS news: https://www.cbsnews.com/news/henry-fords-assembly-line-how-its-still-rolling-along-100-years-later/.

Rojko, A. (2017). Industry 4.0 Concept: Background and Overview. ECPE European Center for Electronics, 7790.

Rosadi, R. (2004). Sejarah Komputer dari Generasi pertama hingga sekarang. Bandung: Acedemia Edu.

Scranton, P. (1997). Endles novelty : specialty production and American industrialization, 1865-1925. Princeton: Princeton University Press.

Sitompul, M. (2018). Mendulang Sejarah Tambang Nusantara. https://historia.id/politik/articles/mendulangsejarah-tambang-nusantara-P4WOp.

Sugiharto, B. (2018). Materi Kuliah Filsafat Ilmu . Bandung: Program Doktoral S3-ITB.

Sundaram, K. (2016). The Internet of things and the changing landscape of product design. Dimensions, 1(1), 14.

Sungkar, L. (2007). Peranan golongan borjuis pada revolusi Prancis tahun 1789. Citra Lekha Jurusan Sastra Inggris Fakultas Sastra Universitas Diponegoro, 1-7.

Trust, N. (2001). Powerful Partnership : Greg, Ewart and the first engine. London: National Trust.

Wijaya, W. P. (2015). Steel converter Bessemer. Malang: Universitas Negeri Malang.

Wilson, J. M. (2014). Henry Ford Vs. Assembly line balancing. Internaltional Journal of Production Research, 757-765.