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Metals in Our IT Equipment: Social and Economic Impacts, Geopolitical Conflicts. Other Social Impacts of ICT Manufacturing

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***Abstract* – The information technology development in which we live now is not free. In fact, there are expensive taxes that we have to pay. Metals as a raw materials used in information and communications technology equipment have impacts on the world economy and on the human social life. Moreover, they may lead sometimes to destructive wars. Here, we will study these impacts on human life and on the national security of European Union.**

***Keywords* – ICT, Social, Economic, Political, Manufacturing.**

I. INTRODUCTION

Information and communication technology (ICT) has become a fact of economic life in most of the countries. Almost all firms use computer and have internet connection. In fact, many firms directly depend on it for their economic progress. ICT is a network technology, hence the more people use it, the more useful it becomes. (Pilat and Wölfl, 2002)

Organization for Economic Co-operation and Development (OECD) countries has tried to estimate the ICT investment in their respective countries. ICT investment is the total amount invested in building the IT infrastructure like purchase of computers, software, setting up servers, and including software to run them. In 1980s, only about 5% to 10% of countries capital was invested in building ICT infrastructure, and by 2000s it has risen to about 25-30% in the OECD countries. Figure 1 shows the countrywide data.

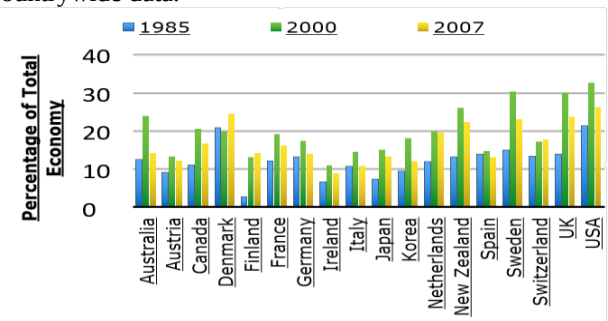

Fig.1. ICT Investment Share in the Economy

Source: Dirk Pilat and Andrew Devlin, Diffusion of ICT in OECD Economies; Chap:2 The Economic Impact of ICT: Measurement Evidence and Implications.

This high growth of ICT investment can be attributed to declining costs of computer equipment production and semi-conductor technologies. It has also contributed to steep increase in demand of metals, which are the basic raw materials of ICT equipment. Figure 2 below shows the demand for certain metal groups in past decade. This abrupt increase in demand of metals has caused some interesting political and social changes.

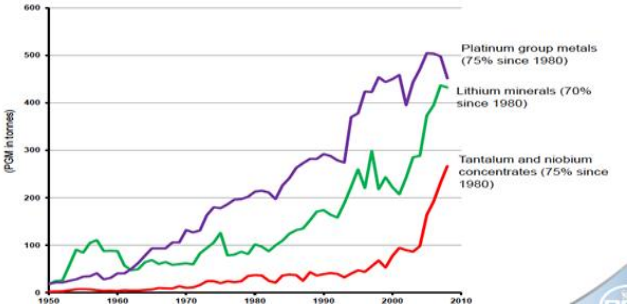

Fig.1. Demand for certain metal groups

Source: Andrew Bloodworth, Critical Metal for ICT: Scarcity or Scarce Story.

II. METALS IN OUR IT EQUIPMENT

Metals such as platinum, gold, silver, indium, rhenium, gallium, "rare earth elements*", antimony and cobalt (Tantalum) are major raw materials for ICT equipment's. Figure 3 below shows the anatomy of a smart phone.

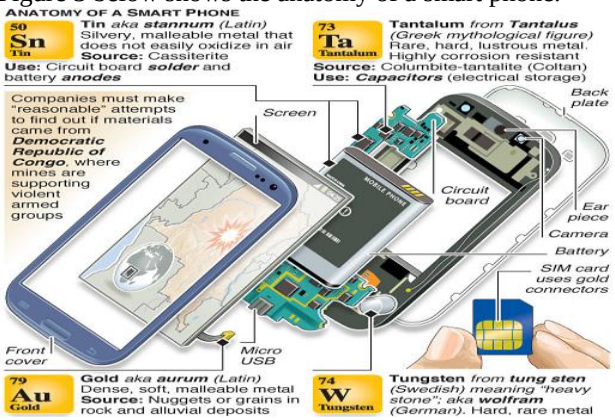

Fig.3. Anatomy of a Smart Phone

Source: https://engtechmag.wordpress.com

Rare Earth Elements (REEs) or Rare Earth Metals are collective name group 3 elements of periodic table. They are chemically similar and are found together in the earth's crust. Figure 4 below shows the rare earth metals in periodic table.

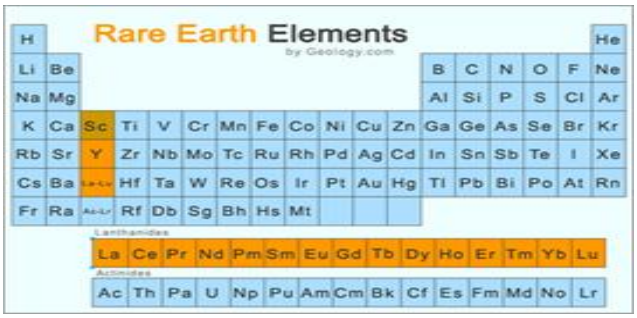

Fig.4. Rare Earth Elements

Source: http://geology.com/articles/rare-earth-elements/

The amount of rare earth metals in earth's crust is comparable to industrial metals like chromium, but economically profitable ores of these metals are rare, hence the name Rare Earth metals. They are widely used in electronic elements of smaller circuits of computers, mobiles etc. In 1990s the demand of electronic devices increased drastically which naturally increased the demand of rare earth metals (Chancerela, 2015).

The extraction of rare earth metals is a complicated and expensive process. Moreover, consistent supply of these metals is not guaranteed due to economic, geological, social and political reasons. The major problem of ICT equipment industry is, the ores of these metals are available in politically unstable countries (Reller, 2011). Hence the market prices are unstable.

III. GEOPOLITICAL ISSUES AROUND ICT METALS

The scarcity of rare metals, can cause geopolitical issues in the following contexts:

- Nationalism: the governments of countries rich of metals try to boost their revenues by gaining control of those resources, which can include nationalizing them.
- Geopolitics: That concentration of the metals in few regions tends to increase the tension between countries who have, like China, and those who do not, like Europe or Japan.
- Conflict: Large revenues from mining can lead to corruption and conflict in poor counties, where usually mines are.
- Skills shortage: there will a big demand for new mines, but there will not be know-how and people to work in them.
- Business models: Many metals have not been used much before so they tend not to be a priority for large mining companies. As the mining of these materials does not fit into their business model and to have a change can need more than 10 years (Levin, 2012).

Therefore in order to avoid instability in EU by the metal resources conflict, the EU has to take some actions. The first step is preventing conflicts related to rare metal resources, and that can be achieved by supporting security and stabilization in rich metal resources regions such as Africa (Garrett, 2012).

The rapid economic growth of emerging market economies in the BRICS countries (Brazil, Russia, India, China and South Africa), has led to a competition within European Union (EU) about the metal resources.

3.1. Relationship Between Metal Resources and Conflicts

The role of trade is financing the armed conflicts and perpetuation of human rights violations in the Democratic Congo Republic (DRC) and in the African Great Lake region. In 2000 the UN Security Council established a Panel to investigate these conflicts in DRC. Even EU has contributed to settle issues in Africa (Garrett, 2010).

For example, the first military operation launched by European Council within the framework of the Common Security and Defense Policy (CSDP, then called ESDP), was in DRC, where metal resources have played important and diverse roles in evolving conflict complexes since the final years of the Mobutu regime(United Nations Security Council, 2003-2005). The conflict in the Democratic Congo Republic can be considered as one of the most tragic conflicts in the last few decades, with a life loss of nearly 1 million (European External Action Service, 2003).

3.2. Conflict over mineral resources in a multipolar global economy

The EU is affected by strong competition on metals by the growing Economics such as the BRICS. In fact, this competition threats the EU economy and labor force. The EU market may lose 30 million jobs as a result of this competition (Barroso, 2011).

China succeeded to build stronger diplomatic relationships with African countries. The African countries want to make higher revenues by exporting metals. For example, DRC government is reviewing the mining contracts in order to increase taxes on exportation of metals.

The Chinese traders build business agreements with corrupted regimes in Africa, so, they get easy access to their metal resources. In addition the presence of China gave African countries a lot of power in the negotiations. Therefore, they are able to choose the most favorable proposal for their countries.

''Those who are not killed by the soldiers of the former army are killed by those of the new army. It is always the innocent ones who are the victims'' (Prunier 2009:174)

In the production of mobile phones, a metal called tantalum is used. This dispositive is essential to mobile phones, computers and other electronic equipment. Tantalum is extracted from an ore called coltan, which is primarily found in Central Africa. Even if Coltan only constitutes about 1% of the value of all raw materials contained in mobiles, the world cannot underestimate its usage since this element allows storage and virtually instantaneous release of electric charge with a minimal loss of power (it is also useful for computers and almost all electronics devices). The company H.C. Starck, which was sold to Advent International and the Carlyle Group in February 2007 by Bayer, was involved in this trade significantly. More than 30 % of world's supply of Coltan

is mined in the Democratic Republic of Congo (United States Geological Survey 2010: 173) by artisanal miners, many of whom are children.

Knowing that the mobile phones manufacturers are increasing their production, it suppose a proportional generation of wealthy for them, and for Congo population. Although, far from this assumption, Coltan has been fueling a deadly conflict between armies of central Africa governments and private militants in the region, causing inhabitants to suffer or die.

3.3. China

The metals used in ICT are quite abundant in China too, and was a leading exporter of rare earth metals. China changed its export policy to facilitate in-house ICT manufacturing, created an artificial scarcity of rare earth metals. This Chinese export restrictions created serious concerns in the US, Europe, Japan, and South Korea, who heavily depend on rare earth supplies for a wide range of industries especially ICT.

Japan and South Korea tried to get contracts with other exporters in order to be sure to not run out of metals.

The European Union started focusing on the problem in 2010 and recommended trade and policy measures for the European Union to ensure steady imports and the promotion of exploration and recycling in the EU.

U.S. Government Accountability Office (GAO) published in April 2010 a report in which warned of the vulnerabilities and did not give much hope of reducing the supply risk anytime soon. Developing a domestic rare earth supply would take 7 to 15 year, according to the report. Despite that, the US Congress is discussing measures to facilitate rare earth mining.

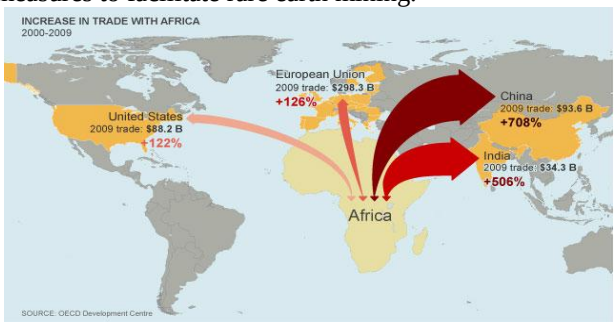

Fig.2. African imports and exports

Source: Kermeliotis, T., 'Why Asian giants scent opportunity in Africa', CNN, 4 August 2011, http://edition.cnn.com/2011/BUSINESS/08/04/china.india.africa.overview

However, Chinese investors are now conscious about the risk of political conflict in Africa financed by their investments. The Chinese government has realized that low military impact in Africa may affect their metal resources supplements from Africa such as the case of liberation of the Niger Delta (MEND) in Nigeria. Currently, 75 % of contribution to UN peacekeeping operations is given by China.

3.4. European Strategies for attain metal resources

In order to keep a steady supply of ICT-metals for Europe, EU has implemented key strategies that need to be taken into account (Wäger, and Stamp, 2011):

Diplomatic strategies: One of the key techniques that the EU use is enhancing the EU's Raw Material Diplomacy. So, the EU is working on having strong relations with the rich mineral resources countries.

Investment-related strategies: The European Commission encourages investment of the European countries in the infrastructure of metal resources in the African countries. The European Investment Bank (EIB) assists in Foreign Direct Investment (FDI) in rare earth producer countries.

Conditional budget support: The EU invest in the infrastructure of the African countries by long term loans which should be returned in as raw materials (Unhelkar, 2011)

IV. SOCIAL IMPACT OF ICT METALS

The information and communication equipment are gaining popularity, and people buy appliances they even do not need (refer Fig.3), or, which is worst, without thinking in the social impact the production of those gadgets is causing. Figure 6 shows the total number of mobile phone users worldwide from 2012 to 2018. In 2017, the source projects the number of mobile phone users to reach almost 5.3 billion.

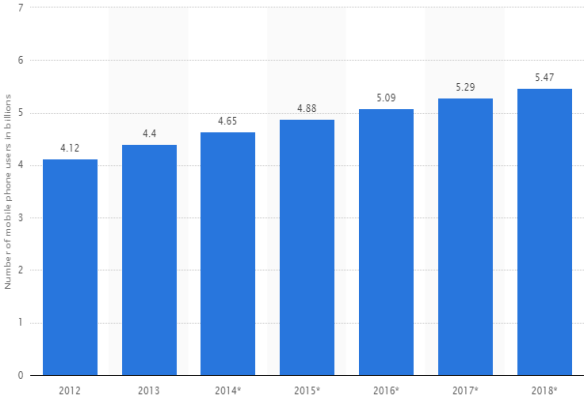

Fig.3. Worldwide mobile users from 2012 to 2018 (in billions)

Source: Number of mobile phone users' worldwide, statista.com

ICT has penetrated to the society, to an extent, which nobody would have expected only a short time ago. Many observers believe that the fast spread of computer networks, mobile telephony and other equipment is having far-reaching, partly even transformative, implications for European society. Child labor, civil conflicts, wars, violence against women and several illness are associated to the mining and manufacturing of ICT equipment.

4.1. Social Effects of ICT Metal Mining

One of the most tragic social problems associated with the mining of ICT-metals are high number of rape of women. The Special Rapporteur on Sexual Violence in Conflict has labeled the Coltan region the rape capital of the world. Along with the mining and violence, many others activities have been developed, as prostitution, extortion, illegal traffic, child labor (working from the age of eight), among others. (Sarkar, 2010)

The funds come from mining finance, the soldiers and their weapons are thus contributing to the continuation of the conflict that has already cost 5 million lives. Further to the vagaries of war are the inhumane working conditions under which the mineworkers are forced to struggle with on a daily basis. Their lungs are affected by metal dust and the mines are prone to landslides, resulting in fatalities.

4.2. Child Labor

Even children work under such harsh and dangerous conditions in a bid to support their families. Here is another important social impact. Child labor is, generally speaking, works by children that harm them or exploits them in some way (physically, mentally, morally, or by blocking their access to education). (Sarkar, 2010)

Out of two million people working in the DRC's artisanal mines, 40 percent of them are children. Most of them began working at the age of 5, from 6 a.m. to 5 p.m. Even if they have the opportunity to go to school, many of the families need the additional income that their children generate. The DRC's constitution guarantees a free elementary education, but is ineffective and there are almost no schools in many of the remote mining areas. The work conditions in the artisanal mines are inhumane. Children use their bare hands and feet to dig, sift, wash and lift heavy loads of metals. These tasks expose them to high probabilities of being injured or killed. Many children get killed in soil collapses, which occur when they extract metals from deep and narrow holes. The average number of child deaths from soil collapses in the DRC's province of Katanga alone is about 6.6 per month. Child miners are also exposed to sicknesses because of their permanent contact with radioactive metals, or injuries that leave them with lifetime disabilities. (Liwanga, 2013)

4.3. Health Risks of ICT Metal Mining

In many instances, the only visible part of an electronic product is its outer shell. Unless that casing is broken, we rarely see the myriad circuit boards; wiring and electrical connections that make the device actually function.

But it's those inner mechanical organs that are so valuable and so toxic. A whole bouquet of heavy metals, semimetals and other chemical compounds lurk inside your seemingly innocent laptop or TV. E-waste dangers stem from ingredients such as lead, mercury, arsenic, cadmium, copper, beryllium, barium, and chromium, and nickel, zinc, silver and gold. Many of these elements are used in circuit boards and comprise electrical parts such as computer chips, monitors and wiring. Many electrical products include various flame-retardant chemicals that might pose potential health risks.

When these elements are safely encased in our refrigerators and laptops, e-waste dangers aren't much of an issue. Problems can occur when devices break -- intentionally or accidentally. Then they can leak and contaminate their immediate environment, whether that's in a landfill or on the streets within a region full of struggling laborers.

Researchers in the Dartmouth Toxic Metals Research Program have compiled a list of the effects that some of toxins take on the human body. This is not an exhaustive list of all the suspected health effects of these metals and mentions only few of the chemicals and compounds used in household products.

- Copper can irritate the throat and lungs and affect the liver, kidneys and other body systems.
- Nickel is carcinogenic in large doses.
- Silver probably will not hurt you, but handle it too frequently and you might come down with a case of Argyria, which is a condition that permanently stains your skin, a blue-gray shade.
- Lead poisoning can cause a whole slew of health problems including the impairment of cognitive and verbal activity. Eventually, lead exposure can cause paralysis, coma and death. (Jim P, Byster L, Westervelt S, Gutierrez R, Davis S, Hussain A, Dutta M., 2002)

V. ECONOMIC IMPACTS OF ICT METALS

The demand for rare earth metals was less until middle of 19th Century. India, Brazil, South Africa and United States were the ones to extract them in a larger scale. The commercial production of color TV started in USA in 1965, which triggered the sudden increase in demand of rare earth metal. Europium is used in color TV for producing colored images.

China has entered the market of rare earth metals around 1980 and by 1990 it raised to number largest producer of rare earth metal in the world (refer Fig.4)**.** China, with their extremely low prices, controlled the rare earth market till the 2000s. China's pricing was competitive that rare metal production of USA almost vanished by 2000.

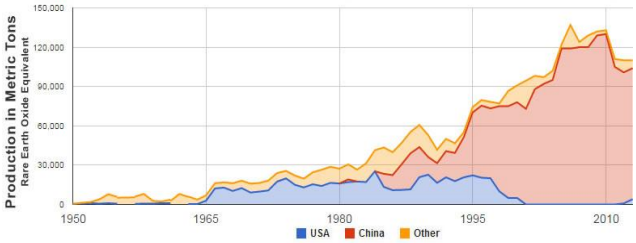

Fig.4. Rare Earth Metal production countrywise
(Source: http://geology.com/articles/rare-earth-elements/)

During the same time, the demand for rare earths increased immensely due to the development and production of industrial components, defense weapons and ICT. China being the leading producers restricted its exports and increased the prices of rare earths by creating an artificial scarce.

By 2010, China was controlling nearly 95% of the rare earth production worldwide. In the previous five years, some metals had an increase of more than 500% in their market prices. This situation made companies reevaluate their production and usage of rare earths. Manufacturers started trying to find solutions, such as reducing the amount of rare earths used in each product; searching other materials to substitute the rare earth metals; or produce different products, which do not use these elements. China continues to be the largest producer of rare earth metals nowadays, although their influence in

market has decreased. Table 1 shows the production levels in the year of 2013.

Table 1: World Mine Production and Reserves,

World Mine Production and Reserves (2013 Estimates)		
Country	Production (Metric Ton)	Reserves (Metric Ton)
United States	4,000	13,000,000
Australia	2,000	2,100,000
Brazil	140	22,000,000
China	100,000	55,000,000
India	2,900	3,100,000
Russia	2,400	No data
Vietnam	220	No data
Malaysia	100	30,000
Other countries	not available	41,000,000
World total (rounded)	110,000	140,000,000

Source: http://geology.com/articles/rare-earth-elements/

VI. ICT MANUFACTURING

6.1. Economic Impacts of ICT Manufacturing

ICT producing sector accounts for only small share of economy, but this small sector can make a relatively large contribution to growth and productive performance. The size of ICT manufacturing sector has direct correlation to higher MFP.

Examining the role of ICT producing sectors in economic growth is heavily influenced by measurement problems. It is very difficult to statically capture significant quality improvements associated with technologic advances in goods such as computers. Different countries assumes different methodology of estimating the economic contribution, hence an appropriate method to estimate the contribution of economic effects of ICT is to be developed.

Fig.5 below shows the contribution of ICT manufacturing to Labor productivity growth in 1990s. In 1990s, the contribution of ICT manufacturing in total manufacturing by a country increased rapidly. Countries like Finland, Ireland and Korea had close to 1% of aggregate labor productivity from ICT manufacturing.

ICT Sector is an important driver of growth and productivity for some countries. Although the place and date of birth of the ICT sector are California, USA in the 1970s, much of the growth in production in the ICT sector has taken place in newly industrializing countries, particularly in Asia. Countries such as Singapore, Taiwan, Malaysia and Thailand initially emerged as low-wage manufacturing hubs for production, followed by China

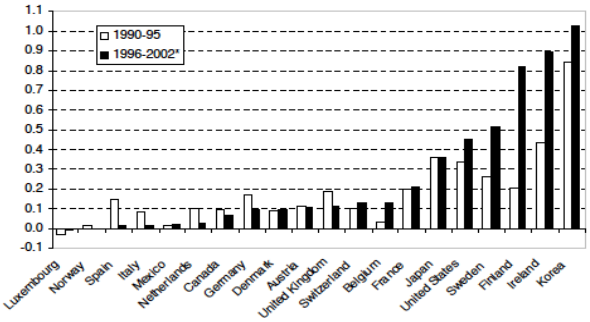

Fig.5. Value added per person employed, contribution in percentage

Source: Dirk Pilat and Anita Wölfl, ICT Production and ICT use; Chap:5 The Economic Impact of ICT: Measurement Evidence and Implications

(massively), the Philippines, Indonesia, and more recently India. Asia has clearly emerged as the central region for ICT manufacturing. In 2003, electronic and electrical products accounted for 60% of total exports from the Philippines and for two-thirds of exports from Singapore; they are also the highest export value for Malaysia. However, low-cost production facilities have also been established in Latin America (Mexico to supply the US and Canadian markets), and Eastern Europe (Hungary, Czech Republic, Poland, Romania and Estonia); the latter locations focus on Europe as the end market.

Taiwan: Largest ICT Producing Country

Taiwan is the world's premier electronics factory; it produces more than two thirds of the world's LCD monitors, nearly three out of four notebook PCs, and four-fifths of PDAs (Personal Data Assistant, i.e. handheld computers).

China: Fastest Growing Production Company

Many western electronics manufacturing services companies (EMS – they are Contract Manufacturers producing the brand names products designed by the OEMs), have also moved their manufacturing to China to take advantage of low labor costs; the vast supply of migrant labor from rural provinces; and the potential of China as a huge consumer market. The labor costs in China are low, less than $1.00 per hour. The large first-tier electronics manufacturing services (EMS) providers like Flextronics, Solectron and Jabil are very well represented in China, as are the Taiwanese ODM companies.

India: New comer in ICT manufacturing

India is traditionally considered a leader in software outsourcing, but is now increasingly being seen as an attractive location for ICT hardware equipment production. Recent moves into India by some major OEMs, including Microsoft and Nokia, and by some large Contract Manufacturers (such as Jabil, Flextronics and Elcoteq) indicate that the nation is on its way to become a significant electronics-production region in the future.

6.2. Social Impacts of ICT Manufacturing

Working conditions in production facilities that produce or assemble ICT equipment are often frightening. Compulsory overtime, insecure employment contract, poor safety measures in factories, hazardous environment of

work, and very low wages came out as key characteristics of ICT manufacturing industries.

Labor rights in ICT Manufacturing sectors:

ICT hardware production is often located in Export Processing Zones. International Labor Organization that is mostly setup in developing countries to attract foreign investors defines these EPZs. Generally the nature of production is low tech, the economic benefits of EPZs are minimal. For Instance, Philippine government offered low labor costs and exemptions in taxes, which resulted in massive influx of multinational companies in ICT hardware sector. (Bloodworth, 2011)

Union rights:

The ICT hardware industry lacks unions in its worldwide factories. In fact, unions are banned in Asian ICT industry. In some countries the EPZs where these manufacturing firms are located are tightly guarded. At times the legal restrictions in EPZs, deprives the union rights of labor. (Bloodworth, 2011)

Job Security:

A number of workers are being employed on short-term contracts in ICT manufacturing sectors. At times there are instances of being dismissed before their contracts get converted to long term one. This precarious employment position is hampering the employee's ability to speak out their working conditions.

In Mexico, workers are increasingly employed on short-term contracts. In Philippines labors are entitled for a 13th month pay, but these short term contracts are framed such way to deny such benefits to employees. Mergers, partnerships, lower demand, all this results in contract workers being dismissed. In 2002 and 2003, Fujitsu computers dismissed 1700 and 1293 employees respectively owing to reorganization. (Bloodworth, 2011)

Difficulty resigning:

In china, as it is rapidly growing the scenario is little opposite. Study conducted show that many workers find resigning very difficult, especially during peak season. Workers usually sacrifice their pay if they want to quit. (Bloodworth, 2011)

Sex Determination:

Systematic pregnancy based decimation occurs in Mexico. Some companies in EPZ of Mexico force women to undergo pregnancy testing as a condition of employment. In January 1998, the U.S. National Administrative Office also concluded that the practice was widespread. And the U.N. Committee on Economic, Social and Cultural Rights (CESCR) stated in 1999 that it was "deeply concerned about the situation of women workers in the maquiladoras, some of whom are subjected to pregnancy tests upon recruitment and at intervals during work, and are dismissed if found to be pregnant." Recent studies have indicated that these practices are still common.

Living Wages:

In Philippines, and in some factories of China the wages of ICT producing sector is relative high, compared to other manufacturing sectors. Even then, the wages are still far lower than the living wage in those countries. For instance, the Food and Nutrition Research Institute calculated that at least PHP 434 (8.51 US dollars) per day was needed to feed a Filipino family. Looking at the wages in 2004, the amount paid to the highest paid workers, according to the research, was still 175 PhP short of this amount prescribed for food alone.

In Mexico, weekly wage lies between 50-100 USD, and a basic healthy food basket costs about 75USD.

In china, some factories wages are paid based on work orders, and minimum wage policy of 480 RMB / month is not followed. At times workers in Acer earn as low as 200-300 RMB per month. Workers in Nokia, Siemens China may have to fines for violations of factory rules.

Hours of work:

ICT hardware is a highly globalized industry, and have to offer customers a customized product in a short lead-time. As a result the manufacturing labor is expected to cooperate and be flexible as per needs. Research has shown that during peak season, laborers work for more than 12 hours a day in Philippines, China, without any off. These are clear violation of labor laws. In factories producing for some leading brands like Fujitsu, Dell, IBM, Siemens, Nokia, workers work 10-13 hours in peak seasons. If workers do not make the quota during normal hours, they are not paid for extra hours. (Bloodworth, 2011).

VII. CONCLUSION

Although technology has changed our life, it resulted in various economic, political and social impacts. Indeed, metal resources, which are used in ICT equipment, are limited and located only in certain places. Since the ICT-metals are commodities, the prices of the metals are highly unstable and dependent on the political manipulations in the globe. So, competition for ICT metals for these reasons led to conflicts. From child labor and sexual abuse to civil wars, this shows the detriment of themselves and society.

If countries continue to think only about their own benefits, the vicious cycle will never end. There are organizations willing to change the current situation, however their effect won't be powerful enough unless the governments, extraction and technology companies take part in the cause.

This research is a clear example of how companies and nations have a huge impact on generating issues worldwide. Economic aspects rely on the international market trade, companies had to change their business models because of the market controlled by China at some point.

Instead of competing, companies must cooperate, technological and extraction companies may invest the money used in wars into recycling of metals and ICT equipment, since the usage of ICT in companies has substantially positive effects on productivity resulting a gain in the market share, expansion in the product range and better response to client demand.

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